
Risk factors and pregnancy outcomes among gestational diabetic mothers: A hospital based study in Bangladesh

Ruhina Tasmin Biswas



Supervisor
Akhtar Hussain MD, PhD, DSc

Thesis submitted as a part of Master of Philosophy degree in
International Community Health



Department of General Practice and Community Medicine
Faculty of Medicine, University of Oslo
Oslo, Norway
February' 2006

Abstract

Background: Gestational diabetes mellitus (GDM) most of which progress to type 2 diabetes mellitus (T2DM) is increasing world wide. An apprehensive increase of GDM is also observed in Bangladesh in line with growing prevalence of T2DM. GDM predisposes mother and offspring to increased risk of complication during pregnancy. Identification of GDM and control of glucose in pregnancy can reduce such complications and improve maternal and neonatal health. A standard guideline on screening of GDM is yet to be developed in Bangladesh.

Objectives: To identify risk factors and to examine the relationship of maternal and neonatal complications associated with GDM in a group of hospital population.

Methods: A case control study was carried out in BIRDEM and MCHTI hospital from 1st of July to 15th October 2004. 106 pregnant women with a diagnosis of GDM and 196 without GDM were included in this study. Data on risk factors and pregnancy outcomes were collected through a face to face interview with the mothers and checking antenatal and delivery records at postnatal word.

Results: Maternal age >25 years, pregnancy BMI >23 kg/m², positive family history of diabetes were found to be independent risk factor for GDM in multivariate analysis. Women who were diagnosed in the first half of the pregnancy were most likely to be treated with insulin [OR 3.7; 95% CI (1.6-8.9)]. Prevalence of hypertension was higher in GDM compared to NonGDM (12.3% vs. 4.1%). Anaemia was less prevalent in the GDM group. Preterm delivery, caesarean section, birth weight >3.5 kg were seen to be independently associated with GDM. No significant difference was found in maternal, fetal or neonatal complications either according to time of diagnosis of GDM or type of treatment they received. Only the occurrence of hypoglycemia in the neonates born to mothers with GDM has been seen to be higher in the women who were diagnosed early (75.8% vs. 52%) and also who received insulin (74.5% vs. 36.7%). Hypertension in pregnancy appeared to be significantly associated (p value <0.01) with the women who were diagnosed of GDM in early stage of pregnancy. Women who were treated with insulin had higher prevalence of birth weight more than 3.5 kg.

Conclusion: This study suggests that relatively older woman; woman with a family history of diabetes or increased BMI possess independent risk for GDM in the study population. Women with GDM have increased risk of preterm birth, caesarean section and larger baby. GDM diagnosed early or treated with insulin in pregnancy predict higher risk of adverse effects in mother and newborn. Therefore, these findings should be given particular importance during antenatal period to initiate a screening programme and treatment protocol for GDM.

Key words: GDM, T2DM, Maternal and neonatal health, Preterm birth, LGA.



This work is dedicated to
my Mamoni and Baba (parents)
for their relentless concern and care to
my upbringing and development
which is still on.....



Acknowledgement

First of all I want to acknowledge Norwegian Agency for Development Cooperation (NORAD) and the department of International Health, University of Oslo for the financial support that has enabled me to take up this programme.

I wish to express my deep gratitude to my dear country, Bangladesh, belonging to whom I was able to avail this opportunity. I am sincerely grateful to all the women of my country who kindly participated in this study and provided necessary information with patience.

My gratitude goes towards my supervisor Dr. Akhtar Hussain, Associate Professor, Section for International Health, Department of General Practice and Community Medicine, Faculty of Medicine, University of Oslo for his patient teaching and guidance in the whole process of planning, field work and final write up of thesis. His critical feedback helped me to gain insight in thesis writing. My special thanks, also to our teacher Prof. Gunnar Bjune and Prof. Johanne Sundby for their valuable inputs during our study.

I would like to thank Prof. AK Azad Khan, Honorary Secretary General, Diabetic Association of Bangladesh for his contribution during my field work. I would also like to thank my colleagues of BIRDEM and MCHTI hospitals for all their assistance in the collection of data.

I would like to thank Vibeke Christie, Ine Andersen, Ragnhild Beyrer and other staff of the department for their kind help and cooperation during the stage of thesis writing.

My heartfelt thanks go to my classmate Penjani Kamudoni and Yang Fang who contributed to my learning by sharing different area of thesis. I also thank my classmates here in Norway, friends and relations for their well wishes towards me.

I feel my loving son, Ovro, who not only gave me mum's feelings but also taught the pathophysiology of gestational diabetes and preeclampsia by his birth.

I have been indebted to my husband for his constant cooperation and support during my time of study here. I am humbled to note his obliging efforts to adorn this monograph. His inspiration and estimable opinion helped me to look forwards with my thesis writing.

I was again and again invigorated with the encouraging emails of my mother and words of wisdom of my father during my study.

Table of Contents

| | <u>Page No</u> |
|-------------------------|----------------|
| Abstract | 2 |
| Acknowledgements | 4 |
| Table of Contents | 5 |
| List of Figures | 9 |
| List of Tables | 10 |
| Abbreviations | 11 |

Chapter 1. Introduction

| | |
|---|----|
| 1.1 Country Profile | 13 |
| 1.1.1 Geography..... | 14 |
| 1.1.2 Economy | 15 |
| 1.1.3 People and culture | 15 |
| 1.1.4 Socio-cultural history | 15 |
| 1.1.5 Education | 16 |
| 1.1.6 Life style and physical activity | 16 |
| 1.1.7 Food habit | 17 |
| 1.1.8 Trend of urbanization in Bangladesh | 17 |
| 1.1.9 Overall health status in Bangladesh | 17 |
| 1.1.10 Health care system in Bangladesh | 18 |
| 1.2 Diabetes Mellitus-Background | 19 |
| 1.2.1 The global burden of diabetes | 19 |
| 1.2.2 Diabetes in Bangladesh | 20 |
| 1.2.3 Existing healthcare services in Bangladesh | 20 |
| 1.3 Gestational diabetes mellitus | 20 |
| 1.3.1 Glucose tolerance in Normal and GDM pregnancy | 20 |
| 1.3.2 Clinical importance of GDM | 21 |
| 1.3.3 Effects of GDM on Maternal and child health..... | 21 |
| 1.3.4 Maternal and child health situation in Bangladesh | 22 |
| 1.3.5 Maternal and child health service in Bangladesh | 22 |
| 1.3.6 Screening of GDM in Bangladesh | 23 |
| 1.4 Statement of problem | 24 |
| 1.5 Literature review | 25 |
| 1.5.1 Pathogenic factors for gestational diabetes | 25 |
| 1.5.2 Prevalence of GDM | 25 |
| 1.5.3 Diagnostic criteria proposed and used in different studies on GDM | 26 |
| 1.5.4 Risk factors for GDM | 27 |
| 1.5.5 Complications of pregnancy in relation to GDM | 28 |

| | |
|--|----|
| 1.6 Research questions, hypothesis and objectives of the study | 31 |
| 1.6.1 Research questions | 31 |
| 1.6.2 Hypothesis | 31 |
| 1.6.3 Objectives of the study | 32 |
| 1.7 Justification of the study | 33 |

Chapter 2. Material and methods

| | |
|--|----|
| 2.1 Target population | 35 |
| 2.2 Study population | 35 |
| 2.3 Study design | 35 |
| 2.4 Study hospitals..... | 35 |
| 2.4.1 BIRDEM hospital | 35 |
| 2.4.2 MCHTI hospital | 36 |
| 2.5 Research tools/instruments | 37 |
| 2.6 Inclusion criteria | 37 |
| 2.7 Exclusion criteria | 37 |
| 2.8 Sample size | 38 |
| 2.9 Sampling procedure | 38 |
| 2.10 Pilot study | 39 |
| 2.11 Data collection procedure | 39 |
| 2.12 Diagnostic criteria used | 40 |
| 2.13 Variables | 42 |
| 2.13.1 Risk factor variablesl | 42 |
| 2.13.2 Time of diagnosis of GDM | 42 |
| 2.13.3 Type of treatment in GDM | 42 |
| 2.13.4 Pregnancy outcome variables | 42 |
| 2.14 Operational definition of the variables | 43 |
| 2.15 Data handling and analysis | 44 |
| 2.16 Ethical issues | 45 |

Chapter 3. Results

| | |
|---|----|
| 3.1 Risk factors for GDM | 47 |
| 3.1.1 Demographic factors | 47 |
| 3.1.1.1 Maternal age | 47 |
| 3.1.1.2 Anthropometric findings | 48 |
| 3.1.2 Socio-economic factors | 50 |
| 3.1.2.1 Level of education | 50 |
| 3.1.2.2 Occupational status of mothers | 52 |
| 3.1.2.3 Monthly expenditure of thr family | 53 |

| | |
|--|----|
| 3.1.3 Family history of diabetes | 54 |
| 3.1.4 Obstetric factors of the mothers | 55 |
| 3.1.4.1 Previous history of GDM | 55 |
| 3.1.4.2 Previous adverse obstetric history | 56 |
| 3.1.4.3 Gravidity | 56 |
| 3.1.5 Risk factors for GDM in multivariate analysis | 57 |
| 3.2 Time of diagnosis and its relationship with type of treatment received | 58 |
| 3.3 Pregnancy outcomes | 60 |
| 3.3.1 Comparison between GDM and NonGDM | 60 |
| 3.3.1.1 Anemia | 60 |
| 3.3.1.2 Hypertension in pregnancy | 60 |
| 3.3.1.3 Gestational age at delivery | 61 |
| 3.3.1.4 Mode of delivery | 62 |
| 3.3.1.5 Outcome of fetus | 62 |
| 3.3.1.6 Birth weight | 63 |
| 3.3.1.7 Apgar at 5 minutes | 64 |
| 3.3.1.8 Pregnancy outcomes in multivariate analysis | 64 |
| 3.3.2 Pregnancy outcome according to period of GDM diagnosis | 65 |
| 3.3.3 Pregnancy outcome according to type of treatment | 67 |

Chapter 4. Discussion

| | |
|---|----|
| 4.1 Methodological consideration | 71 |
| 4.1.1 Study design | 71 |
| 4.1.2 Selection of hospitals | 71 |
| 4.1.3 Diagnostic criteria in cases and controls | 72 |
| 4.1.4 Sampling technique and sample size | 72 |
| 4.1.5 Responses of the participants and data collection | 72 |
| 4.2 Methodological discussion | 72 |
| 4.2.1 Strength of the study | 73 |
| 4.2.1.1 Pretest | 73 |
| 4.2.1.2 Data collection procedures and tools | 73 |
| 4.2.2 Limitations of the study | 73 |
| 4.2.2.1 Confounding effects | 73 |
| 4.2.2.2 Biases | 74 |
| 4.2.2.3 Internal validity of the findings to objectives | 75 |
| 4.2.2.4 External validity for generalization | 75 |
| 4.2.2.5 Reliability | 75 |
| 4.3 Discussion on the findings of the study | 76 |
| 4.3.1 Risk factors for GDM | 76 |

| | |
|--|----|
| 4.3.2 Pregnancy complications in GDM | 80 |
| Chapter 5. Conclusions, Recommendations and Future Research Implication | |
| 5.1 Conclusions | 85 |
| 5.2 Recommendations | 86 |
| 5.3 Future research implication | 87 |
| Reference List | 89 |
| Appendices | 99 |

List of Figures

| | <u>Page No</u> |
|--|----------------|
| Figure 1.1. a). Location of Bangladesh within the world map (marked by the white square) b). Map of Bangladesh and surrounding area. The area of study hospitals is marked by the black star | 14 |
| Figure 2.1 Screening and diagnosis algorithm for DM based on venous plasma glucose. Red arrows explain three different stages of glucose intolerance included in GDM (modified after BIRDEM) | 40 |
| Figure. 3.1 Prevalence percentage in different age group in GDM and Control group | 48 |
| Figure. 3.2 Means, fractile and distribution of BMI in GDM and control group..... | 50 |
| Figure. 3.3 Prevalence percentage of women with GDM and the control group according to their level of education | 51 |
| Figure. 3.4 Distribution of prevalence percentage of GDM and control group at different level of monthly expenditure | 53 |
| Figure. 3.5 Distribution of the participants on family history of diabetes | 54 |
| Figure. 3.6 Prevalence percentage of Previous history of GDM in current GDM and the control group..... | 55 |
| Figure. 3.7 Prevalence percentage of miscarriage, still birth and premature birth in GDM and the control group | 56 |
| Figure 3.8 Prevalence percentage of gravidity in GDM and the control group | 57 |
| Figure. 3.9 Prevalence percentage of treatment with diet and insulin in women with GDM according to phase of diagnosis | 59 |
| Figure. 3.10 Distribution of gestation at delivery in both GDM and NonGDM group | 61 |
| Figure. 3.11 Prevalence proportion of birth weight in GDM and control group | 63 |

List of Tables

| | <u>Page No</u> |
|--|----------------|
| Table 1. Health care service in public sector in Bangladesh | 18 |
| Table 2. Maternal and child health in Bangladesh: Key Indicators | 22 |
| Table 3. Diagnosis values for the OGTT. Glucose concentration mmol/l (mg/dl) | 41 |
| Table 4. Characteristics of Demographic factors of the study population. | 49 |
| Table 5. Characteristics of socioeconomic factors of the study population | 52 |
| Table 6. Characteristics of familial factor in the study population | 54 |
| Table 7. Characteristics of obstetric factors of the study population. | 55 |
| Table 8. Independent predictors for GDM in multivariate analysis. | 58 |
| Table 9. Prevalence proportion of women with one or more than one independent risk factor | 58 |
| Table 10. Association of main treatment received during pregnancy with time of diagnosis of GDM in GDM population | 59 |
| Table 11. Association of pregnancy complication in GDM in the study population | 60 |
| Table 12. Comparison of delivery outcomes in between GDM and NonGDM group | 62 |
| Table 13. Comparison of fetal and neonatal outcomes in between GDM and NonGDM group | 64 |
| Table 14. Pregnancy outcome from GDM pregnancy in multivariate analysis .. | 65 |
| Table 15. Characteristics of pregnancy outcome according to time of diagnosis of GDM and relationship in between them on pregnancy outcomes .. | 66 |
| Table 16. Comparison of pregnancy outcomes in early and lately diagnosed GDM cases with background (NonGDM) population | 67 |
| Table 17. Characteristics and relationship of pregnancy outcome according to type of treatment received in GDM | 68 |
| Table 18. Relationship of pregnancy outcome in women treated with diet and exercise and insulin in comparison to background (Non GDM) population | 69 |

Abbreviations

APGAR-Appearance Pulse Grimace Activity Reflex
BMI-Body Mass Index
BIRDEM-Bangladesh Institute of Research on Diabetes, Endocrinology and Metabolic disorder
CI-Confidence Interval
DAB -Diabetic Association of Bangladesh
FBG-Fasting Blood glucose
2hBG-Blood Glucose 2 Hours after 75gm Glucose Intake
GCT-Glucose Tolerance Test
GDM-Gestational diabetes Mellitus
GDP-Gross Domestic Product
HNPS-Health Nutrition and Population Sector Program
IFG-Impaired Fasting Glucose
LGA-Large for Gestational Age
IGT-Impaired Glucose Tolerance
IMR-Infant Mortality Rate
IUD-Intra Uterine Death
MCHTI-Maternal and Child Health Training Institute
MDG-Millennium Development Goal
MPS-Making Pregnancy Safer
MMR-Maternal Mortality Rate
MOHFW-Ministry of Health and Family Welfare
NCD-Non Communicable Disease
NDDG-National Diabetes Data Group
NGO-Non Governmental Organization
NHN-National Healthcare Network
OGSB-Obstetric and Gynecological Society Bangladesh
OGTT-Oral Glucose Tolerance Test
OR-Odds Ratio
PPP-Purchasing Power Parity
RBG-Random Blood Glucose
T2DM-Type 2 Diabetes mellitus
TFR-Total Fertility Rate
UNICEF-United Nations Children's Fund
WHO-World Health Organization

Chapter 1 Introduction



1. Introduction

Gestational diabetes mellitus (GDM) refers to any degree of glucose intolerance with onset or first recognition during pregnancy (1). Evidences showed that GDM poses a threat to adverse maternal and perinatal outcome as a result of maternal hyperglycemia. The United Nation's Millennium Development Goal (MDG) targets for reduction of child mortality and improvement of maternal health. These are the 4th and 5th of the 8 goals prioritized by MDG. Women with a history of GDM have a high risk of progression to type 2 diabetes mellitus (T2DM) (4). With the rapidly increasing prevalence of diabetes around the world especially in South Asian countries there is an urgent need to develop affordable and effective preventive strategies for T2DM. Identification of high risk population by identifying the risk factors and pregnancy outcomes of GDM can aid in the implementation of such strategies. Bangladesh has been ranked as 10th highest of all the countries in the world according to the number of diabetic population (5). Over the past few years a growing prevalence of GDM has also been observed in the hospitals of Bangladesh. But information is scanty on risk factors and pregnancy outcome. Therefore this study had focused on some aspects relevant to risk factors and pregnancy outcomes of GDM mothers.

1.1 Country Profile

Bangladesh though has made great strides in improving the lives of its people, yet remains as one of the poorest countries in the world (6). A brief overview of the country is given below:

Location: Southern Asia (Table1.1a)
Population density: 819/Sq. Km
GDP-per capita: 2100\$ (PPP)
Literacy rate: 43.1%
Female literacy rate: 31.8%
Local currency: Taka (1USD eq. 65 Taka)
Total Fertility rate: 3.13 children per woman
Crude Birth rate: 30.1 births/1000 population
Infant mortality: 62.6 per 1000 live births

Source: World Fact book, 2005

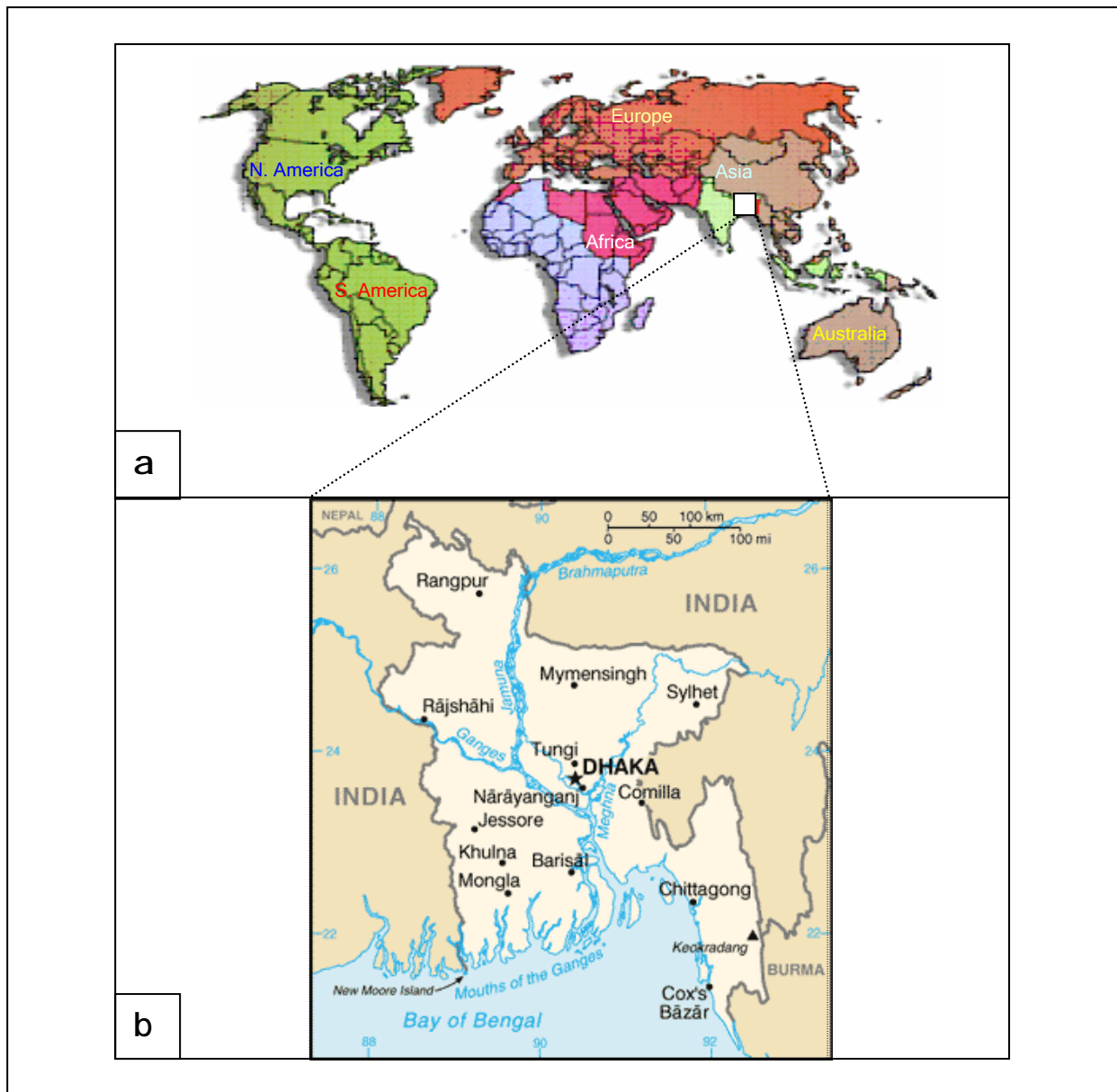


Fig. 1. 1 a). Location of Bangladesh within the world map (marked by the white square) b). Map of Bangladesh and surrounding area. The area of study hospitals is marked by the black star.

1.1.1 Geography

With an area of about 144,000 sq km, Bangladesh is situated between latitudes 20°34' and 26°38' North and longitudes 88°01' and 92°41' East. The country is bordered by India on the east, west and north and by the Bay of Bengal on the south. There is also a small strip of frontier with Burma on the southeastern edge (Fig. 1.1b).

Bangladesh has mostly tropical monsoon type climate with sweltering temperature and high humidity. It is a low-lying country situated in the middle of the Ganges delta. This delta landmass comprises mainly of three mighty rivers the Ganges, the Brahmaputra and the Meghna. Though the alluvial deposits from flood makes the soil very fertile, the devastation and loss from this type of catastrophe causes huge loss of life, different health problems and affects economy massively.

1.1.2 Economy

Bangladesh's economy depends heavily on agriculture. Textile industry and remittance from people abroad are also the potential sources of GDP in Bangladesh. Bangladesh suffers from economic difficulties and relies on foreign aid. The country's total health expenditure per capita is 3.1% of GDP. A greater part of the health expenditure comes from out of pocket due to insufficient capacity in public sector even for basic health needs.

1.1.3 People and culture

According to the world health report 2005 total population of Bangladesh is assumed to be 147,360000 and population density more than 819 per sq.km. Despite better progress in growth rate (2.23%) it has remained as one of the most densely populated countries in the world. About 25% of the population lives in urban areas.

Over 97.5% of its people are Bengalis; the remainders are Biharis and indigenous tribal peoples. Bangladeshis identify themselves closely with Bangla, their state language. Family and kinship was the core of social life in Bangladesh. Although the age at marriage appeared to be rising since the 1980s, still 80% of girls are married by adolescent period (56).

1.1.4 Socio cultural history

Bengal was probably the wealthiest part of the subcontinent until the 16th century. Bangladesh came to today's shape through a long history of political and cultural evolution. This nation was ruled by the British regime for about 200 years until 1947. Initially a part of Pakistan, following partition from India in 1947, Bangladesh achieved full independence in 1971.

The present and main ethnic identity of Bangladeshi people is represented by Bengali. Ethnicity refers to a complex concept which has both socio-cultural and biological

components. Ethnic groups change through time in complex ways. Thus ethnicity bears a historical construct. Like Hindi, Urdu or Punjabi speaking people Bengalis are also the modern decedents who might be belonged to ancient Indo Aryan and Dravidian arising out of central and Middle East Asia. That's why a closed ethnic similarity is found among them.

1.1.5 Education

Education in Bangladesh is mostly subsidized by the Government, which operates many schools and colleges in the primary, secondary and higher secondary level as well as many public universities and university colleges. The current literacy rate of Bangladesh is about 41% while female literacy rate is 30%. To promote literacy among women, education is now free upto the higher secondary level for female students. There are also government funded programs which gives incentives like stipends and food for continuing education to girls in the secondary level. But this has also been heavily criticised for nonfunctioning of the system due to hugely practised corruption in the country. In contrast the role of UNICEF and some NGOs working for development of women in Bangladesh has been greatly recognised.

In Bangladesh, educational system is categorized in the following steps

| | |
|--------------------------------|--------------------|
| Primary Level | 1-5 year |
| Secondary Level | 6-10 year |
| Higher Secondary level | 11-12 year |
| Higher study | |
| Graduation (Pass course) | 13-14 year |
| Graduation (Honours) | 13-15 year or more |
| Post graduation | 15/16 year or more |

1.1.6 Life style and physical activity

Life style of people differs markedly according to rural and urban dwellings. Women in the rural area have to do different kind of manual works during their daily activities even inside the house. Cleaning of house, cooking, washing, taking care of children, gardening etc. all those requires good physical activities in the rural place. On the other hand, city people are exposed to rather easy way of daily life. But economic condition of the people and social status do also control the way of life of the people. Like the other Asians, Bangladeshi people do not have the tradition of doing extra physical exercise apart from the requirement for their occupation in daily life.

Most of the women put lots of their efforts in house hold activities being a housewife after marriage. However there prevails a marked difference in amount of work in household activities between rural and urban set up and socioeconomic status.

1.1.7 Food habit

Bengali food is very similar to that of the rest of the Indian subcontinent. There are more fish recipes in the standard diet because of the availability of fish from the rivers and sea. But it has been seen to be insufficient as well as expensive to meet increasing population load and people of varying economic status. As rice has been the main staple food, available in sufficient quantity and relatively cheap, people developed a kind of dependency on rice in almost every meal. People of this region have a tendency to satisfy hunger by taking bulks of rice with very minimum spicy fish or meat or vegetable curry. Their inherent taste for a spicy, sweet or salty food often restrains them to take less cooked vegetables and salad. Similar to other countries of south Asia sleeping after lunch and immediately after late dinner is also a very common tradition in Bangladesh.

1.1.8 Trend of urbanization in Bangladesh

Bangladesh is still an agrarian society though nearly one quarter of the population lives in the urban areas. A total of 50.1 million of people are involved in institutional work. Due to gradual urbanization relatively educated and rich people had moved in to the urban area. Poor people also moved towards urban area in search of work. Population burden and political instability pushed the country towards severe poverty tarnishing the history of glorious past which is once used to have food surplus.

Dhaka with a total population of 9.4 million is one of the densest cities of the world. It is expanding very rapidly. Population of Dhaka, the capital city of Bangladesh, is 3 times greater than the next largest city. According to the 2001 population census, the urban population in Bangladesh is 29 million, and has increased at the rate of 38% during the last 10 years, which is about 4 times the rural rate (MOHFW 2001). This shift may have a large impact on the urban health care system. Compared to demand of this huge population, health care facilities in Dhaka are quite inadequate.

1.1.9 Overall health status in Bangladesh

Though there has been a significant decline of infant and child mortality the maternal death ratio is still high at over 380 per 100,000 live births (7). Apart from new and old infectious diseases, such as malaria, tuberculosis and acquired immune deficiency

syndrome (AIDS) non communicable diseases such as diabetes, hypertensions are important threats to health for the years ahead.

The nutritional status of adolescent girls and women is a key factor in the persistence of malnutrition in Bangladesh. Low birth weight is estimated to affect 30-50 percent of infants (8). About 70% of the women suffer from nutritionally deficiency anemia (9).

Bangladesh has been experiencing an epidemiological transition from communicable diseases to non-communicable diseases (NCD). Tertiary level hospital data indicates that cardiovascular diseases have already appeared as one of the leading causes of mortality. NCDs are important cause of disease burden, morbidity and mortality. At least 25% of the deaths in primary and secondary government health facilities are caused by these diseases. Presently, Bangladesh does not have a community based public health program for NCDs. Only hospital based service, although poor, is available (10).

The Health, Nutrition, Population Sector Programme (HNPSP) has identified three NCDs-cancer, cardiovascular diseases and diabetes mellitus-as major public health problems. Looking at the surveillance finding worldwide WHO has recommended to list prevalence of diabetes as one of the basic health indicator for its member states (11).

1.1.10 Health care system in Bangladesh

Government of Bangladesh provides health care service under a health system infrastructure which follows local government system. Six divisions of local government are broken down into 64 districts, subdivided into 460 thanas, thence into unions and villages (Table 1). Besides the public sector, private, citizen organizations and NGOs (Non Governmental Organizations) also play large roles in the Bangladesh health sector.

Table 1: Health care service in public sector in Bangladesh

| Level of care | Administrative Unit (Number) | Health facility (Number) |
|-------------------|------------------------------|--|
| Tertiary level | Division (6) | Teaching hospital /Institute (16) |
| Secondary level | District (64) | District hospital (59) |
| Primary level | Upazilla (460) | Upazilla health complex (397) |
| | Union | Union Health and Family Welfare centers (3275) |
| Out reach service | Village (68000) | Satellite or mobile clinic |

Source: Bangladesh National Health Accounts, 1996-97

1.2 Diabetes Mellitus - Background

Diabetes mellitus is a chronic disease caused by inherited and/or acquired deficiency in production of insulin by the pancreas, or by the ineffectiveness of the insulin produced (12). An acquired deficiency may be triggered by life style factors. However a deficiency of insulin results in increased concentrations of glucose in the blood, which in turn damage many of the body's systems, in particular the blood vessels and nerves.

There are two principle forms of diabetes:

- * **Type 1** diabetes (formerly known as insulin dependent) in which the pancreas fails to produce the insulin which is essential for survival. This form develops most frequently in children and adolescents, but is being increasingly noted later in life.
- * **Type 2** diabetes (formerly named non-insulin dependent) which results from the body's inability to respond properly to the action of insulin produced by the pancreas. Type 2 diabetes is much more common and accounts for around 90% of all diabetes cases worldwide. It occurs most frequently in adults, but is being noted increasingly in younger people as well.

Certain genetic markers have been shown to increase the risk of developing Type 1 diabetes. Type 2 diabetes is strongly familial, but it is only recently that some genes have been consistently associated with increased risk for Type 2 diabetes in certain populations. Both types of diabetes are complex diseases caused by mutations in more than one gene, as well as by environmental factors.

1.2.1 The global burden of diabetes

According to WHO in 2004 at least 171 million people worldwide had diabetes; this figure is likely to be more than double by 2030. WHO predicts 170% increase in the number of people with diabetes for the developing countries (8). The greatest increase is projected in India (195%) (13). An increasing trend of prevalence of diabetes has been found in the urban areas in comparison to rural areas in developing countries and in female population in Indian continent (8).

1.2.2 Diabetes in Bangladesh

Diabetes mellitus particularly type 2 diabetes is now recognized as a major chronic public health problem in Bangladesh. The magnitude of diabetes remains unknown due to lack of countrywide survey. Some studies showed that the prevalence is higher in urban areas (14;15). In a recent study in Bangladesh a higher prevalence of diabetes was found in urban (8.1%) compared with rural populations (2.3%) (14).

1.2.3 Existing diabetes health care services in Bangladesh

The comprehensive diabetic health care delivery in Bangladesh is a unique program of Diabetes Association of Bangladesh (DAB). The Association executes its program primarily through its central institute called the Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM), and through the Satellite Diagnostic Clinic at different peripheral region to provide services at doorsteps. Now days, BIRDEM is recognized as the center of excellence and reference center in diabetes care.

To improve the diabetic care and enlarge the service for a wide range of population, diabetic association has established National Healthcare Network (NHN) through out the country. In addition to diagnosis, the NHN centers provide out patients service free of cost.

1.3 Gestational Diabetes Mellitus (GDM)

GDM as mentioned is any form of diabetes mellitus or impaired glucose tolerance (IGT) or impaired fasting glucose with first onset or first recognition during the index pregnancy. Thus the diagnosis of GDM is independent of possibility that diabetes or glucose intolerance may have antedated the pregnancy. As diabetes or glucose intolerance in women is more frequently discovered during pregnancy WHO has recommended to include such cases under the definition of GDM. Such a broad definition has a great practical value and has boosted research on GDM.

1.3.1 Glucose tolerance in Normal and GDM pregnancy

Pregnancy is normally attended by progressive insulin resistance that begins near mid-pregnancy and progresses through the third trimester. The fact that insulin resistance rapidly abates following delivery suggests that the major contributors to this state of resistance are placental hormones. Moreover pancreatic β cells normally increase their

insulin secretion to compensate for the insulin resistance of pregnancy. As a result, changes in circulating glucose levels over the course of pregnancy are quite small compared with the large changes in insulin sensitivity (16).

From a pathophysiological point of view, GDM pregnancies are characterized by increased insulin resistance compared with normal pregnancies. The insulin resistance affects carbohydrate and lipid metabolism and presumably protein metabolism as well (4). Though in most of the cases it disappears once the pregnancy is over, it may persist as diabetes, impaired fasting plasma glucose or impaired glucose tolerance-after delivery or recur as such in the following pregnancy or any time after delivery.

1.3.2 Clinical importance of GDM

- i). Maternal hyperglycemia causes fetal outcome i.e. macrosomia, large for gestational age, baby, intrauterine death, preterm birth, birth defects etc.
- ii). Association of GDM with preeclampsia, which very often threatens mother's life and pregnancy outcome, has been evident in many studies.
- iii). GDM predicts subsequent development of diabetes later in life. The incidence of subsequent type 2 diabetes following gestational diabetes has been reported to be between 3 and 60 % in various studies.

1.3.3 Effects of GDM on Maternal and child health

The millennium development Goals have placed maternal and newborn's health firmly on international agenda. Though gestational diabetes has not yet brought up directly in developing countries in maternal and newborn health; it is the fact that it threatens pregnancy and the newborn if maternal glucose level is not controlled during the pregnancy. Certainly it has potential role on reducing risk of maternal health and infant mortality. In GDM risk of macrosomia, intrauterine death of the fetus and preeclampsia make the pregnancy unsafe. WHO is working on supportive funding for the interventions necessary to ensure the health of pregnant women and newborn babies.

1.3.4 Maternal and child health situation in Bangladesh

WHO launched the Making Pregnancy Safer (MPS) initiative in Bangladesh in 1999 to respond to global challenges of maternal and newborn health (3). Their strategy is to focus on evidence based intervention that target the major causes of maternal and newborn morbidity and mortality. The five major causes of maternal death are haemorrhage, eclampsia, unsafe abortion, sepsis and obstructed labor (17).

The goal is to reduce maternal and newborn mortality and morbidity. Maternal mortality ratio is aimed to be reduced by 75 percent from 1990 levels by 2015 and infant mortality ratio to below 35 per1000 live birth. The MPS initiative aims to save the lives of more than 500,000 women who die world wide every year, as a result of causes related to pregnancy and child birth.

The key indicators related to maternal and child health in Bangladesh is presented in the table 2.

Table 2: Maternal and child health in Bangladesh: Key Indicators

| | |
|--|--------------------|
| Average age of first marriage, 2003 | 16 ¹ |
| Average age at first Birth, 2003 | 18 ¹ |
| Total fertility rate (TFR), 2000-2005 | 3.3 ¹ |
| Maternal mortality ratio (MMR), 2000 | 320 ¹ |
| Infant mortality rate (IMR), 2000-2005 | 66 ¹ |
| Anemia in pregnant women (<11mg %) | 49% ² |
| Home Delivery | 90% ³ |
| Attended by trained health personnel | 11.8 ³ |
| % of low birth weight | 50% ⁴ |
| Woman avail one or more antenatal care check | 47.5% ³ |

Source:

1. The Department of Family and Community health, WHO South East Asian Regional Office.
2. HNPSP (PIP)
3. Making Pregnancy Safer, Family and Community Health, World Health Organization, Bangladesh.
4. United Nation Administrative Committee on Coordination, Sub Committee on Nutrition, Nutrition Policy. Paper No.18, February' 2000.

1.3.5 Maternal and child health service in Bangladesh

There has been a significant increase in use of antenatal care among pregnant women, from 33% in 2000 to 49% in 2004. Now, almost half of pregnant women receive at least one antenatal care visit from a trained health provider. Despite the rise in antenatal

care, only one in four women receive three or more antenatal visits during her pregnancy, and a vast majority of women give birth without a trained birth attendant.

Component of antenatal care in public health facility in Bangladesh

- Measurement of Height of pregnant women.
- Measurement of Weight of pregnant women.
- Physical examination for anemia and edema.
- Blood test for Hb%.
- Urine examination for glucose and albumin.
- Blood Pressure measurement of the women.
- Fundal height.
- Fetal sound in late pregnancy.
- Health education on pregnancy care.
- Tetanus toxoid vaccination
- Birth planning
- Knowledge on danger sign of the pregnancy and what to do if situation arises like these.
In referral (secondary and tertiary hospital)
- Random blood sugar \pm
- Ultra sonogram for pregnancy profile \pm

1.3.6 Screening of GDM in Bangladesh

WHO and BIRDEM jointly worked for formulation of standard treatment guideline for diabetes. Thereby they proposed screening of diabetes in non pregnant women which is also applicable to pregnant women of Bangladesh. Screening for diabetes has not yet integrated in antenatal care component routinely in Bangladesh. Secondary and tertiary hospitals advise the pregnant women to do random blood glucose test. Based on the report they make further planning of respective pregnancies. A standard guideline for screening diabetic pregnancy is still non existent. Some of the private practitioners or specialists recommend diabetes screening routinely or if they find any risk factor to their patients. A guideline for screening diabetes proposed by BIRDEM is presented in the material and method chapter (Fig. 2.1) which can also be used for screening GDM..

1.4 Statement of problem

In the aftermath of increasing prevalence of type 2 diabetes in Bangladesh, it is reasonable to postulate that there is a growing prevalence of gestational diabetes. Bangladeshi women have been seen to have higher IGT than their male counterpart (15). Compared to the other South Asian population Bangladesh has higher birth rate (18) and has the prevalence of multiparity. Perinatal mortality and infant mortality is also high in Bangladesh (19). Though there is no published report on the prevalence of preeclampsia in Bangladesh the Obstetric and Gynaecological society (OGSB) in Bangladesh estimates 16% of maternal death from eclampsia (20). In addition, according to OGSB obstructed labour accounts for 8% of maternal death. Frequency of congenital malformations and low birth weight also appears to be higher in Bangladesh.

Increased morbidity and mortality among mothers and newborns in Bangladesh may in part be due to the effect of GDM (2). Data on the subject is scarce resulting in a lack of guideline for clinical investigation for pregnant mother which is likely to bear grave consequence. Risk factors predisposed to GDM need to be identified in this region in order to initiate a selective screening during pregnancy period to ensure safe mother hood and identify women with risk of diabetes later in life.

Studies addressing the relationship of gestational age at GDM diagnosis and pregnancy outcomes are scarce in Bangladesh. Evidences report that gestational diabetes affects pregnancy and fetus adversely if mother's glycaemia is uncontrolled and has been high. Therefore the aim of treatment during the pregnancy is to keep mothers' blood glucose level under normal range either by diet or by insulin. Information on the risk of these complications would have helped to continue or readjust the treatment protocol of GDM in Bangladesh.

Careful search of literature provided no data on prevalence of GDM based on the time of diagnosis in Bangladesh perspectives. In spite of reports that claim 40-66% of gestational diabetes can be detected in early pregnancy there have been conflicting studies on the usefulness of glucose screening at early pregnancy (21). Nevertheless one could reasonably suggest that women with gestational diabetes in early pregnancy could benefit from earlier metabolic control as well as prediction of pregnancy and fetal complication in this group.

A study conducted in India found different types of fetal complication at different level of glycaemic control. With improved glycaemic control and advanced neonatal care

perinatal adversities in GDM have approached that of non diabetic mothers (1;22). Thus intervention either by diet or by insulin in GDM may predict risk or possible outcome of the index pregnancy. Information on this would help to take preventive measures and make a birth planning in order to ensure a safer pregnancy for Bangladeshi women.

1.5 Literature Review

We conducted a detail literature search in order to elicit known and unknown facts on gestational diabetes relevant to our study. Specific search was also conducted on risk factors, ethnic distribution and fetal and maternal complication of GDM.

1.5.1 Pathogenic factors for gestational diabetes

From pathogenic point of view the exaggerated insulin resistance could be to some extent be explained by overweight or obesity which is more frequent in women with GDM (23). Gene mutation that is responsible for maturity onset diabetes of the young, a genetically and clinically heterogeneous group of autosomally dominant early onset type 2 diabetes with insulin secretion defects , have also been found in some women with GDM (20). One study in Germany found that the presence of auto antibodies identified a subgroup of GDM who are at risk for subsequent development of type 1 diabetes (24).

Pregnancy has commonly been viewed as a cooperative interaction between a mother and her fetus. The effects of natural selection on genes expressed in fetuses, however, may be opposed by the effects of natural selection on genes expressed in mothers. In this sense, a genetic conflict can be said to exist between maternal and fetal genes. Placental hormones are predicted to manipulate maternal physiology for fetal benefit. Gestational diabetes develops if the mother is unable to mount an adequate response to fetal manipulation (25). Thus pathogenic factors related to both type 1 and type 2 diabetes have been characterized by women with GDM. It appears therefore that GDM is pathogenetically a heterogeneous syndrome.

1.5.2 Prevalence of GDM

The prevalence of GDM varies in direct proportion to the prevalence of Type 2 diabetes in a given population or ethnic group (26). The reported prevalence of GDM in the USA ranges from 1% to 14%, with 2-5% being the most common rate (27). The WHO Ad

Hoc Diabetes Reporting Group noted markedly different rates of diabetes and IGT in different populations, from as low as < 1% to > 10%. In some of the populations, more than half the cases of diabetes were undiagnosed prior to the survey. IGT was mostly overlooked in routine clinical practice. Thus, a substantial proportion of abnormal glucose tolerance in pregnancy goes undetected without screening (28).

An especially high prevalence was detected in Zuni Indian women (14.3%), Chinese women (13.9%), Indian-born women (15%) in Melbourne Australia and Asian women in Illawarra, Australia (11.9%) (29). One WHO study (1) showed that for a given population and ethnicity, the risk of diabetes in pregnancy reflects the underlying frequency of Type 2 diabetes.

In Bangladesh a recent study conducted in a rural community found the overall prevalence (95% CI) of diabetes 6.8% (1.88-9.32) and 8.2% (3.74-12.64) according to FBG and 2hBG, respectively (2). From hospital registry of BIRDEM hospital it has been seen that the number of GDM cases were registered 403 in 2001 and 412 in 2002.

1.5.3 Diagnostic criteria proposed and used in different studies on GDM

The ADA Expert Committee (1997) recommended a screening test performed with a 50-g glucose load between 24 and 28 weeks of gestation. Those values were based on the cut off value proposed by O'Sullivan and Mahan in 1964 .But these were converted to plasma values by the NDDG in 1979. Discrepancies arose because of the interpretation of O'Sullivan and Mahan's values. Not only the substrate measured switched from whole venous blood to venous plasma, but also the laboratory technique switched from Somogyi-Nelson method to enzymatic ones. Furthermore, the NDDG approach based on O'Sullivan and Mahan's values were rounded differently by Carpenter and Coustan (1982). The Fourth Workshop recommended the use of the plasma glucose values proposed by Carpenter and Coustan (1).

The recent 1999 WHO recommendations (12) indicated that women meeting either criteria for diabetes or impaired glucose tolerance or fasting glucose by OGTT were considered to have gestational diabetes. Values for screening different glucose intolerance are same for pregnant and nonpregnant state (12). An oral glucose tolerance test (OGTT) to establish diagnostic status of glucose intolerance need only be considered if random blood glucose values lie in the uncertain range (i.e. between the levels that establish or exclude) and fasting glucose levels are below those which establish the diagnosis(30).

1.5.4 Risk factors for GDM

The traditional and most often reported risk factors for GDM were high maternal age, weight and parity, previous delivery of a macrocosmic infant, and family history of diabetes. In Sweden, a population-based study revealed that advanced maternal age and high BMI were found to be risk factors for increased OGTT values (4).

In USA at New York City older mothers, heavier women, those with a positive family history of diabetes, women with a history of infertility, and those who delivered on the clinic service are the high risk group for GDM. Their data suggest that, after controlling for traditional risk factors (maternal age, prepregnancy weight, and a family history of diabetes), Orientals, first generation Hispanics, women from the Indian subcontinent and the Middle East, those with a history of infertility, and low socioeconomic status women are at an increased risk for gestational diabetes (31).

In Italian women universal screening of GDM found the rate of GDM significantly higher in women with a positive history of diabetes, increasing age, previous pregnancies, prepregnancy overweight and short stature (32). In China, the risk of glucose intolerance in young women with positive family history is similar to that in the background pregnant population. Standard oral glucose tolerance test may not be necessary in this group of women if selective screening policy is adopted (33).

A case control study conducted in Melbourne have found out that age ≥ 25 years body mass index ≥ 27 kg/m², high-risk racial heritage, family history of diabetes mellitus carries risk for GDM. Other proposed criteria (previous GDM and glycosuria) added no further diagnostic power. Selective screening using the above four criteria would have missed two of 313 cases (0.6%) and could have saved screening up to 1,025 women without GDM (17% of all women). So it has been shown that selective screening for GDM based on prior risk assessment can reduce the need for testing with negligible loss of diagnostic efficiency (34).

One study done in London found that Bengali-Asians pregnant women with GDM living in an east London health district were older and of higher parity than the Caucasians and more frequently required insulin therapy. 20% of the Bengali population demonstrated persisting abnormality of glucose tolerance, whereas no abnormalities were evident in the Caucasian group (35).

A study has been done in Bangladesh to look at the nutritional status and birth outcomes diabetic and non diabetic pregnancies which found out that mothers age,

anthropometrical measurements like mean height, weight and less educational level of women have been higher for diabetic mothers from non diabetic mothers (36). Another recent study conducted in rural community in Bangladesh didn't find any association of mother's age, Height, weight, BMI with GDM (2).

1.5.5 Complications of pregnancy in relation to GDM

Nasrat et al. (Saudi Arabia) examined pregnancy outcome in 212 women with untreated IGT and 212 women with normal glucose tolerance, and concluded that IGT does not lead to any adverse outcome (37). Similar findings were reported by Ramtoola *et al.* (Mauritius), who failed to find an excess perinatal mortality in 267 pregnant women with IGT compared with a background population (38).

By contrast, Moses and Calvert (Australia) suggested that the clinically optimal level for glycaemia during pregnancy should be as near to normal as possible. They studied the proportion of assisted deliveries and the proportion of infants admitted to special care in relation to the range of glucose tolerance, and found an association between glycaemia and both outcomes (39).

Aberg et al. (Sweden) conducted a population-based study of maternal and neonatal characteristics and delivery complications in relation to findings for the 75-g, 2-h OGTT at 25-30 weeks' gestation. An increased rate of caesarean section and infant macrosomia was observed in the group with a glucose tolerance of 140-162 mg/dl (7.8-9 mmol/l) and in the GDM group (4).

Fetal outcomes examined were miscarriage <24 weeks, stillbirths, neonatal deaths up to 28 days of life, prenatal mortality, congenital malformations and size for gestational age. Maternal outcomes examined were rates of caesarean section and normal deliveries, and number of pre-term deliveries <37 completed weeks of gestation. Outcomes for Indo-Asian and Caucasian women were similar, with a take-home baby rate of 96% and 92% (40).

When correcting for ethnicity more Asian than White/European GDM mothers delivered LGA infants. This study remarks that ethnic influences were important when defining LGA infants and that mild disturbance of maternal glycaemia had a greater influence on the birth weight of Asian than White/European infants (41).

In a study a randomized clinical trial to determine whether treatment of women with gestational diabetes mellitus reduced the risk of prenatal complications. The rate of serious prenatal complications was significantly lower among the infants of the women

in the intervention group than among the infants of the women in the routine-care group. Women in the intervention group had a higher rate of induction of labor than the women in the routine-care group. Thus treatment of gestational diabetes reduces serious prenatal morbidity and may also improve the woman's health-related quality of life (42).

After adjustment for BMI, age, ethnicity, parity and prenatal care, gestational diabetes was found to be strongly associated with different grades of pregnancy induced hypertension in one study in USA. Early screening and management of pregnant women with maternal historical risk factors is emphasized from the view of diminishing complications, especially the frequency of macrosomia (43).

One study done in India looked at the effects of different glycaemic control on fetus. Even tight control of glucose caused large for gestational age newborn where as average control of glucose displayed better result with lower incidence of LGA. But both in tight control and average control of blood glucose incidence of small for gestational age and birth asphyxia has been higher in contrast to uncontrolled glucose. For GDM patients all parameters may not be uniformly affected by the same degree of glycaemic control. A tight control may not be the only factor to decide on the outcomes for PGDM patients (22).

In India, Ramachandann et al. conducted a study over south Indian women and noticed that macrosomia, premature deliveries are higher in GDM pregnancy than normal pregnancy (44). In Pakistan, patients with GDM were also found to have a higher incidence of preterm labour and caesarean section. In the neonates hypoglycemia and hyperbilirubinemia were similarly higher. The fetal abnormality rate was 5.6% and the perinatal mortality was 28/1,000 which was higher than the controls (45). In another study in Pakistan, pregnancies with a abnormal glucose tolerance showed that incidence of pre-eclampsia and caesarian birth were highest in Group with abnormal glucose tolerance test. For macrosomia, the incidence increased in those with abnormal GCT but normal GTT (46).

Another study in Pakistan was done to look at prevalence and complications in diabetic pregnancies in an South Asian community. It found out 3.3%GDM and 0.6% women having pre-existing diabetes mellitus. Overall maternal complications were high; pre-eclampsia (19%), polyhydramnios (4.6%), and threatened abortion (3.4%). Fetal complications of macrosomia (13.1%), intrauterine growth retardation (7.1%), and intrauterine deaths (5.3%) were noted. Complications were higher in poorly controlled groups (47).

One study was done in England to look at the fetal and maternal outcomes in Indo-Asian compared to Caucasian women with diabetes in pregnancy. Pregnancies complicated by type 2 diabetes in both groups posed the greatest threat to a successful pregnancy outcome. Both maternal and fetal outcome in both these groups were similar, but the prevalence of GDM is higher (25% vs 10%) in Indo-Asian women and vaginal delivery had been higher for this population than Caucasian population (40).

Another study in Norway found out that macrosomia, preterm birth, preeclampsia, cesarean delivery, APGAR score <7 at 5 min are higher in immigrant women of South Asian origin having diabetes during pregnancies (48).

One study was done to look at the nutritional status and birth outcomes diabetic and non-diabetic pregnancies at BIRDEM hospital in Bangladesh which found out that mothers' age, anthropometrical measurements like mean height, weight and preterm birth have been higher for diabetic mothers from non-diabetic mothers (36). The crude prevalence of systolic and diastolic hypertension was 6.8 and 5.4%, in a respective study conducted in rural community in Bangladesh. The history of abortion, neonatal death and stillbirth was found in 19.9, 11.4 and 9.6%, respectively. Higher prevalence of hypertension was also noticed in the women with GDM (2).

1.6 Research questions, hypothesis and objectives of the study

1.6.1 Research questions

- i). What are the risk factors of GDM in Bangladesh?
- ii). Is GDM associated with pregnancy related and neonatal complications?
- iii). Do pregnancy associated and neonatal complications differ according to the time of diagnosis of GDM?
- iv). Do pregnancy associated and neonatal complications differ according to the type of treatment in GDM?

1.6.2 Hypothesis

- i) There exist risk factors of GDM in Bangladesh same as those found in other previous and regional studies. For instance, Positive family history of diabetes, increased maternal age, higher BMI, History of previous GDM.
- ii) GDM is associated with pregnancy related and neonatal complications.
- iii) Pregnancy associated and neonatal complications in GDM differ according to the time of diagnosis.
- iv) Pregnancy associated and neonatal complications in GDM differ according to the type of treatment.

1.6.3 Objectives of the study

General objectives

- ✓ To identify the risk factors of GDM and to examine the relationship of maternal, fetal and neonatal complications with GDM in Bangladesh.

Specific objectives

- ✓ To identify the risk factors of GDM in Bangladesh.
- ✓ To examine the relationship between the time of diagnosis of GDM and the type of treatment received by them.
- ✓ To measure the association of pregnancy associated complications with GDM.
- ✓ To measure the association of fetal and neonatal complications with GDM.
- ✓ To examine the pregnancy associated, fetal and neonatal complication according to time of their diagnosis in GDM women.
- ✓ To examine the pregnancy associated, fetal and neonatal complication according to the type of treatment received in GDM women.

1.7 Justification of the study

- GDM has been seen to be associated with growing pregnancy complication by hospital observation in Bangladesh. Urban prevalence of GDM is predicted even much more while the rural prevalence was found 6.8% and 8.2% according to FBG and 2hBG respectively (2).
- According to Millennium development goals complicated pregnancies need to be identified beforehand so that pregnant women can make a safer birth planning and be attended by skilled health personnel at their delivery.
- Neonatal mortality and morbidity would have also to be reduced in line with the targets of MDG.
- Most of the GDM cases progress to diabetes type 2 later in life. In Bangladesh diabetes has become highly prevalent and is growing at a faster rate. Identification of high risk group like GDM helps to initiate preventive measures for them so that the onset of diabetes can be delayed or prevented. Thereby the huge health expenditure for diabetes can be minimized.

Chapter 2

Material and Methods



2. Material and Methods

2.1 Target population

The target population was pregnant women with Gestational diabetes in Bangladesh.

2.2 Study population

The study focused on pregnant women who attended BIRDEM and MCHTI hospitals for delivery.

2.3 Study design

A hospital based case control study was designed to collect data for this research which was fully quantitative and observational. Two hospitals from the Dhaka city were chosen for the collection of data. To collect necessary information a face to face interview with the mothers and a retrospective clinical chart review of all the cases (GDM) and controls (NonGDM) were done in postnatal phase.

2.4 Study hospitals

Data for GDM and NonGDM were collected from the women who came to attend delivery in BIRDEM and MCHTI hospital in Dhaka City respectively.

2.4.1 BIRDEM hospital

BIRDEM, an autonomous hospital in Dhaka city, belonging to Bangladesh Institute of Research on Diabetes, Endocrinology and Metabolic Disorders serves a comprehensive health care service for all diabetic patients through out the country at a subsidized price. This hospital also provides general treatment to other patients but at relatively higher price. As this is the tertiary level hospital and has specialised care system for diabetes, quite a significant number of patients with diabetes come to BIRDEM hospital from all over the country including Dhaka City.

On an average 3-4 deliveries take place daily at BIRDEM. These are mostly GDM and pregestational diabetic deliveries (*source: hospital registry*). Most of the GDM women are referred to BIRDEM from other hospitals or doctors after the diagnosis or suspicion of diabetes in them for the better management of diabetes during pregnancy. They are

screened off for diabetes by OGTT according to WHO criteria when they are referred there. Once their diagnosis is confirmed they are recruited as newly diagnosed GDM patient in the hospital. Thereby they can utilize BIRDEM services for both the treatments of diabetes and pregnancy care at a subsidized rate.

Cases other than referred ones are usually screened off early in third trimester or in second trimester based on the suspicion of the attending doctors in obstetric outpatient unit. Thus these women start to receive treatment for diabetes from BIRDEM hospital. Their demographic and medical history, clinical and laboratory findings and treatment on diabetes are recorded systematically in a book developed by Bangladesh Diabetic Association (Appendix-4). At the same time they also go for antenatal checkup in the same unit which is recorded in the antenatal card (Appendix-2).

2.4.2 MCHTI hospital

Maternal and Child Health Training Institute (MCHTI) is a tertiary level public hospital in Dhaka city. This has been upgraded to a well equipped hospital for obstetric and child health care by the assistance of Government of Japan on 2001. This hospital is not a specialized hospital for diabetes care or other type of diseases. It mostly renders obstetric services to pregnant women at a reasonable price. This hospital has been accredited and reputed for holding well-maintained antenatal card (Appendix-3). All of the women who deliver here usually have been on their regular antenatal check up. The hospital conducts about 10-15 deliveries a day (source: hospital registry).

In MCHTI, the practice of screening for diabetic pregnancies is different. During the first or second antenatal check up, it performs a routine test of random blood glucose (RBG) irrespective of time of meal to all pregnant women. If that is found equal or more than 7 mmol/l, they take another RBG test. If that again comes the same as before they are asked to take a GCT/ OGTT. If the result of the test confirmed GDM they are referred to diabetic hospitals for better and proper management of diabetes. BIRDEM hospital is one of those referral hospitals. This is how MCHTI hospital screens out diabetic pregnancies and intends to provide routine pregnancy care for the women not detected as diabetic according to their criteria.

2.5 Research tool/instrument

The following research tool was used in this study for collection of data.

- a). Questionnaire (Appendix-1).

Sources for data

- a) Answers from the participants in interview
- b). Antenatal cards (Appendix-2 & Appendix-3).
- c). Diabetic book of the women with GDM (Appendix-4).
- d). Hospital files for delivery and birth records.

2.6 Inclusion criteria

Cases

- a). Women with singleton pregnancy.
- b). Women with any degree of glucose intolerance with onset or first recognised during pregnancy.
- c). Women with a diabetic book and antenatal card with necessary information for this study.

Control

- a). Women with singleton pregnancy.
- b). Women with an antenatal card with necessary information for this study.
- c). Women with RBS less than 5.5 mmol/l.

2.7 Exclusion criteria

Cases

- a). Known history of diabetes before pregnancy.
 - b). Women with twin or multiple pregnancies.
 - c). Women with a diabetic book and antenatal card lacking necessary information for the study.
-

Control

- a). Women who experienced any degree of glucose intolerance before pregnancy.
- b). Women with twin or multiple pregnancies.
- c). Women with an antenatal card lacking information necessary for the study.
- d) Women with RBS value equal or more than 5.5 mmol/l.

2.8 Sample size

We collected data from **106** cases (GDM) and **196** controls (NonGDM) during the period of field work.

In planning phase we estimated a total sample size of 800 with equal number for cases and controls. Calculation was performed by a statistician. But in place due to shorter period of time and limited logistic support we could not reach up to that many samples.

2.9 Sampling procedure

We underwent continuous sampling for selection of cases and controls for this study.

In BIRDEM hospital 111 women who fulfilled inclusion criteria were asked to take part in the study. Among them 5 refused to participate. The rest 106 women with GDM, willing to participate, were selected as cases for the study. These women were already diagnosed GDM patients by OGTT. They had been on treatment by BIRDEM outpatient service for control of their diabetes and pregnancy care.

In MCHTI 266 women who fulfilled inclusion criteria were identified initially. Then they were asked for rechecking of random blood glucose level before delivery. Among them 62 women, declined from giving blood sample to recheck blood glucose level were excluded from the study. Blood glucose levels of them were tested from capillary blood with a haemocue machine. 8 were found to have blood glucose more than 5.5 mmol/l and were also excluded from the study. The rest 196 women had been followed to postnatal ward after their delivery.

2.10 Pilot study

Prior to the initiation of the main study a small pilot study was performed on 10 subjects from each hospital. The intention was to identify the potential problems to collect data necessary for the study. Antenatal cards, diabetes record books and delivery cards were examined thoroughly to look for the information available and their consistency. Due to lack of reliable or sufficient information in the medical records some of the variables like microalbuminuria, fasting glycosuria, lipid profile, HbA1C was excluded from the study. On the other hand some variables like APGAR at 5, hypoglycaemia in babies born to GDM mothers were added. Necessary adjustments were made in the questionnaire following the pilot study.

2.11 Data collection procedure

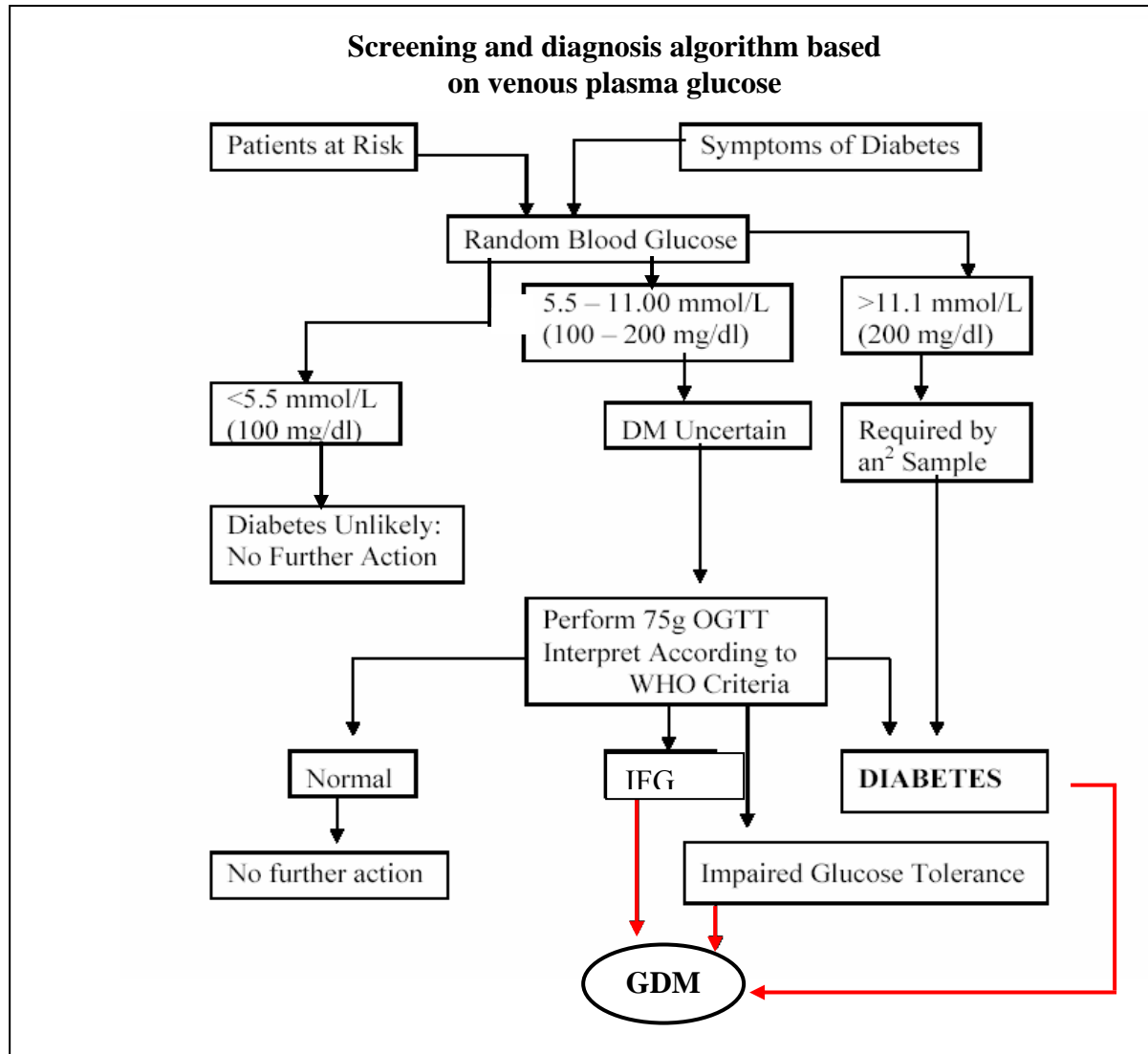
Along with principal investigator two doctors belonged to the respective hospitals took part in data collection. They followed the sampling technique to select the sample for the study. Assistance of the doctors from respective hospitals was sought because of the load of an apparently larger sample size and their easy access to the necessary information.

A two days training was provided to the assisting doctors by the principal investigator. The training focused on the demonstration of the questionnaire, collection of information from the records, operation of the haemocue machine, approach of communication and ethical issues. This training was conducted before the pilot phase of testing the questionnaire.

Data were collected from July 1 to October 15, 2004 with a structured questionnaire. Women selected as cases and controls were interviewed by an investigator in their apparently stable situation after the delivery in post natal ward. The purpose of the study was clearly explained to them. Those who gave consent to take part, a face to face interview was taken and antenatal card and delivery records were reviewed to collect the necessary information. Sometimes husband and other family person accompanied the woman during the interview and helped her providing information to the interviewer. An interview took about 20-30 min. The data were regularly cross checked by the principal investigator.

2.12 Diagnostic criteria used

We depended on the method adopted by respective hospital for screening of GDM. We followed the guideline for diagnosis and screening of DM proposed by the clinical research division BIRDEM to set a cut off value for screening GDM women (Fig. 2.1).



Source: BIRDEM Clinical Research Group,

Fig. 2.1. Screening and diagnosis algorithm for DM based on venous plasma glucose. Red arrows explain three different stages of glucose intolerance included in GDM (modified after BIRDEM).

In BIRDEM diagnosis of GDM was made by oral glucose tolerance test according to the WHO recommended criteria. Thus we included pregnant women detected as cases

with diabetes or impaired glucose tolerance or impaired fasting hyperglycaemia. Their blood glucose value represented the venous plasma glucose value undertaken in oxidase method. The values of diagnostic criteria are described in the following table (Table 3). For controls random blood glucose which represented the venous plasma glucose value below 5.5 mmol was considered in the way mentioned earlier.

Table 3: Values for diagnosis of diabetes mellitus and other categories of hyperglycemia by the OGTT. Glucose concentration mmol/l (mg/dl)

| | Whole blood Capillary | Plasma Venous |
|---|--|--|
| Diabetes mellitus Fasting 2-h post glucose load or both | ≥6.1(≥110) ≥ 11.1(≥200) | ≥7.0(≥126) ≥ 11.1(≥200) |
| Impaired Glucose Tolerance (IGT) Fasting (if measured) 2-h post glucose load | ≥6.1(≥110) ≥ 7.8(≥140) and <11.1(<200) | <7.0(<126) ≥ 7.8(≥140) and <11.1(<200) |
| Impaired Fasting glucose Fasting 2-h post glucose load (if measured) | ≥5.6(≥100) and<6.1(<110) < 7.8 (<140) | ≥6.1(≥110) and <7.0(<126) <7.8 (<140) |

Source: WHO, Department of Noncommunicable disease surveillance, 1999 (49).

2.13 Variables

In this study GDM is the only dependent variable. All others are independent variables

2.13.1 Risk factor variables

- i) Socio demographic risk factors: Maternal age, First recorded maternal weight in this pregnancy, Height, BMI, Level of education of the women, monthly expenditure of the family and occupational status of the women.
- ii) Familial risk factor: Family history of diabetes and first and second degree relatives.
- iii) Obstetric risk factors: Gravidity, previous adverse obstetric history and previous history of GDM.

2.13.2 Time of diagnosis of GDM

Gestational week at which GDM was diagnosed

2.13.3 Type of treatment in GDM

Diet control or insulin whichever was received by the women with GDM for longer duration.

2.13.4 Pregnancy outcome variables

- i). Pregnancy complications: Hypertension in pregnancy, anaemia
- ii). Delivery outcome: Gestational age at delivery, Mode of delivery.
- iii). Fetal and neonatal Outcome: Birth weight of the newborn, Normal live or abnormal birth of foetus or babies, APGAR score at 5 min.

2.14 Operational definition of variables

Maternal Age: Age of mother at the current pregnancy.

Pregnancy weight: First recorded weight in the antenatal card during this pregnancy.

Maternal Height: Height recorded in the antenatal cards.

Pregnancy BMI: Body mass index was calculated by pregnancy weight (in kg) divided by height (in meter) squared.

Years of education: Numbers of years until which our study population have received institutional education. Years of education are further subdivided into primary, secondary, higher secondary and higher level of education.

Occupational status: We have looked into whether the woman is housewife or not as the number of women working outside home or directly involved in income generation is very limited. Women who are not directly involved in income generation activity we referred them as housewife in our study. Mentionable housewives, who were student, were not put into house wife category.

Monthly expenditure: The monthly expenditure of the family in taka (local currency). This includes expenditure irrespective of structure of the family whether small or large.

Intra-uterine death: A fetal death occurred inside the mother's womb after 24 weeks of pregnancy. Women usually felt no fetal movement before the onset of labour.

Gravida: Number of conception by our study population including the current pregnancy. It includes miscarriage, abortion, still birth and events of menstrual regulation.

Miscarriage: A fetal death in early pregnancy. It refers to death of fetus early in pregnancy or more precisely before 24 week of gestation.

Still Birth: It means the birth of a dead fetus late in pregnancy which happened during the process of delivery.

Hypertension recorded in pregnancy: Presence of high diastolic blood pressure in two or more antenatal check-up that is recorded in antenatal card or women taking antihypertensive drugs. Two records of diastolic blood pressure ≥ 90 mm Hg in antenatal card has been taken as hypertension in pregnancy for this study.

Anaemia: Hemoglobin level <11 mg/dl in pregnant women.

Gestation at delivery: Gestational week of pregnancy at which delivery takes place. In this study it was calculated from menstrual history.

Mode of Delivery: Mode of delivery was categorized into normal delivery and caesarean section.

Pre-term birth: Less than 37 completed weeks (less than 259 days) of gestation.

Live Birth: Live birth was taken as when the newborn breathed or showed any sign of life. These were presence of heart beat, pulsation in the umbilical cord or movements of voluntary muscle.

Birth weight: The first weight of the newborn obtained after birth. In both the hospital they recorded babies' weight by digital baby weighing machine.

Apgar score: Evaluation of a newborn's physical status by assigning numeric values (0 to 2) to each of the 5 criteria: 1) heart rate, 2) respiratory effort, 3) muscle tone, 4) response to stimulation and 5) skin color. In this study the recorded score at 5 min of birth has been included.

Low birth weight (LBW): Birth weight less than 2500 gm (up to and including 2499 gm).

Macrosomia: Birth weight more than 4000 gm.

Hypoglycemia of infants: Blood glucose level of infants recorded below 2.5 mmol/L.

2.15 Data handling and analysis

Individual case was given a case number to avoid mixing up of data. In the field data were entered into **Microsoft Access 98** according to pre-coded categories. Later this data were converted into the software package **SPSS 12.0.1** (Statistical Package for Social Sciences) for windows operating platform. The data were checked by going through each and every questionnaire.

SPSS 12.0.1 was used to examine the frequency distributions of maternal socio-demographic characteristics, family and obstetric histories, pregnancy and neonatal outcomes according to case and control status. For a general description of the study population group differences were recorded in χ^2 test, while individual t-test was employed to identify differences for some of the continuous variables. Initial univariate analyses were carried out to determine crude odds ratios (ORs) and 95% confidence interval (CI). Effect modification was evaluated in multivariate logistic regression models. If there appeared to be no effect modification, logistic regression procedures were used to simultaneously control for confounding variables while estimating ORs and 95% CIs. Final logistic regression models included confounders as well as those covariates of a priori interest. Statistical significance was set at <0.05 .


2.16 Ethical issues

Approval to carry out the study was sought from the Ethical Review Committee in Norway and from the Bangladesh Medical Research Council before the commencement of the study. It was approved by the countries. The purpose, objectives of the study and possible benefits of the study were explained to the relevant authorities at BIRDEM and MCHTI.

Prior to interview, the purpose and objectives of the study was explained to the prospective participants. Decision to join in the study was made on the basis of informed consent. Verbal consent to take part in this study was sought prior to their inclusion to this study in presence of a witness (Appendix-5). Participation in this study had been voluntary and participants had the right to withdraw at any period of the investigation. No penalty was attached to such decisions. The findings were treated with highest possible degree of confidentiality. Each participant was given a separate identity number.

In cases of adverse pregnancy outcome like complicated delivery, mother's and baby's illness or in any emergency situation psychological effects of the participants had been taken care of while asking question or collecting information. Researchers were available for counselling bereaved people if they need such assistance.

Chapter 3 Results



3. Results

The findings in this study will impart on the data collected from two hospitals in Dhaka city from July 1st to 15th of October 2004. A total of 106 women from BIRDEM and 196 women from MCHTI were interviewed during this period. The data were based on the answers came from interviews and medical records registered in the antenatal cards, diabetic booklet and delivery notes in hospital files. Medical records were reviewed retrospectively for information on medical history, physical findings, course of the disease, treatments, complications, and outcomes in accordance with the objective of the study. It is noteworthy that all the women in this study dwelt in either urban or semi urban areas.

In this chapter results will be divided into three parts. First, descriptive analysis of the risk factor variables will be presented followed by multivariate analysis. Secondly, the association of the time of diagnosis of GDM with the type of treatment received by the women will be described. Finally, we will compare pregnancy outcomes of GDM by univariate and multivariate analysis between cases and controls. We will also compare pregnancy outcomes in GDM according to the type of treatment received by the women and time of diagnosis of GDM made in this pregnancy.

3.1 Risk Factors for GDM

Maternal age, pregnancy weight, height, level of education and occupational status of the women, monthly expenditure of the family, and family history of diabetes, gravidity and previous obstetric history were examined to identify risk factors of GDM.

3.1.1 Demographic factors

3.1.1.1 Maternal Age

Women with GDM have been seen to have an increase of prevalence with increasing age of pregnancy. The mean age of GDM and NonGDM group was 29.6 ± 4.1 and 24.3 ± 5.2 respectively. About 86.8% of women in GDM group were over 25 years. No woman under the age of 20 was found in the cases. On the contrary we observed 17.3% women in control group below 20 years. But the lowest recorded age in GDM group was 21 years. The prevalence proportion of GDM increased with age from 13.2 % in the age group 20-24 to 42.5% for the group 30-34 (Fig. 3.1).

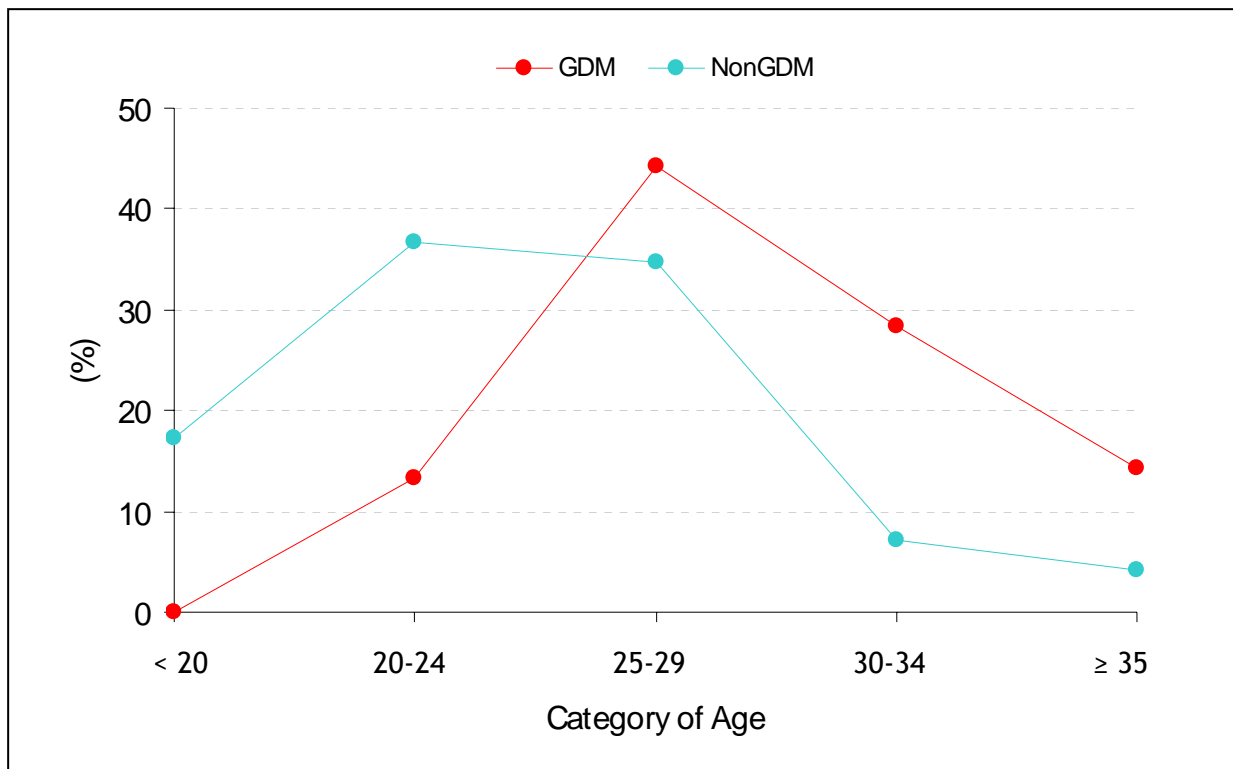


Fig. 3.1 Prevalence percentage in different age group in GDM and Control group.

Larger difference of prevalence was also marked between GDM and the control group (14.2% vs. 4.1%) in the women over 35 years. The distribution of age in control group was noticed to have a predominance of younger age pregnancy than GDM group. In bivariate analysis we have seen that risk for GDM was higher in the women from 25 years and above. We observed a significant difference (p value <0.001) in the distribution of age between GDM and control group (Table 4).

3.1.1.2 Anthropometric findings

Anthropometrical measurements in this study were derived from medical records provided in the antenatal cards. We found a preponderance of heavier women in GDM group in comparison to the control group as there was a marked difference on the mean weight of both the groups (61.7 ± 9.1 vs. 56.4 ± 8.7). Individual t-test had shown significant difference in distribution of weight in between the groups (p value <0.001). In this study the mean height of women in GDM and control group was 153.4 ± 5.3 and 153.7 ± 5.1 cm respectively. In individual t-test the distribution of height didn't reveal any difference (p value <0.61) in between these two groups. The measurement of obesity depends on the proportion of both the height and weight of an individual.

Therefore we focused on the BMI of the women in order to examine the relationship of obesity with GDM. Based on the recorded weight and height, we calculated BMI of each participant.

Table 4: Demographic factors and their association with GDM in the study population

| Distribution | | | | | Risk estimation for GDM |
|---------------------|-------|------|---------|------|---------------------------|
| Category | GDM | | Non GDM | | Crude Odds ratio (95% CI) |
| | Count | % | Count | % | |
| Age in years *** | | | | | |
| 20-24 | 14 | 13.2 | 72 | 36.7 | 1.00 |
| <20 | 0 | 0.0 | 34 | 17.3 | - |
| 25-29 | 47 | 44.3 | 68 | 34.7 | 3.5(1.8-7.0) |
| 30-34 | 30 | 28.3 | 14 | 7.1 | 11.02(4.7-26.1) |
| ≥35 | 15 | 14.2 | 8 | 4.1 | 9.6(3.4-27.1) |
| Body mass index *** | | | | | |
| ≤20 | 3 | 2.9 | 22 | 11.4 | 1.00 |
| 21-25 | 40 | 39.2 | 109 | 56.4 | 6.3(1.8-22.7) |
| 26-30 | 47 | 46.1 | 54 | 28.0 | 2.6(0.7-9.3) |
| >30 | 12 | 11.8 | 8 | 4.1 | 11.0(2.4-49.4) |

***p value<0.001

In this study women with GDM were found obese in relation to the control group (Table 4). The mean BMI of women with GDM was 26.2±3.6 and the control group 23.8±3.6. Seventy five percent of the women in GDM group had BMI over 24 while seventy five percent of women in the control group had below 26 (Fig. 3.2). In descriptive analysis chi square test revealed significant difference of obesity in between these two groups. Risk of GDM was about 11 times [OR 11.0; 95% CI (2.4-49.4)] more in the women with BMI more than 30 than those below 20 (Table 4).

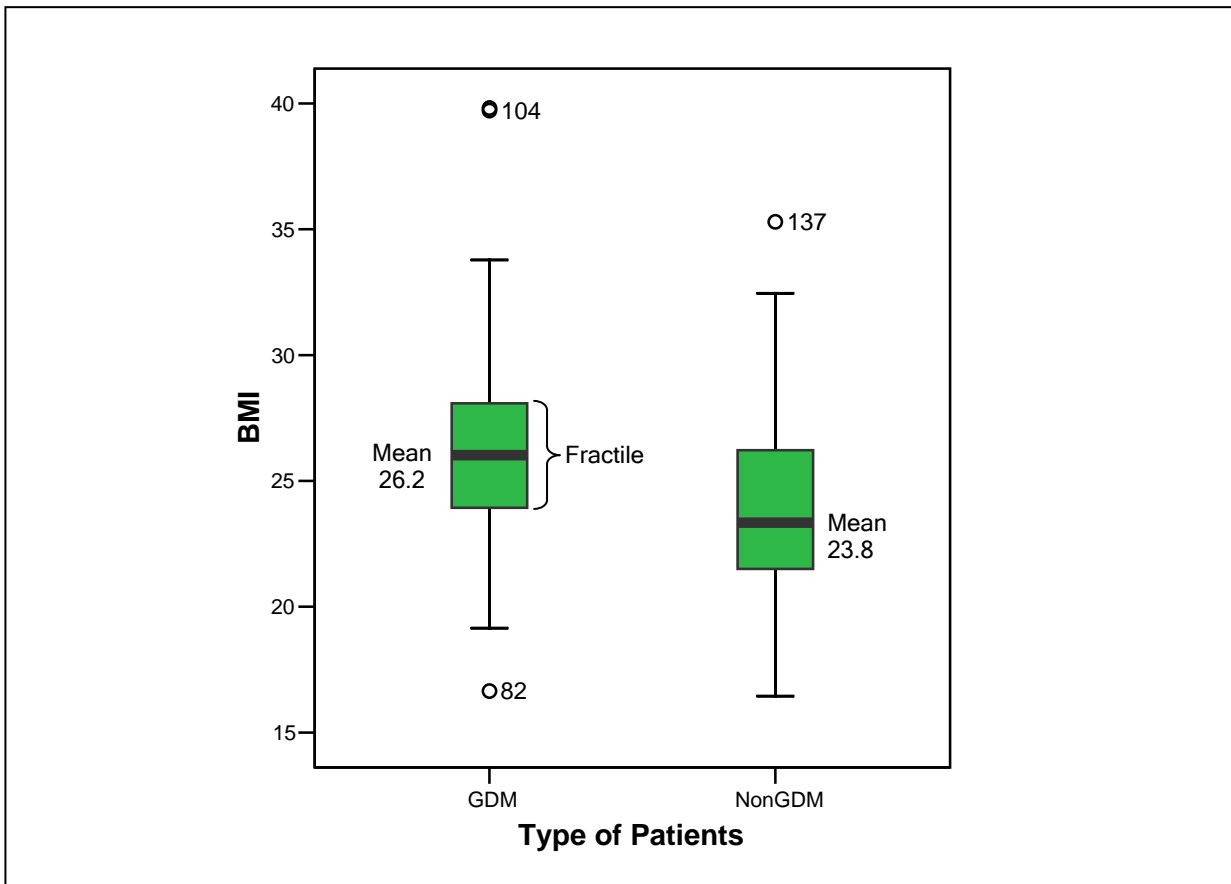


Fig. 3.2 Means, fractile and distribution of BMI in GDM and control group.

3.1.2 Socio- economic factors

3.1.2.1 Level of education

It has been seen that women with higher level of education had GDM more than those with less institutional education (Fig. 3.3). Meanwhile, highest level of education attained by the women of this study was classified in different level ranging from primary to higher education. The difference was highest in the women with higher education (29% vs. 12%). The proportion of prevalence was also higher (37.7%) in 11 to 14 years group. But the difference turns into the opposite direction (26.4% vs. 51%) in the group with secondary level of education (Fig. 3.3).

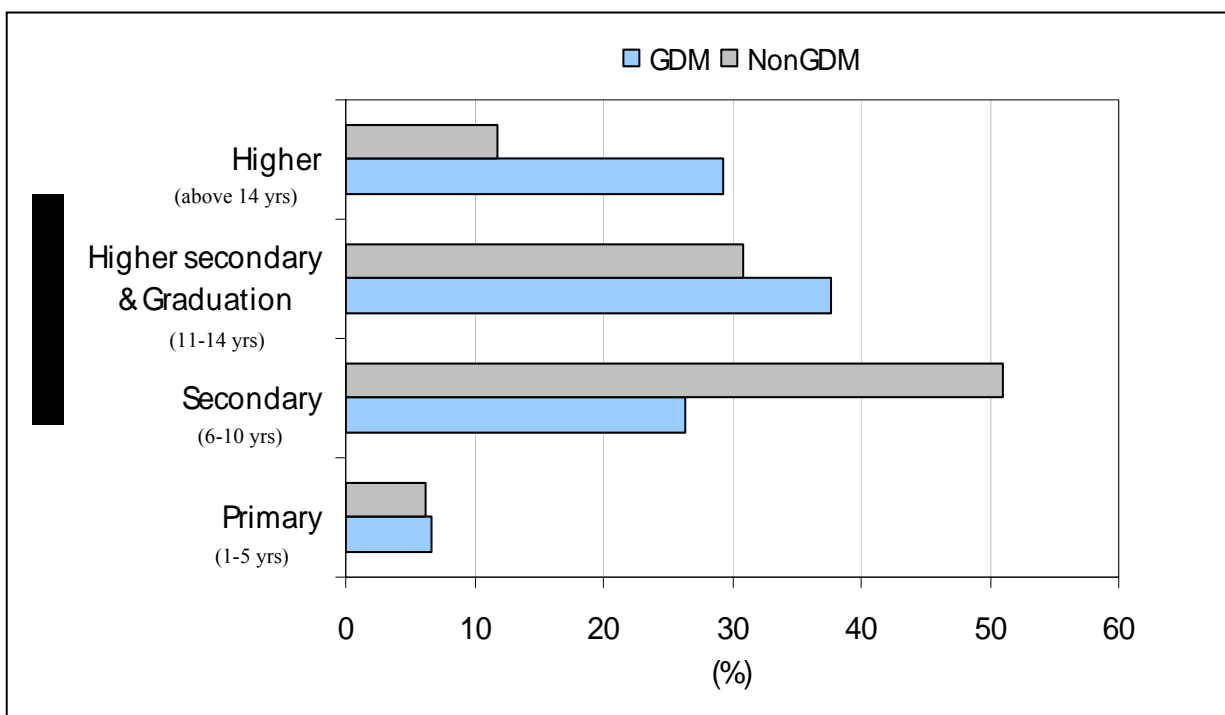


Fig. 3.3 Prevalence percentage of women with GDM and the control group according to their level of education.

However, women having primary level of education had almost the same percentage in these two groups (Table 5). The mean years of education were 12 ± 3 for women with GDM and 10 ± 3 for women in the control group. Risk of GDM appears to be more in the women with education more than 14 years [OR 2.3; 95% CI (0.8-6.9)] than those with 5 years of education. Chi square test displayed that level of education in between the groups was significantly associated with GDM (p value < 0.001; Table 5).

Table 5: Socio- economic factors and their association with GDM in the study population

| Distribution | | | | | Risk estimation for GDM in Bivariate analysis Odds ratio (95% CI) |
|-----------------------------|-------|--------|---------|------|---|
| Category | GDM | | Non GDM | | |
| | Count | % | Count | % | |
| Years of education *** | | | | | |
| 0-5 | 7 | 6.6 | 12 | 6.2 | 1.00 |
| 6-10 | 28 | 26.4 | 99 | 51.0 | 0.5(0.2-1.3) |
| 11-14 | 40 | 37.7 | 60 | 30.9 | 1.1(0.4-3.2) |
| >14 | 31 | 29.2 | 23 | 11.9 | 2.3(0.8-6.9) |
| Occupation Δ | | | | | |
| Others | 20 | 18.9 | 28 | 14.4 | 1.00 |
| House wife | 86 | 81.1 | 167 | 85.6 | 0.72(0.4-1.3) |
| Monthly expenses (in TK)*** | | | | | |
| <5000 | 12 | (11.7) | 61 | 13.0 | 1.00 |
| 5000-10000 | 45 | (43.7) | 99 | 53.8 | 2.3(1.1-4.7) |
| >10000 | 46 | (44.7) | 24 | 13.1 | 9.7(4.4-21.5) |

Δ not significant

*** p value <0.001

3.1.2.2 Occupational status of mothers

All the women in this study were married and most of them were housewives (Table 5). About 81 % in GDM and 86% in the control group were found as being solely housewives. According to the answers provided by them these women were involved only in household activities and didn't have any other working status. Types of occupation seen to be hold by the women in this study were clerical and officer post in the government service, bank, hospitals and NGOs. These women were described under 'others' category. The operational definition of house wife was described in methodology chapter. Chi square test revealed no difference of occupational status in between the groups.

3.1.2.3 Monthly expenditure of the family

Women having better economic status were more likely to have GDM than those having low economic status in these study population (Table 5). Only 12 % of women with monthly expenditure less than 5000 taka (\$87) were found to have GDM. It has been noticed that GDM increased with increasing monthly expenditure of the family (Fig. 3.4). The difference was highest in those with monthly expenditure more than 10000 taka (\$154) (44.7% vs. 13.1%). In univariate analysis significant difference was observed (p value <0.001) in between these two groups.

Those who had monthly expenditure more than 10000 taka (\geq \$154) had about 9.7 times more risk of GDM [OR 9.7; 95% CI (4.4-21.5)] than those had less than 5000 taka (Table 5).

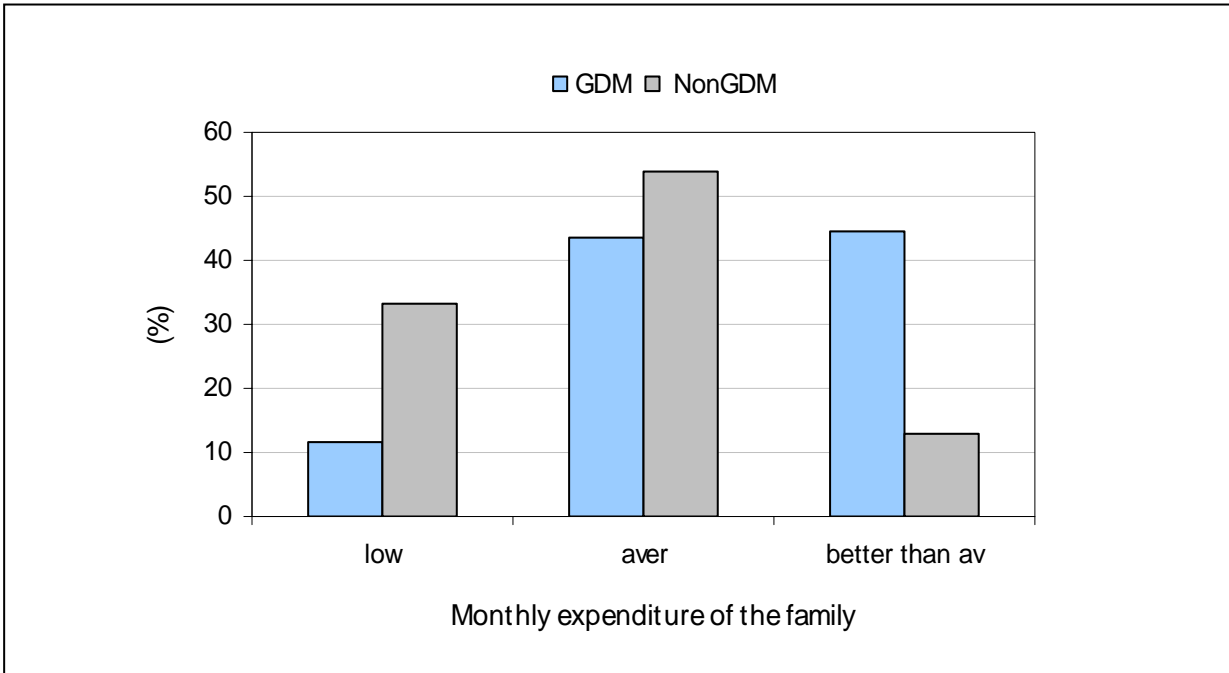


Fig. 3.4 Distribution of prevalence percentage of GDM and control group at different level of monthly expenditure

3.1.3 Family history of diabetes

Family History of diabetes was found as a strong risk factor for GDM and significantly associated with GDM in this study (p value <0.001) (Table 6). About seventy four percent women with GDM answered 'yes' when they are asked whether any in their immediate relation like parents, siblings, children, uncles and aunts, grant parents have known history of diabetes. On the contrary about 26% responded as 'yes' to this question in the control group. We noted that the risk of GDM in the women with a known positive family history is 8.7 times more than [OR 8.7; 95% CI (4.6-16.4)] those who didn't have (Table 6). Quite a large number of women replied that they did not know whether any in their family had diabetes in both the groups. Meanwhile, most of them belonged to the women without GDM (Fig. 3.5).

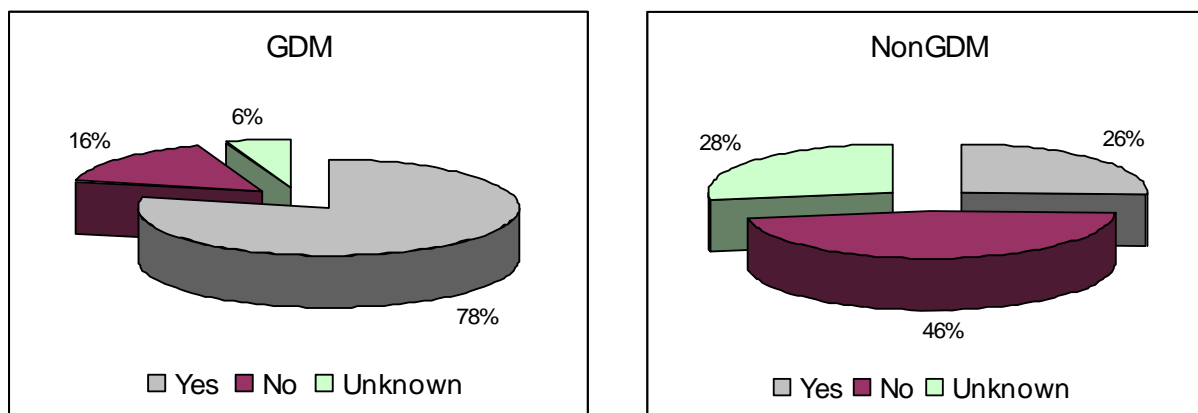


Fig. 3.5 Distribution of the participants on family history of diabetes.

Table 6: Characteristics of familial factor in the study population

| Variables | GDM Count (%) | Non GDM Count (%) | Odds ratio for GDM In bivariate analysis (95% confidence interval) |
|-------------------------------------|---------------|-------------------|--|
| Known family history of diabetes*** | | | |
| No | 17 (16) | 84 (46) | 1.00 |
| Yes | 83 (78.3) | 47 (26) | 8.7 (4.6-16.4) |
| Unknown | 6 (5.7) | 50 (27.6) | 0.6 (0.2-1.6) |

*** p value <0.001

3.1.4 Obstetric factors of the mothers

3.1.4.1 Previous history of GDM

In our study all the women who had GDM in their previous pregnancy (26%) developed GDM in the current pregnancy while no one in the control group had GDM in their previous pregnancy (Fig. 3.6). Women who were primi gravida or had prior history of menstrual regulation or miscarriage were excluded in the previous obstetric history analysis. Previous history of GDM was found to have a significant association with GDM. A positive history of GDM in the previous pregnancy predicts high risk for GDM in the following pregnancies [OR 2.1; 95% CI (1.7-2.6)] (Table 7).

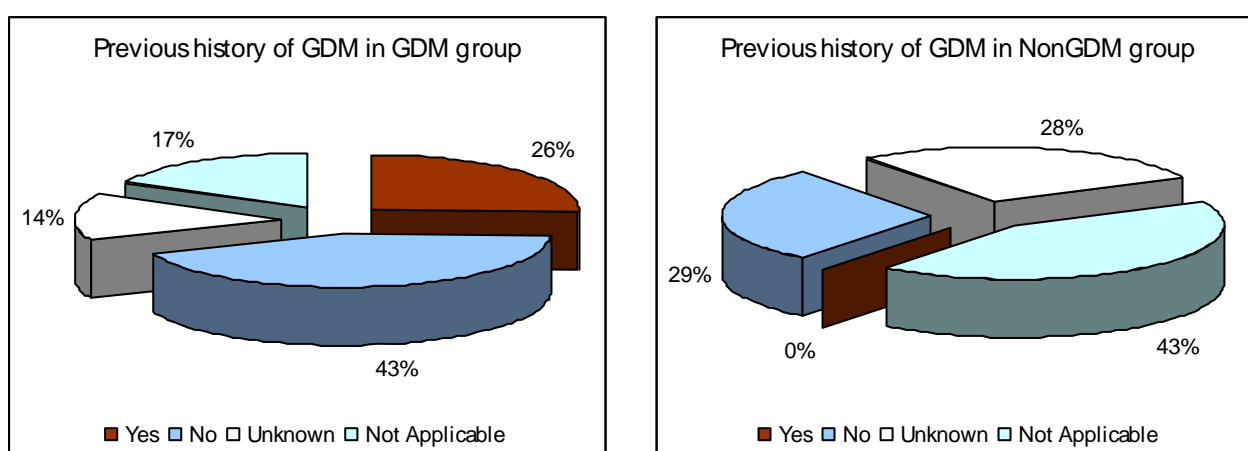


Fig. 3.6 Prevalence percentage of Previous history of GDM in current GDM and the control group.

Table 7. Characteristics of obstetric factors and its association with GDM of the study population

| Variables | GDM Count (%) | Non GDM Count (%) | Odds ratio for GDM (confidence interval) |
|---|---------------|-------------------|--|
| Gravidity p<0.01 | | | |
| Primi | 19 (18) | 65 (33.2) | 1.00 |
| Second | 43 (40.6) | 65 (33.2) | 2.3 (1.2-4.3) |
| Third and more | 44 (41.5) | 66 (33.7) | 2.3 (1.2-4.4) |
| Previous history of GDM p<0.001 | | | |
| No | 27 (26) | 0 (0) | 1.00 |
| Yes | 44 (42.3) | 48 (29.1) | 2.1 (1,7-2.6) |
| unknown | 15 (14.4) | 47 (28.5) | 0.3 (0.2-0.7) |
| Previous adverse obstetric history p<0.01 | | | |
| Yes | 37 (34.9) | 35 (17.9) | 1.00 |
| no | 69 (65.1) | 161 (82.1) | 2.5 (1.4-4.2) |

3.1.4.2 Previous adverse obstetric history

We looked for history of miscarriage, still birth including intrauterine death (IUD), live birth with congenital anomalies and preterm birth in the previous pregnancies of our participants. We found higher incidence of miscarriage and still birth and IUD in GDM compared to the control group (Fig. 3.7). In contrast only one in GDM group had preterm birth in their previous pregnancy while no one had a history of live birth with congenital anomalies in either of these groups. Due to lower occurrence rate of these events in their past pregnancies we put all them under ‘previous adverse obstetric outcome’ during analysis instead of taking them separately. In univariate analysis an adverse obstetric history in the previous pregnancy displayed significant difference in between the groups and found it as a risk factor for GDM in the following pregnancy (Table 7).

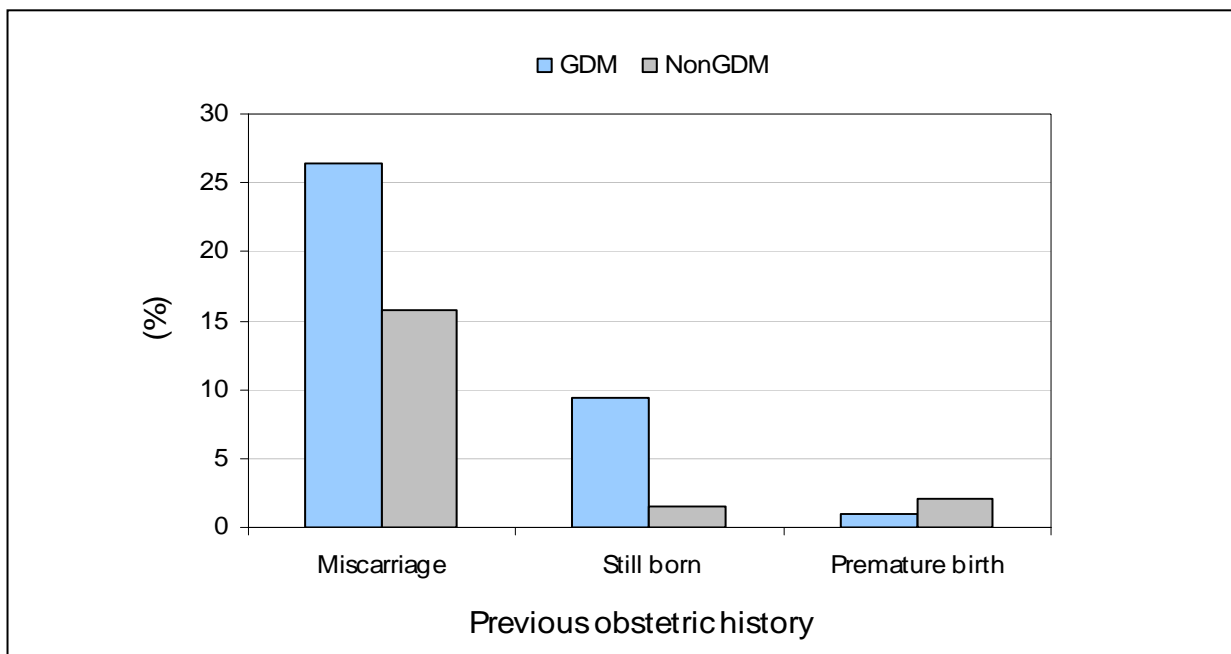


Fig. 3.7 Prevalence percentage of miscarriage, still birth and premature birth in GDM and the control group.

3.1.4.3 Gravidity

Most of the women in GDM group were multi gravida (83%). It has been seen that the prevalence percentage of GDM increased with gravidity while it remained almost static in control group (Fig. 3.8). In chi square test gravidity appeared to be significantly associated with the incidence of GDM. The risk of GDM in multi gravida (two or more gravida) was seen about two and half times more than that was in the primi (Table 7).

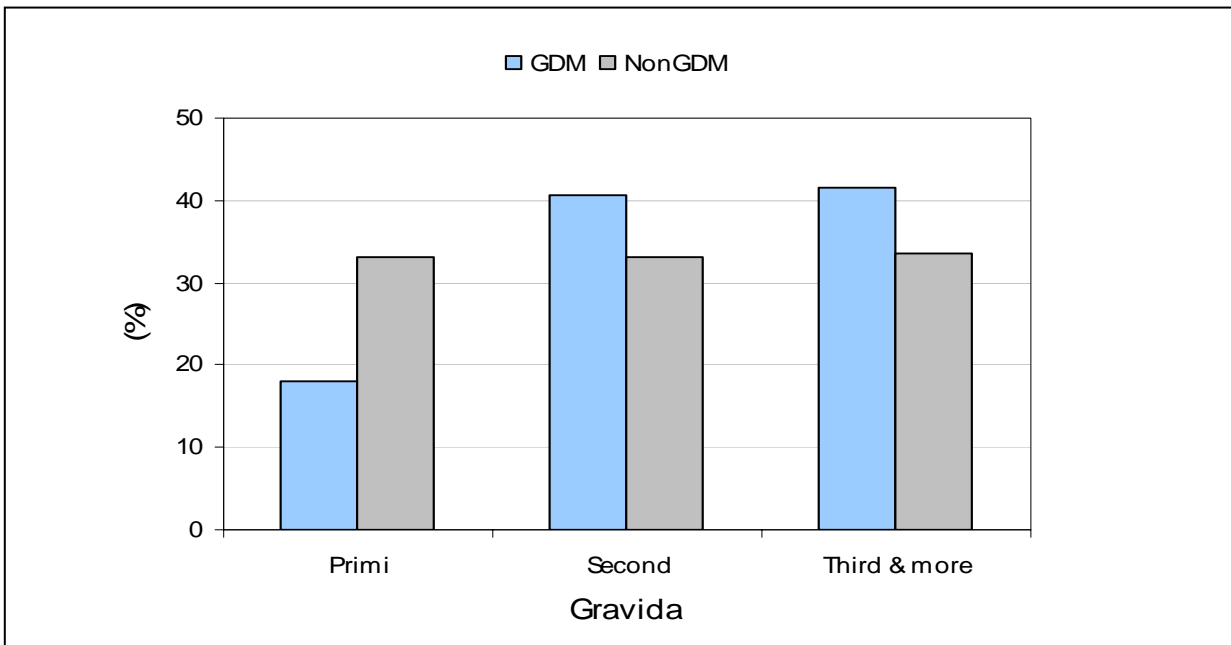


Fig. 3.8 Prevalence percentage of gravidity in GDM and the control group.

3.1. 5 Risk factors for GDM in multivariate analysis

When all the associated risk factors ($p < 0.05$) with GDM were put in a logistic regression model positive family history of GDM, maternal age more than 25 years and BMI in pregnancy < 23 was explored as independent predictors for GDM (Table 8). Other factors those which displayed association with GDM in descriptive analysis might have influenced by confounding factors. Hence level of education, monthly expenditure, gravidity, and previous bad obstetric history was not appeared as independent risk factor for GDM in multivariate analysis. It is worth to note that we dichotomized all these variables to analyze them by multivariate model. For example, level of education was dichotomized to, equal and less than 10 years and more than 10 years and monthly expenditure of the family, less than 8000 (115\$) taka and equal and more than 8000 taka.

Table 8: Independent predictors for GDM in multivariate analysis

| | OR (CI) | P value |
|-------------------------------------|---------------|---------|
| Positive family history of diabetes | 7.9(1.9-32.8) | 0.023 |
| Maternal age > 25years | 5.0(1.2-21.6) | 0.027 |
| Pregnancy BMI > 23 | 5.9(1.3-27.4) | 0.004 |

After adjusting for Maternal age, BMI, family history of diabetes, previous history of GDM, level of education, monthly expenditure, gravidity, previous bad obstetric history altogether in logistic regression model.

Based on the findings of multivariate analysis we looked into proportion of risk factors in our study population .About 56% on average of our study population had one risk factor while about 43% had two risk factors. Individual percentages were presented in Table 9.

Table 9. Prevalence proportion of women with one or more than one independent risk factor

| Risk factor | GDM (% within GDM) | Control (% within control) |
|---------------------------------|--------------------|----------------------------|
| Age >25 | 84.0 | 34.7 |
| Positive Family history | 85.2 | 48.6 |
| BMI >23 | 83.0 | 35.9 |
| Age>25+ Positive family history | 70.0 | 16.0 |
| Age >25+BMI>23 | 70.5 | 22.3 |
| Positive family history+ BMI>23 | 69.9 | 12.6 |

3.2 Time of diagnosis of GDM and its relationship with type of treatment received

In this study we noted down the gestational week of diagnosis of GDM and the main treatment received throughout the pregnancy for GDM mothers. The mean gestational week for diagnosis of GDM was 23±8 (median is 25 week) .About 43 % were diagnosed before 20 week of gestation. The earliest diagnosis was made at 7 weeks and the latest was at 38 weeks. We categorized the time of diagnosis in two groups. If the diagnosis was made before 20 weeks of gestation that is put in ‘early diagnosis’ ,on the other hand If the diagnosis was made at 20 weeks or after that then that is put under ‘late diagnosis’ .Out of 106 GDM patient 45 were diagnosed in early and 61 in late pregnancy in the study(Fig.3.9).

In our study 41 women were treated with diet and 64 with insulin. We came across one woman who didn’t receive any treatment as was not diagnosed until onset of labour. This woman was excluded in the analysis.

In our study we noticed that women who were diagnosed in early phase were more likely to be treated with insulin than those who were diagnosed late (Figure 3.9). Chi square test showed that type of treatment received by the women was significantly associated with the time of diagnosis of GDM. Univariate analysis revealed that risk of being treated with insulin was 3.7 times higher in the women diagnosed early than those diagnosed late (Table 10).

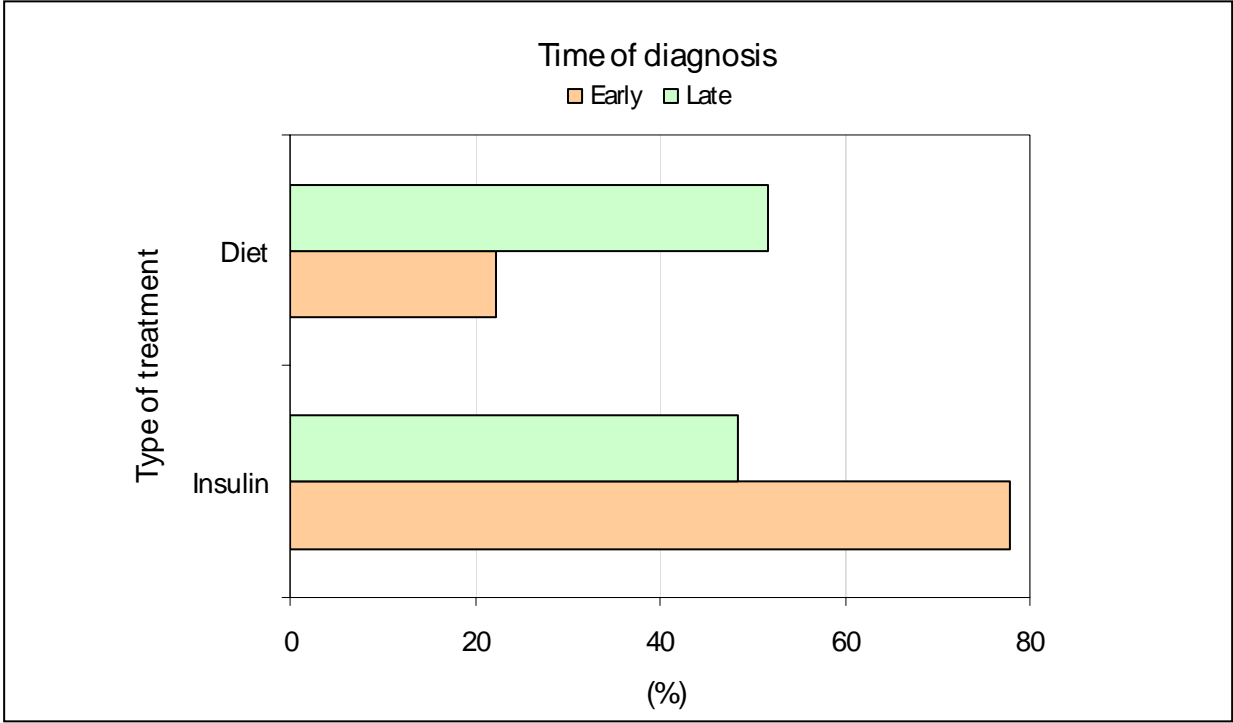


Fig. 3.9 Prevalence percentage of treatment with diet and insulin in women with GDM according to phase of diagnosis.

Table 10: Association of the main treatment received during pregnancy with the time of diagnosis of GDM in GDM population

| | Diet and exercise (41) | Insulin (64) | Odds ratio (CI) for Insulin |
|--------------------|------------------------|--------------|-----------------------------|
| Time of diagnosis* | | | |
| Late (60) | 31 (75.6) | 29 (45.3) | 1.00 |
| Early (45) | 10 (24.4) | 35 (55) | 3.7(1.6-8-9) |

*P value< 0.05

3.3 Pregnancy outcomes

Pregnancy outcomes were presented as pregnancy complications i.e. anemia, hypertension in pregnancy, delivery outcome i.e. gestation at delivery, mode of delivery, fetal outcome i.e. live or abnormal birth, neonatal outcomes i.e. birth weight and Apgar at 5 min. We compared the pregnancy outcomes between cases and controls and also in between GDM mothers grouped by time of diagnosis of GDM and type of treatment they received parts.

3.3.1 Comparison of pregnancy outcomes between GDM and NonGDM

a). Complications in pregnancy

3.3.1.1 Anemia

About 18 % of women in GDM were found to have anemia when the cut off value for Hb% was set off at 11 mg. The percentage was about 4 times high in the control group in contrast to GDM group (Table 11). The mean hemoglobin level in GDM group was 11.8 ± 0.9 whereas in control group that was 10.8 ± 1.2 . Only 2 in the control and none in GDM group was found to have Hb <8mg/dl. P value shows there is a significant differences in between the groups on being anemic in this study .In this study we found that control group was more likely to have moderate anemia in pregnancy than the GDM group .

Table 11: Association of pregnancy complication in GDM in the study population

| Variables | GDM Count (%) | Non GDM Count (%) | Odds ratio for GDM (95% CI) |
|----------------------------------|---------------|-------------------|-----------------------------|
| Anaemia p<0.001 | | | |
| Anaemic | 16 (18.4) | 114 (60.3) | 1.00 |
| Non-anaemic | 71 (81.6) | 75 (39.7) | 0.15 (0.1-0.3) |
| Hypertension in Pregnancy p<0.05 | | | |
| No | 93 (87.7) | 188 (95.9) | 1.00 |
| Yes | 13 (12.3) | 8 (4.1) | 3.3 (1.3-8.2) |

3.3.1.2 Hypertension in Pregnancy

Those who were found to have high blood pressure recorded twice or more in pregnancy during the antenatal checkup were taken as having hypertension in pregnancy. The occurrence of hypertension was high in GDM group in contrast to the

NonGDM group (Table11). Hypertension in pregnancy differs significantly between these two groups (p value <0.05). In bivariate analysis the risk of GDM was found 3 times more in the women with GDM than those without GDM.

b). Complications in delivery

3.3.1.3 Gestation at delivery

Preterm birth (<37 completed weeks) was found to be more prevalent in the GDM pregnancies than the normal pregnancies. Prevalence proportion varied markedly in between 32-36 weeks of delivery in these groups (Figure 3.10). But before 32 weeks the percentage of preterm birth in both the groups was almost same (Figure 3.10a and b). Very small number of cases (8) in GDM group continued until full term. But in NonGDM most of the pregnancies ended at term. A significant difference was noticed in the gestation at delivery in between these two groups in univariate analysis. The data showed women with GDM have more than three times risk of preterm delivery [OR 3. 6; 95% CI (1.9-6.8)] than that of women with NonGDM (Table 12).

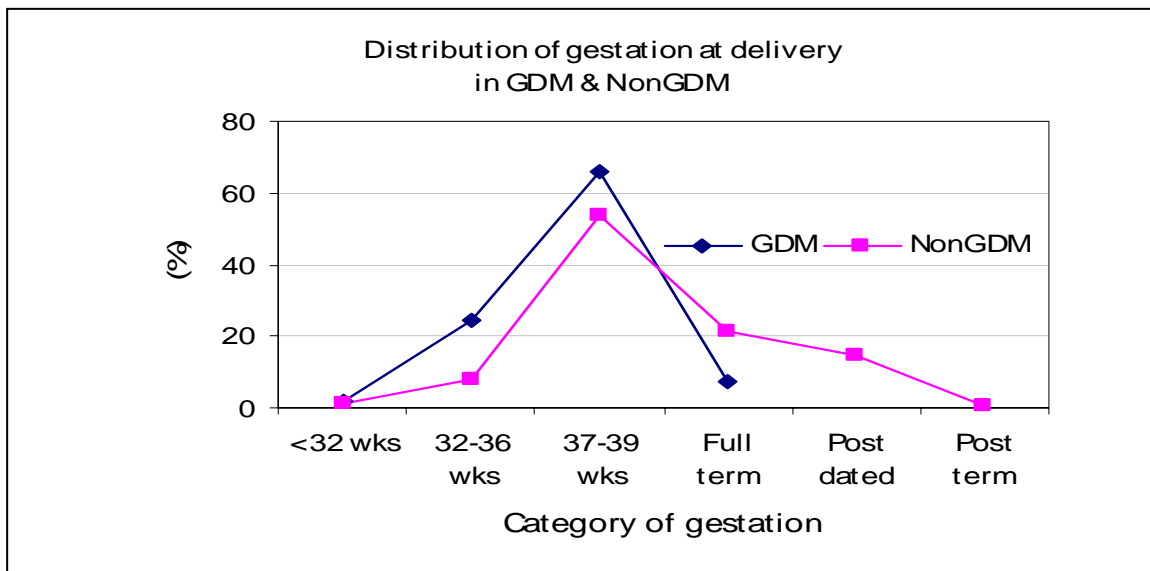


Fig. 3.10 Distribution of gestation at delivery in both GDM and NonGDM group.

Table 12: Comparison of delivery outcomes in between GDM and NonGDM group

| Variables | GDM Count (%) | Non GDM Count (%) | Odds ratio for GDM (95% CI) |
|----------------------------------|---------------|-------------------|-----------------------------|
| Gestation at delivery *** | | | |
| term | 69 (65.1) | 178 (90.8) | 1.00 |
| preterm | 28 (26.4) | 18 (9.2) | 3.6 (1.9-6.8) |
| Mode of delivery*** | | | |
| Normal | 23 (21.7) | 153 (79.1) | 1.00 |
| caesarean | 83 (78.3) | 41 (20.1) | 13.6 (7.6-24.3) |

*** p value < 0.001

3.3.1.4 Mode of delivery

Our data revealed that only 21% normal delivery happened in GDM pregnancy. Occurrences of caesarean delivery in GDM were much higher (78.3% vs 20.1%) in relation to normal delivery. It is worth to note that we didn't investigate the indication of caesarean section in our study. In descriptive analysis significant difference was observed in between these two groups (p value <0.001) (Table 12).

c). Fetal and Neonatal complications

3.3.1.5 Outcome of fetus

About 4.7% of intrauterine death was noticed in GDM pregnancy. The number was relatively low in NonGDM group (1.5%). Two live born babies with congenital anomaly were found in GDM group. No still born birth was not taken place in this study in GDM group where as 4 cases of still born birth happened in the control group. It can be noted that one of those was minor (cleft palate) and the other one is major (single ventricle) type of birth defect. In this study no congenital anomaly were found in NonGDM group. We assembled the number of IUD, still born birth, birth with injury, and birth defects under the group of abnormal birth to calculate the odds ratio in relation to normal live birth. Univariate analysis revealed that risk of abnormal birth in GDM pregnancy was about two times [OR 1.9; 95% CI (0.6-5.8)] more than that of normal pregnancy .But chi square test in descriptive analysis didn't find any significant difference on the occurrence of abnormal birth in between these two groups (Table 13).

3.3.1.6 Birth weight

About 19% of the birth in GDM group had birth weight more than 3.5 kilogram. But only one was found to be born with macrosomia (birth wt. > 4 kg) in this study in GDM group. The mean birth weight in GDM and the control group had been 3.04 ± 0.46 and 2.77 ± 0.41 respectively. Percentage of low birth weight was 5.7% in GDM and 18.1 % in Non GDM group if we consider cut off value 2.5 kg. Only 2 in GDM and but 11 in Non GDM had birth weight less than 2 kilogram. Cumulative proportion of birth weight of newborn born to GDM mothers in this study runs above that of control group above 3 kilogram but before that it had been lower than the control group (Fig 3.11). This means the number of heavier baby were more in GDM group above three kg. We have seen that prevalence proportion of birth weight above three kilogram is more (60%) in GDM. P value revealed significant difference in distribution of birth weight in between these two groups. Risk for having a baby over 3.5 kilogram in GDM was found to be about four and half times more than those who didn't have GDM (Table 13).

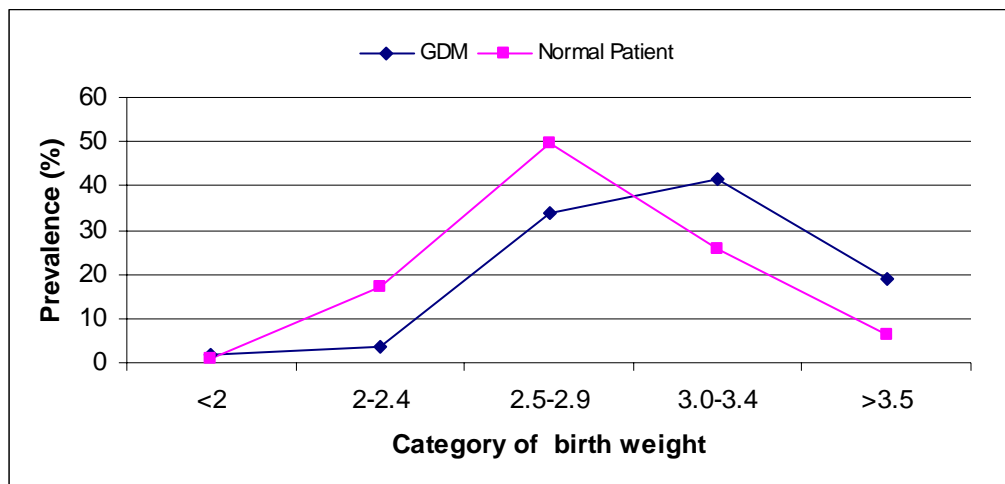


Fig. 3.11 Prevalence proportion of birth weight in GDM and control group.

Table 13: Comparison of fetal and neonatal outcomes between GDM and Non GDM group

| Variables | GDM Count (%) | Non GDM Count (%) | Odds ratio for GDM (95% CI) |
|----------------------------------|---------------|-------------------|-----------------------------|
| Outcome of fetus.Δ | | | |
| Normal birth | | | 1.00 |
| Adverse outcome | | | 1.9(0.6-5.8) |
| Still born | 0(0) | 4(2) | |
| IUD | 5(4.7) | 3(1.5) | |
| Congenital anomaly | 2(1.9) | 0(0) | |
| Birth injury | 2(1.9) | 3(1.5) | |
| Birth weight (in Kg) *** | | | |
| <2 | 2(1.9) | 2(1.0) | 2.6(0.3-19.6) |
| 2-2.4 | 4(3.8) | 33(17.1) | 0.3(0.1-0.9) |
| 2.5-2.9 | 36(34.0) | 96(49.7) | 1.00 |
| 3-3.4 | 44(41.5) | 50(25.9) | 2.3(1.3-4.1) |
| >3.5 | 20(18.9) | 12(6.2) | 4.4(2.0-10.0) |
| Birth weight >3.5 kg** | | | |
| <3.5 | 20(18.9) | 12 (6.2) | 1.00 |
| >3.5 | 86(81.1) | 183(93.8) | 3.5(1.6-7.5) |
| Birth weight <2.5 kg** | | | |
| >2.5 | 6(5.7) | 35(18) | 1.00 |
| <2.5 | 100(94.3) | 159(82) | 0.3(0.1-0.7) |
| Apgar at 5 min.Δ | | | |
| ≥7 | 85(95.5) | 180(97.3) | 1.00 |
| <7 | 4(4.5) | 5(2.7) | 1.7(0.4-6.5) |

*** p value < 0.001, ** p value <0.01 ,Δ not significant

3.3.1.7 Apgar at 5 minutes

Among the newborn babies 4.5 % in GDM and 2.7% in the control group had Apgar score below 7 at their 5 min of age. However this difference was not statistically significant (p value > 0.05).Univariate analysis revealed that risk apgar less than 7 at 5 min in GDM pregnancy was about twice of who don't have diabetes (Table13).

3.3.1.8 Pregnancy outcomes in multivariate analysis

When all the associated pregnancy outcomes (p<0.05) with GDM were computed in a logistic regression model birth weight > 3.5 kg, incidences of caesarean section,

preterm delivery , hypertension in pregnancy and hemoglobin level were found to have independent association with GDM pregnancy .Thus GDM predicted for a birth weight more than three kilogram, caesarean section, preterm delivery (before 37 completed weeks) and hypertension in pregnancy and not likely to have anemia during pregnancy (Table 14).

Table 14: Pregnancy outcomes from GDM pregnancy in multivariate analysis

| | *Adjusted OR (95% CI) | P value |
|---------------------------|------------------------------|----------------|
| Birth weight > 3.5 kg | 1.8(1-2.9) | 0.03 |
| Caesarean section | 11.7(5.6-24.3) | 0.000 |
| Preterm delivery | 7.2(2.3-22.8) | 0.001 |
| Hypertension in pregnancy | 3.8(1.0-13.3) | 0.044 |
| Hb% | 0.2(0.1-0.3) | 0.000 |

* when adjusted for birth weight > 3.5 kg, Birth weight <2.5 kg, caesarean section, preterm delivery , hypertension in pregnancy and hemoglobin level in logistic regression model.

3.3.2 Pregnancy outcome according to period of GDM diagnosis

Comparison between early and late diagnosis group in GDM

We compared the outcome of women who were diagnosed early with those who were late according to the aim of the study. Again we also compared them separately with the outcome of control population.

No significant difference was observed between the groups with early diagnosis and late diagnosis except the events of hypoglycaemia. Hypoglycaemic episodes were about three times more likely to occur in the early diagnosed group than that in the late diagnosis group (Table 15).

Table 15: Characteristics of pregnancy outcome according to time of diagnosis of GDM and relationship between them on pregnancy outcomes

| Variables | Early | | Late | | Early over late | P value |
|---------------------------|-------|------|-------|------|-----------------|---------|
| | Count | % | Count | % | OR(95% CI) | |
| Hypertension in Pregnancy | | | | | | |
| Yes | 8 | 17.8 | 5 | 8.2 | 2.3(0.7-7.7) | ns |
| no | 37 | 81.2 | 56 | 91.8 | 1.00 | |
| Anemia | | | | | | |
| Yes | | 18.9 | 9 | 18 | 1.2(0.4-3.5) | ns |
| no | 7 | 81.1 | 41 | 82 | 1.00 | |
| Preterm delivery | | | | | | |
| Yes | 11 | 24.4 | 17 | 27.9 | 0.8(0.3-2.0) | ns |
| no | 34 | 35.6 | 44 | 72.1 | 1.00 | |
| Caesarean section | | | | | | |
| Yes | 36 | 80.0 | 47 | 77 | 1.2(0.5-3) | ns |
| no | 9 | 20.0 | 14 | 23 | 1.00 | |
| Outcome of fetus | | | | | | |
| ◆Abnormal | 4 | 8.9 | 3 | 4.9 | 1.9(0.4-8.9) | ns |
| normal | 41 | 91.1 | 58 | 95.1 | 1.00 | |
| Birth weight | | | | | | |
| ≥3.5kg | 10 | 22.2 | 10 | 16.4 | 1.4(0.5-3.8) | ns |
| <3.5kg | 35 | 77.8 | 51 | 83.6 | 1.00 | |
| Birth weight | | | | | | |
| < 2.5kg | 2 | 4.4 | 4 | 6.6 | 0.7 (0.1-3.7) | ns |
| ≥2.5kg | 43 | 95.6 | 57 | 93.4 | 1.00 | |
| Hypoglycemia | | | | | | |
| Yes | 25 | 75.8 | 28 | 52.8 | 2.8(1.1-7.3) | *0.02 |
| no | 8 | 24.2 | 25 | 47.2 | 1.00 | |
| Apgar score at 5 min | | | | | | |
| <7 | 3 | 8.3 | 1 | 19.0 | 0.9(0.8-1.0) | ns |
| ≥7 | 33 | 91.7 | 52 | 98.1 | 1.00 | |

*-p value < 0.05, ns - not significant,
Reference value (1.00) is shown in the lower row.
◆Stillbirth,IUD,Birth injury and Congenital anomaly

Hypertension in pregnancy was seen to be significantly associated with the group who were diagnosed as GDM in early pregnancy when we compared both these two groups with the control or background population. We also found preterm delivery and birth weight > 3.5 kg is more significantly associated with the women with GDM who were diagnosed late in pregnancy (Table 16).

Table 16: Comparison of pregnancy outcomes in early and lately diagnosed GDM cases with control (NonGDM) population

| Variables | Early diagnosed GDM vs control group (46 vs 196) | | Late diagnosed GDM vs control group (60 vs 196) | |
|-----------------------------|--|--------------|---|--------------|
| | OR(95% CI) | p value | OR(95% CI) | p value |
| Hypertension in Pregnancy | 4.7(1.7-13.3) | ** 0.005 | 2.0(0.6-6.4) | ns 0.186 |
| Anemia | 0.2(0.1-0.4) | *** 0.000 | 0.1(0.06-0.31) | *** 0.000 |
| Preterm delivery | 3.1(1.4-7.3) | ** 0.009 | 4.2(2.0-8.8) | *** 0.000 |
| Caesarean section | 14.1(6.8-30.7) | *** 0.000 | 11.9(6.0-30.4) | *** .000 |
| ◆ Abnormal outcome of fetus | 2.5(.7-8.8) | ns 0.149 | 1.3(0.3-5.4) | ns 0.468 |
| Birth weight >3.5kg | 4.3(1.7-10.9) | ** 0.002 | 2.9(1.2-7.3) | * 0.017 |
| Birth weight<2.5 | 0.2(0.1-1.0) | * 0.014 | 0.3(0.1-0.9) | * 0.019 |
| Apgar at 5 min < 7 | 3.3(0.7-14.4) | ns 0.124 | 0.7(0.1-6.1) | ns 0.599 |

*p value <0.05, **p value <0.01, ***p value <0.001

◆ Stillbirth, IUD, Birth injury and Congenital anomaly

3.3.3 Pregnancy outcome according to type of treatment

Pregnancy outcome in GDM didn't differ according to the type of treatment the women with GDM received when compared between them. But like time of diagnosis GDM occurrence of hypoglycemia appeared to be significantly associated with type of treatment. Risk of hypoglycemia was about 5.6 times more in the group treated with insulin (Table 17).

Table 17: Characteristics and relationship of pregnancy outcome according to type of treatment received in GDM

| Variables | Insulin | | Diet | | Insulin over diet | |
|---------------------------|---------|------|------|------|-------------------|---------|
| | n | % | n | % | OR(95% CI) | P value |
| Hypertension in Pregnancy | | | | | | |
| Yes | 5 | 7.8 | 8 | 19.5 | 0.3(0.1-1.1) | ns |
| No | 59 | 92.2 | 33 | 81.5 | 1.00 | |
| Anemia | | | | | | |
| Yes | 11 | 20.0 | 5 | 15.6 | 1.5(0.5-4.8) | ns |
| No | 44 | 80.0 | 27 | 84.4 | 1.00 | |
| Preterm delivery | | | | | | |
| Yes | 17 | 26.6 | 10 | 24.4 | 1.0(0.4-2.4) | ns |
| No | 47 | 83.6 | 31 | 86.3 | 1.00 | |
| Caesarean section | | | | | | |
| Yes | 52 | 81.3 | 32 | 78.0 | 1.4(0.6-3.6) | ns |
| No | 12 | 18.7 | 09 | 22.0 | 1.00 | |
| Outcome of fetus | | | | | | |
| ♦Abnormal | 4 | 6.3 | 2 | 4.9 | 1.3(0.2-7.5) | ns |
| Normal | 60 | 93.7 | 39 | 95.1 | 1.00 | |
| Birth weight of babies | | | | | | |
| ≥3,5 | 15 | 23.4 | 4 | 9.8 | 2.8(0.8-9.2) | ns |
| <3.5 | 49 | 76.6 | 37 | 90.2 | 1.00 | |
| Birth weight | | | | | | |
| < 2.5 | 4 | 6.2 | 2 | 4.9 | 1.3(0.2-7.4) | ns |
| ≥2.5 | 60 | 93.8 | 39 | 95.1 | 1.00 | |
| Hypoglycemia | | | | | | |
| Yes | 41 | 74.5 | 11 | 36.7 | 5.4(2.1-14.1) | ** |
| No | 14 | 25.5 | 19 | 63.3 | 1.00 | 0.000 |
| Apgar less than 7 | | | | | | |
| ≥7 | 53 | 94.6 | 31 | 96.9 | 1.00 | |
| <7 | 3 | 5.4 | 1 | 3.1 | 0.5(0.07-4.1) | ns |

** p value < 0.001, ns - not significant

Reference value (1.00) is shown in the lower row.

♦ Stillbirth, IUD, Birth injury and Congenital anomaly

When diet and insulin treated group compared with control group separately hypertension in pregnancy was found only to be associated with the women treated with diet. We also found that preterm delivery was more significantly associated with the women treated with insulin. Our study revealed that risk of having birth weight more than 3.5 kg was more in the women treated with insulin [OR 4.6; 95% CI (2.0-10.6)].

Insulin treated GDM had significant association with birth weight more than 3.5 kg (Table 18).

Table 18: Relationship of pregnancy outcome in women treated with diet and exercise and insulin in comparison to control (Non GDM) population

| | Diet group GDM vs control (41 vs 196) | | Insulin group GDM vs control (64 vs 196) | |
|-----------------------------|--|---------|---|---------|
| | OR(95% CI) | p value | OR(95% CI) | p value |
| Hypertension in Pregnancy | 5.5(1.9-15.6) | * | 1.9(0.6-6.1) | ns |
| Anemia | 0.1(0.04-0.3) | ** | 0.2(0.1-0.4) | ** |
| Preterm delivery | 3.5(2.1-8.6) | * | 3.7(1.8-7.8) | ** |
| Caesarean section | 10.6(5.0-23.5) | ** | 15.4(7.6-31.0) | ** |
| ♣ Abnormal outcome of fetus | 1.3(0.3-6.7) | ns | 1.8(0.5-6.2) | ns |
| Birth weight ≥3.5kg | 1.6(0.5-5.4) | ns | 4.6(2.0-10.6) | *** |
| Birth weight <2.5kg | 0.2(0.1-1.0) | * | 0.3(0.1-0.9) | * |
| Apgar at 5min < 7 | 1.2(0.2-5.7) | ns | 0.7(0.1-3.1) | ns |

*p value <0.05, **p value <0.01, ***p value <0.001

♣ Stillbirth, IUD, Birth injury and Congenital anomaly

Chapter 4 Discussion



4. Discussion

The objective of the study was to examine the risk factors and pregnancy outcome of gestational diabetes in Bangladesh. This was set to serve the purpose of getting an overview of risk and effects of gestational diabetes in Bangladeshi population.

4.1 Methodological consideration

4.1.1 Study design

A hospital based case control study was chosen in order to get a preliminary overview of the risks as well as effects of GDM in Bangladesh. We acknowledge some caveats in our study as 29% women come to the hospital for pregnancy care and delivery in Bangladesh (50). Despite of this fact a hospital based study is the most convenient way to select a group of pregnant women and a low cost method to obtain a health service data because of lack of infrastructure. We agree that a prospective study in hospital settings would have been more appropriate to establish epidemiological causation of risk factors and effects of GDM. But such type of study is very time and resource intensive. So in order to meet the objectives in shorter time and in limitation of logistics and resources we chose a case control design instead. We sought to collect data retrospectively from the pregnant women after the delivery in order to obtain necessary information on both the pregnancy events and risk factors. We selected the control group to get the reflection of distribution of study factors similar to cases. Thus a case control study enabled us to compare strength of association of risk factors and pregnancy effects in between GDM and Non GDM population (51).

4.1.2 Selection of hospitals

In the beginning we intended to collect both the cases and controls from BIRDEM. As we mentioned previously that diabetic hospital (BIRDEM) delivers the cheapest and standard diabetic care to all groups of diabetic patients but general health service are provided at a standard cost. Therefore cases and controls would have varied by socioeconomic factors. So, we went back to another hospital (MCHTI) which would have a representation of general population in order to recruit control group.

In selection of hospitals we also prioritized the availability of systematized medical record of pregnancy. Hence, after a small survey in some public hospitals in Dhaka city we chose MCHTI hospital. MCHTI has been accredited for systematized obstetric health service to general people in Bangladesh.

4.1.3 Diagnostic criteria of GDM in cases and controls

We were unable to screen off GDM by a same diagnostic test to differentiate cases and controls for our study. One of the reasons behind this was any uniform or standard protocol for screening of GDM has yet not been practiced in public hospitals of Bangladesh. The other one was we aimed to collect data from the women after delivery. Therefore it was not possible for us to carry out a screening beforehand for a required number of samples within shorter period of study. However, both the hospitals have their own protocol to screen GDM and we had to carry out our study based on that. BIRDEM followed WHO criteria (46) so that the cases of GDM we selected for this study were true GDM cases.

On the other hand MCHTI assesses random blood sugar and screens out women as nondiabetic if the result comes below 7mmol/l. By taking 5.5 mmol as cut off value we included women unlikely to have any diabetes (49). This cut off value was recommended in standard guideline of diagnosis and management of diabetes proposed by Clinical Research group BIRDEM (52).

4.1.4 Sampling technique and sample size

We conducted continuous sampling to reach the required number of sample size. But as mentioned earlier due to lack of resources and time we could not collect according to our estimates. However the study was able to include a good number of cases than many other previous studies done on it. Thus the sample size enabled us to analysis and interprets the result in most of the occasion.

4.1.6 Response of the participants and data collection

We depended on the information provided to us by the participants. As in our setting the availability of birth registration, previous medical records, data on socioeconomic condition etc are rare we don't have any existing system of verification of the answer made by them. We were able to recheck those from antenatal and delivery records in case of recall problem and misleading information. The information available in the patient journal or hospital registry is often insufficient and incomplete. Hence we chose to interview the women after delivery and check the medical records of the pregnancy from antenatal card and delivery records available at hospital file.

4.2 Methodological discussion

Even though this methodology was examined to focus on objectives, some questions on its strength and limitation can be raised.

4.2.1 Strength of the study

4.2.1.1 Pretest

A pretest was undertaken in 10 of cases and 10 of controls from respective hospital to examine the data collection tools and sampling procedure and to assess the reaction of the respondents to our research procedure. This enabled us to obtain a range of possible answers for our questions. We had to take away history of large baby when we saw most of our patients could not provide any medical documentation or recall correctly how large their baby was at birth. This is how we also integrated Apgar at 5 min and Hemoglobin level but took away Microalbuminuria and Fasting glycosuria from the questionnaire. Thereby, we tested the construct validity of the questionnaire that was formulated based on the literature review from different publications and book.

4.2.1.2 Data collection procedures and tools

Information was obtained by the principal investigator and working doctors of respective hospitals. It had a positive bearing on the reliability of the results in the way that all of them were well acquainted with the interpretation of the medical records from respective system. Training of the doctors on data collection procedure prior to the initiation of the study enabled them to follow the research objectives and get ensured that respondents had understood well the interview questions in the light of the objectives of the study. A preliminary survey on data collection tools and selection of hospitals helped to obtain complete and reliable data necessary for the study. There had been scope to recheck information from the medical records for many of the variables those were answered by the patients. This even helped to increase the reliability of the answers obtained from the patients.

4.2.2 Limitations of the study

4.2.2.1 Confounding effects

In a case control study a researcher usually attempts to relate an exposure to an outcome but often measures an effect of third variable termed as confounding variable.

Pregnancy weight?

In our study prepregnancy weight of these women was not recorded. Hence, we were also unable to measure rate of weight gain in pregnancy. Increased prepregnancy weight and weight gain in pregnancy might have an association on development of GDM (31). The risk of GDM in relatively overweight pregnant women in our study might have confounded by increased prepregnancy weight or pregnancy weight gain.

Caesarean section?

Increased caesarean section in this study might have taken place from other associated phenomenon in particular with a previous history of caesarean section in addition to GDM. We did not ask about history of previous c/s in our study .Thus it can be assumed that previous c/s could have been confounded to increased c/s in GDM pregnancy that was found as a significant predictor in outcome of GDM pregnancy.

Hemoglobin level?

Women with GDM were found nonanemic where as those without GDM have been noticed moderately anemic in pregnancy. As obesity and better socioeconomic status also contribute to good hemoglobin level we can refer both of these conditions which might have acted as confounding factors for better hemoglobin level in GDM pregnancy.

In multivariate analysis mathematical modeling has measured a potential effect of one variable while simultaneously controlling for the effect of many other variables (46). Thus this study was able to show independent predictors for risk and outcome of GDM by controlling the confounding effects of some other variable.

4.2.2.2 Biases**Selection Bias**

We acknowledge that hospital population and nonrandom sampling procedure had put potential limitations on the selected samples. It is noteworthy that any hospital based study does have inherent selectiveness for its population group. According to statistical point of view all observational studies have built in bias but the challenge is to interpret how they have affected the outcome of the research. However in this case control study cases and controls were selected from same source of population. They represented a part of the general population coming to the hospital for pregnancy care.

Recall and reporting bias

Retrospective way of data collection in a case control study may pose some biases from recall problems. In the answer regarding positive family history of diabetes mellitus we encountered quite a lot of unknown answers in the control. Again, time of premature delivery in the previous pregnancies in some aspects was not recalled very correctly due to lack of previous pregnancy record. It might have affirmed the fact that better recall of cases are common than non cases (48).

Reporting bias can arise from the standpoint of local cultural context. When the investigator compared the history of prior abortion obtained by personal interview against central medical record they documented systematic underreporting of abortion in control. This might have arisen from the local cultural phenomenon where pregnant women feel ashamed of telling about their pregnancy.

4.2.2.3 Internal validity of the findings

This study represented the measurement based on the hospital record. We admit that this might have impact on internal validity. Beyond this assumption as BIRDEM is the best service provider for diabetes and MCHTI is also well recognized for obstetric care service the finding of the study possess reliable data.

4.2.2.4 External validity for generalization

In terms of generalizability or external validity the findings of this study reflected the scenario of urban or semi urban pregnant women. The rural picture might have been different from this population group as some studies already were able to bring up different pattern of diabetes in between rural and urban area in Bangladesh on some aspects (14). Given that we believe the findings of the study can be inferred on the general population and is more likely to be externally valid for the pregnant women of Bangladesh.

4.2.2.5 Reliability

A face to face interview along with use of medical records has enabled the doctors to supplement information lacking in medical records from interview. In case of disagreement in medical record and interview an agreement was made and information was corrected. Moreover data procurement with direct inspection of mother and baby helped the doctors to verify their physical status and information collected. Still the retrospective way of data collection from two different health facility might have raised

question on its reproducibility .We agree that a prospective way of data collection would have powered more on reliability of findings.

4.3 Discussion on the findings of the study

4.3.1 Risk factors for GDM

The results of this study have demonstrated that increasing maternal age is an independent risk factor for GDM in our obstetric population. Women aged 25 years or over were seen to have five times risk of GDM compared to women without GDM in this study. This was in line with the findings of another study done in the same institution where about 86.7 % of women with diabetic pregnancy were aged 25 or more than that (36). Our finding is also in accordance with the findings of a study conducted in rural Bangladesh where more than 50 % of the pregnant women with GDM diagnosed by WHO criteria had age range from 21- 30 years (2). In another hospital based study in Pakistan it has also been seen that about one half of the GDM women diagnosed by O Sullivan criteria lie in the range of 25-30 years (53). Our result on maternal age also supports the findings of other studies from India and Pakistan(40;54-57). Even though the GDM mothers were older than non-diabetic mothers, GDM women in this study are younger than the Caucasian mothers(58;59). This finding is an agreement with the result of other studies conducted in Indian subcontinent (55;57;60;61) .

In our study we didn't find any women with GDM under the age of 20 but about 17% were seen from control group. Thereby it affirms more on that the risk of GDM is low in very younger or adolescent age. This finding bears significant importance when we see that still about 80% of women in Bangladesh marry in adolescence and 50% of them when they reach at 15 years (62). The average age of first child birth has also been seen very early (18 years) after marriage in the younger girls (61). However, the median age at marriage for the urban females is higher than rural females (58) which tend to impose increased risk of GDM in urban female population.

This study showed strong association of pregnancy BMI with GDM. This finding was consistent with another study on diabetic pregnancy done in BIRDEM in 1999 (36). But the figure differed from a rural community based study in Bangladesh where mean BMI was found to be low in the women with GDM (2). Studies suggest that risk factors were similar for GDM and T2DM and include, among others, obesity, family history, and ethnic background. GDM was also associated with the metabolic syndrome (63). Some studies also demonstrated that risk related to obesity for diabetes type 2 was higher in urban subject in comparison to rural (15;64). Therefore those facts are in agreement

with our study population who mostly belonged to urban area, had higher BMI and were increased risk of GDM. This is also with conformity with the findings of some studies conducted in India and Pakistan (55;65-68).

We also observed in our study that pregnancy weight also differed significantly in GDM and control group while no significant difference was seen in the height of mothers. Our findings regarding pregnancy weight were in agreement with a previous study on diabetic pregnancy at BIRDEM (36). But the referred study was also able to show significant association of height with diabetes in pregnancy. However, our finding is consistent with a study done over a Bengali population in India (69). No association of height with GDM was also revealed by another study on GDM in a rural community in Bangladesh despite the difference in the mean height (153 vs. 149 cm.) of women with GDM varied in these two studies (2). This dissimilarity might have arisen from selection of samples in respective study.

We have seen in our study that women from middle and upper socioeconomic group possess risk of GDM. But previous studies done in BIRDEM found that pregnant women with diabetes were less educated than nondiabetic women (36). The reason in difference might have come from the fact that pregnant women without diabetes who are coming to BIRDEM for pregnancy care belonged to even wealthier group who can afford private health care service provided by BIRDEM. Another is that all the doctors, nurses and other staffs of BIRDEM get free treatment from this hospital and therefore their rate of utilization is higher. However, prevalence of IGT and DM had been found higher in relatively wealthier people for both rural and urban area in Bangladesh (15). Another study done in Khagrachori district has found that diabetes type 2 is more prevalent in high income groups (70). So our finding is in line with the result of above mentioned studies.

Based on our results it appears that educated women are at risk of GDM. By contrast another study in BIRDEM found less educated women to have diabetic pregnancy (36). This discrepancy might have arisen from the selection of samples. That study selected the controls from BIRDEM hospital which represented a rather wealthier and educated group of women. The explanation behind our finding might be that educated women tend to delay marriage and become pregnant at relatively older age. Despite the total fertility rate 3 per woman in Bangladesh the number of children ever born is lower in the educated women who marry at older age (71). This fact fits well in our study as we see that higher prevalence of GDM was found in educated women.

The impact of socioeconomic factor on development of diabetes has been presented in different ways according to the socio-cultural perspective. The scenario has been seen to present opposite picture in developed (31) and developing country .In developed country the poorer are seen to be obese and are likely to develop noncommunicable disease (72). On the other hand in developing country wealthier are at risk of noncommunicable disease. Our finding from this study has been seen to be in line with this postulation.

We did not find any association of occupational status of women with GDM. Both in GDM and control group we noticed the predominance of housewife group who were not involved with any outdoor and income generation activities. It may be thought that the extent of physical activity done by housewives or women who had other type of job apart from being housewives doesn't vary to a greater extent. Our study confirms that most of the women in our country are involved in house work. Women with a better socioeconomic condition usually get 'paid helps' in an urban structure at a very low cost which put them to reduced physical activities. In our culture there is no tradition of doing extra physical work or exercise apart from the daily job we do. So the occupational status of women represented the extent of daily physical activity performed by this group of women. Irrespective of their social class and level of education we may note that GDM doesn't differ according to occupational status.

We have observed a significant association of positive family history of diabetes with GDM. The finding of our study is an agreement with other studies in Bangladesh, India and other areas globally (33;34;57;60;61;72-75). We have also noticed many (25%) women without GDM with a positive family history of diabetes. It can be postulated from the findings that though these women are genetically predisposed to gestational diabetes, other controlling factors like increased physical activity, diet habit have regulated their glucose tolerance. Chan L.Y et al. reported that a positive family history is an isolated risk factor for the women over 30 years (33).It fits well with our control group as we saw many of them had positive family history of diabetes but no GDM.

In univariate analysis we have seen that prevalence of GDM is affected by previous adverse obstetric outcome which included history of miscarriage, still birth and premature birth in our study. Our findings is in accordance with another population based study conducted in rural Bangladesh (2). Prevalence of GDM has been seen to increase steadily with a previous history of no, one, two or more miscarriage in Kashmiri women (57). Previous still birth rate was seen to be higher in diabetic pregnancy compare to women without diabetes (76). Similarly Naylor et al also found association of previous adverse obstetric outcome with GDM. However in multivariate

analysis we didn't find a significant association. Our control group also had quite a large number of previous incidences of miscarriage and still birth. So it can be assumed that virtual absence of medical care facilities is responsible for the large numbers of fetal deaths due to complications of pregnancy, delivery, and environmental influences (77). The risk is high in Bangladesh context where more than 90% of delivery still takes place at home and most of which are not attended by skilled birth attended(78).

We have observed that prevalence proportion of GDM increased with increase of gravidity from primi to multi. This affirms the result of a recent cross sectional study on GDM conducted in Indian hospital (55). There are many other studies in India, Pakistan, other Asian countries and other parts of the world which support this observation (32;35;55;57;65;75). Bangladeshi women have a longer reproductive age span and are of greater parity including grand multiparty. It is good to note that fertility rate has been found to have difference according to the place they belong to or live in Bangladesh. In multi-variate analysis we didn't find any significant differences on the status of gravidity with GDM. One of the possible explanations for this is gravidity increases with increase of age. Increasing maternal age which is acting as a strong risk factor for GDM might have influenced the relationship of gravidity with GDM in descriptive analysis.

Despite the observed risk of GDM in the women with a history of previous GDM it was not found to be associated with GDM in multivariate analysis. However all the women who had a history of previous GDM were also found to have GDM in the current pregnancy (79). Moreover we didn't find anyone from the control group with a previous history of GDM. We are also aware that diagnosis of GDM in their previous pregnancy could be missed due to lack of diabetic screening during pregnancy. Women with a history of gestational diabetes mellitus (GDM) have a high risk of progression to type 2 diabetes mellitus (T2DM). In women with impaired glucose tolerance, lifestyle modification or pharmacologic therapy may prevent or delay the onset of T2DM (63). One study has shown that Women with a history of gestational diabetes mellitus who have a BMI greater than 35 kg/m², whose previous newborn was LGA, and who required insulin during their previous pregnancy are at increased risk for recurrence of gestational diabetes mellitus (80). So it can be postulated that by modification of life style in between the pregnancies the risk of GDM in the following pregnancy can be reduced.

4.3.2 Pregnancy outcomes in GDM

We have noticed lower prevalence of anemia in GDM population in comparison to the women without GDM in our study. In contrast, a previous study on diabetic pregnancy revealed higher prevalence of anemia in diabetic mother than those without diabetes. However that study included both gestational and pregestational diabetic women from BIRDEM and the findings on GDM were not analyzed separately. The elevated blood hemoglobin concentration in the GDM mothers can be ascribed to their increased body mass index. This finding is similar to several studies conducted by Lao TT et al. of China(81).

Studies demonstrated that the prevalence of anemia is more than 50% in pregnant women among the rural population (82;83). Despite the high prevalence of anemia, severe cases of anemia were absent. This scenario was reflected in our control group. On the contrary, GDM mothers in our study possess nutritional adequacy. This finding matches well the fact GDM women usually represent wealthier part of the general population.

One of our key findings was that the rate of hypertension in pregnancy was higher in GDM compared to the women without GDM. This is consistent with other reports in Bangladesh (2;36). However we could not rule out whether hypertension was not existent before pregnancy. Several studies in India (16), Pakistan (47;84) and also in Saudi Arab (85) have reported increased risk for gestational hypertension and preeclampsia in pregnancies complicated by gestational diabetes(16). 16% of maternal death occurs due to eclampsia in Bangladesh (20;85). Preeclampsia was noticed to be associated with GDM in another study conducted in Bangladesh(86) which is an agreement with our findings.

The overall incidence of caesarean section in the present study was significantly higher even after adjustment for confounders. Our finding supports the increased prevalence of caesarean section in GDM in one recent study done in Bangladesh (86). This has also similarity with the finding of some studies in Srilanka (60) and India (63) and Pakistan (45).

The high rate of caesarean section in our study might be influenced by other factors extraneous to GDM in pregnancy (87). In GDM induction of labour is usually followed by caesarean section (88). As there is increased chance of stillbirth in GDM despite modern management (76), the caution was taken on fetal monitoring. If there is any risk of fetus, immediate termination by caesarean section is the choice of intervention in order to ensure a safe delivery outcome. The presence of fasting hyperglycemia >5.8

mmol/l may be associated with an increase in the risk of intrauterine fetal death during the last 4-8 weeks of gestation (76). Perinatal complications are preventable with good glycemic control and early induction of labor, but at a cost of a higher Cesarean section rate (88). Mother's psychological stress from death or bad outcome of previous infants and previous caesarean section were also seen to be responsible for increased caesarean delivery in GDM (87).

We found that GDM was associated with an increased risk of preterm birth. This association was also independent of hypertension of pregnancy and birth weight of the newborn which might have triggered an earlier delivery. Our results are consistent with another study in India (63) and in Pakistan (45). Our study also revealed that prevalence of full term birth is very scarce in GDM. It must be acknowledged that this study didn't draw any distinction between indicated preterm birth and spontaneous preterm birth. So the preterm delivery might have been affected by physician intervention by induced labor or caesarean delivery which has always been taking place as a safe guard for any type of risk in GDM in BIRDEM as well as other private hospitals in Bangladesh.

In the present study, incidence of birth weight more than 3.5 kg in newborn babies born to mothers was significantly higher in the women with GDM than those without diabetes. The mean birth weight in both the group are an agreement with another study done in BIRDEM (36) and in a public maternity hospital in Dhaka (89). Though we haven't encountered more than one case of macrocosmic infant, our study observed the difference in distribution of birth weight between the groups. All of our women with GDM except one have been on treatment to control of their blood glucose level. Several studies were able to show that average control of glucose during the pregnancy period helped to restrict increasing progression of birth weight (22;44).

The most commonly used definition of macrosomia is a birth weight equal to or exceeding 4000g. In our study the incidence was 0.08 % in GDM and 0.0% in Control group. The incidence is however far lower than other many published studies (>30%) conducted on GDM (54;90). Control of diabetes in most of the pregnancies either by diet or insulin might reduce the incidence of macrosomia in GDM. Studies proclaim that prophylactic insulin therapy will reduce the incidence of macrosomia among infants of GDM (91). This is also in conformity with a previous study done in BIRDEM hospital which included both pre GDM and GDM cases. It has been evidenced by some studies that babies born to Bangladesh women are also relatively smaller than that of Caucasian (56;92).

However we have found that women with GDM who were treated with insulin predict higher risk for increased birth weight of baby. One recent investigation in India has explored that tight control of GDM causes large for gestational age of the baby instead of reducing the birth weight (22). Another study done in New Zealand also demonstrated that women are more likely to have larger babies in spite of high use of insulin (93). One of the explanation behind this result could be the effect of rebound hyperglycemias in insulin treatment (22).

In our study, fetal abnormalities and complications such as intrauterine death, still birth, congenital anomalies were higher in GDM compared to normal pregnancies. But in bivariate analysis we haven't found any difference between the foetal outcomes between these two groups. However, our findings are consistent with the result of several other studies which claim that perinatal mortality can be reduced with proper glycaemic control in pregnancy (22;40). Crother et al from a study in Australia also showed that severe perinatal complication were reduced through effective treatment in GDM (42). Ramachandran et al (44) found that infants of diabetic mother who had any type of diabetes before the onset of pregnancy, have higher mortality rate. GDM which mostly includes diabetes onset in pregnancy might have less incidences of infant mortality.

Our study encountered only two babies with congenital anomaly in GDM group while no one in the Non GDM group. But the statistical analysis did not show an association between GDM and congenital malformations. A larger number of sample would have been required to establish the relationship. However, one south Indian urban study found that congenital abnormalities in the fetus were more common among those, born of mothers with higher plasma glucose (9 versus 1.1%) (44). One study in Bangladesh has found incidence of congenital anomalies is about 2.3% (92). That study observed that GDM is a risk factor for congenital anomaly in Bangladesh. This could also be due to the heterogeneity of the GDM; an entity usually detected relatively late in pregnancy but probably present since the first weeks of gestation when the teratogenic effect could occur. Occurrence of congenital anomaly might have been decreased because of earlier diagnosis of GDM and treatment in this study.

Occurrence of low Apgar score didn't vary statistically in our study between GDM and NonGDM. Some studies didn't find association of low Apgar score at 5 min between treated GDM and a control group with normal pregnancy (94;95). However, another study suggested that early diagnosis of GDM predicts low Apgar score. But we didn't find any statistical difference either by period of diagnosis or type of treatment. It can be

explained by the fact that early institution of tight metabolic control can reduce perinatal morbidity and mortality in GDM to normal level(96).


We observed that hypoglycemia in neonates born to GDM mothers was significantly high in early diagnosed and insulin treated group. Several studies showed that maternal hyperglycemia is a contributing factor for neonatal hypoglycemia(37;93).In addition women treated with insulin who usually have higher blood glucose also predict risk of hypoglycemia in newborn(93).In accordance with these findings ,early diagnosed GDM mothers in our study ,most of who were treated with insulin ,possess higher risk for hypoglycemia in their newborn.

The mean gestational week of diagnosis of GDM in our study was lower (23 weeks) than recommended time screening for GDM. Moreover about 43% of the women were diagnosed early. Meyer WJ et al. also found 40% of GDM detected in early pregnancy screening protocol(21). This matches well with reports which claim that 40%-60% of gestational diabetes can be detected in early pregnancy(97) .It is likely that most of these women were Type 2 pregestational diabetes who were diagnosed during pregnancy more than having actual pregnancy-induced glucose intolerance. Nevertheless changes in carbohydrate homeostasis can start as early as 6 weeks' gestation.Consequently they could have pregnancy induced glucose tolerance. In both situations it has been glucose intolerance found in early pregnancy implies a higher risk(98). They predict increased incidence of obstetric (4) and neonatal complications which also fits with our finding. Therefore early diagnosis of them is needed in order to control adverse pregnancy outcome(97).

Our study revealed that women diagnosed early in pregnancy had higher risk for being treated with insulin. This finding is in conformity with a study conducted by Barahona MJ et al (99).It can be explained by the hypothesis that these women had increased insulin resistance for which most of them need insulin to control their hyperglycaemia.In addition they are then at increased risk of getting Type 2 diabetes early or at younger age(4).

Hypertension in pregnancy was significantly associated with the women diagnosed early in pregnancy in our study when compared with the controls. The increased rate of hypertension in the early diagnosed GDM it is probable that many of these women had undiagnosed type 2 diabetes, which is known to be linked with hypertension. Our finding is an agreement with another study which demonstrated that despite appropriate obstetric management, women with early onset gestational diabetes increases the risks of hypertension (98).

Chapter 5
Conclusions, Recommendation
& Future Implication



5. Conclusions, Recommendations and Future Research Implication

5.1 Conclusions

In summary we conclude that commonly recognized risk factors for GDM are prevalent in the study population. The results suggest that urban and suburban woman with increasing age or who has a family history of diabetes or increased BMI was at higher risk for GDM.

Onset of GDM can be as early as before 20 weeks of gestation in quite a larger portion of women with GDM .Women diagnosed with GDM at an early pregnancy were more likely to be treated with insulin.

Hypertension, caesarean section and preterm delivery were more prevalent in the women with GDM. The occurrence of macrosomia was very low in the treated cases of GDM but the likelihood of birth weight more than 3.5 kg was rather more in them than the women without diabetes.

Maternal and neonatal complications did not vary among those either treated with insulin or diet .Events of hypoglycemia was more prevalent in the women who were diagnosed early or treated with insulin.

Women diagnosed as GDM early in pregnancy predict higher risk of having hypertension in pregnancy than those with no GDM .Over representation of birth weight more than 3.5 kg was noted for the women treated with insulin in GDM.

Selective screening for GDM for all the pregnant women of Bangladesh bears significant importance as women with GDM are at high risk of pregnancy and delivery outcome. Therefore we made the following recommendations based on our findings of the study.

5.2 Recommendations

1. Diagnosis and treatment of GDM are to be put into national antenatal check up program so that 5-8% of the risk pregnancy from GDM can be identified .Thus measures are to be taken to avoid preventable consequence to the mother and fetus/newborn.
2. Pregnant women at their first antenatal check up needs to be checked for gestational diabetes.
3. As quite a large number of women were diagnosed early in pregnancy screening of GDM needs to be carried out in early trimester. We suggest that this subgroup of women with gestational diabetes is to be promptly identified. Their situation can be considered equivalent to that of women with pregestational diabetes mellitus and managed as such.
4. A standard treatment guideline including referral instruction is to be prepared and available to the health professional so that they can identify GDM as well as make a birth plan for GDM in pregnancy.
5. Particular attention needs to be given to the women who are diagnosed early in pregnancy as they are more likely to develop hypertension in pregnancy, need insulin treatment and their newborn are prone to develop hypoglycemia. In this regard all health personnel concerned with conducting diabetic delivery are to be trained off on management of hypoglycemia in newborn to prevent grave and undesired effect of hypoglycemia in newborn.
6. Women who are treated with insulin need particular attention as they may lead to birth of relatively larger baby if their blood glucose was not controlled in a proper way.
7. Women with GDM should be followed after delivery in order to monitor hyperglycemic status and so advised accordingly.

5.3 Further research implication

1. Our study could not focus on the association of fasting glycosuria, problem of fertility, history of preterm birth or macrosomia or previous caesarean section and rate of miscarriage or other fatalities due to limitations time and resources. An additional study needs to be taken up to measure the association of all these conditions related to GDM in Bangladesh.
2. We would also suggest for conducting a hospital based surveillance study for risk factors and pregnancy associated complications of GDM in line with diabetes type 2 under the ongoing surveillance of noncommunicable diseases in Bangladesh.
3. Women with GDM should be followed up in a prospective study in order to look at the risk of DMT2 in them. The women identified as GDM are to be put under an intervention study so that what actually happens to them in the future can be traced out. Thus a further interventional prospective study on this issue would have long term implication of GDM on the promotion of health and reduction of diseases burden.
4. A prospective study to measure the association of GDM and varying grade of hypertension in pregnancy demands attention in the increased prevalence of diabetes type 2, preeclampsia and hypertension in the women of Bangladesh.
5. We also suggest carrying out a study to further assess the mode of delivery in GDM. As our study found a huge number of caesarean section in GDM pregnancy, this made us to be critical to think on the indication of caesarean section as well as effective birth plan for the GDM cases in Bangladesh.
6. We also recommend carrying out a study with the children born to mothers with GDM to look at the pattern of illness and risk of diabetes or coronary heart diseases in them.
7. Early diagnosed GDM were seen as a high risk subgroup among GDM. Further studies is also suggested to clarify outcome of pregnancy according to period of diagnosis of GDM.

References

Reference List

- (1) Metzger BE, Coustan DR. Summary and recommendations of the Fourth International Workshop-Conference on Gestational Diabetes Mellitus. The Organizing Committee. Diabetes Care 1998; 21 Suppl 2:B161-B167.
- (2) Sayeed MA, Mahtab H, Khanam PA, Begum R, Banu A, Azad Khan AK. Diabetes and hypertension in pregnancy in a rural community of Bangladesh: a population-based study. Diabet Med 2005; 22(9):1267-1271.
- (3) Making Pregnancy Safer, Family and Community Health, World Health Organization, Bangladesh, Available at http://www.whoban.org/family_com_health.html Accessed on 27.10.05
- (4) Ben Haroush A, Yogev Y, Hod M. Epidemiology of gestational diabetes mellitus and its association with Type 2 diabetes. Diabet Med 2004; 21(2):103-113.
- (5) International diabetic foundation, Diabetic Atlas, second edition.
- (6) The World Bank in Bangladesh, Country brief, July 2005. Available at <http://siteresources.worldbank.org/INTBANGLADESH/Resources/BD06.pdf>. Accessed on 25.10.05 (Four screens).
- (7) World Health Organization Statistics, 2005. Part 1.
- (8) Nutrition, Health and Nutrition, UNICEF Bangladesh. Available at http://www.unicef.org/bangladesh/health_nutrition_406.htm. Accessed on 20.10.05 (One Screen).
- (9) NATIONAL POLICY ON MATERNAL HEALTH. Ministry of Health, Government of the People's Republic of Bangladesh .Available at <http://www.bangladeshgateway.org/meternalhealth.php?PHPSESSID=c2859da4f1c8b5579991766219fd2c06>. Accessed on 27.01.06
- (10) Health Profile Of Bangladesh , World Health Organization, Bangladesh. Available at http://www.whoban.org/country_health_profile.html, Accessed on 27.10,05 (One screen)
- (11) King H, Aubert RE, Herman WH. Global burden of diabetes, 1995-2025: prevalence, numerical estimates, and projections. Diabetes Care 1998; 21(9):1414-1431.
- (12) Alberti KG, Zimmet PZ. Definition, diagnosis and classification of diabetes mellitus and its complications. Part 1: diagnosis and classification of diabetes mellitus provisional report of a WHO consultation. Diabet Med 1998; 15(7):539-553.

-
- (13) Global Burden of diabetes, Press Release WHO /63, 14 September 1998. Available at <http://www.who.int/inf-pr-1998/en/pr98-63.html> Accessed on 27.10.05
- (14) Hussain A, Rahim MA, Azad Khan AK, Ali SM, Vaaler S. Type 2 diabetes in rural and urban population: diverse prevalence and associated risk factors in Bangladesh. *Diabet Med* 2005; 22(7):931-936.
- (15) Abu SM, Ali L, Hussain MZ, Rumi MA, Banu A, Azad Khan AK. Effect of socioeconomic risk factors on the difference in prevalence of diabetes between rural and urban populations in Bangladesh. *Diabetes Care* 1997; 20(4):551-555.
- (16) Buchanan TA, Xiang AH. Gestational diabetes mellitus. *J Clin Invest* 2005; 115(3):485-491.
- (17) Ahmed S, Khanum PA, Islam A. Maternal morbidity in rural Bangladesh: where do women go for care? [WP113, 1998] Available at <http://www.icddrb.org/pub/publication.jsp?classificationID=47&pubID=4354>. Accessed on 28.01.06(One screen).
- (18) Bangladesh Bureau of Statistics. Statistical Pocket Book of Bangladesh 2000. Ed; Singha AC, Statistical Division, Ministry of Planning, Government Of The People's Republic Of Bangladesh.
- (19) Low Birth Weight of a Meeting, Dhaka, Bangladesh, 14-17 June 1999. United nation Administrative Committee On Coordination, Sub Committee on Nutrition, Nutrition Policy Paper No.18 February 2000 (page 7) . Available at http://www.unsystem.org/scn/Publications/NPP/npp18_lbw.pdf. Accessed on 27.10.05 (Page no. 7 of 56).
- (20) Begum MR, Begum A, Quadir E, Akhter S, Shamsuddin L. Eclampsia: still a problem in Bangladesh. *MedGenMed* 2004; 6(4):52.
- (21) Meyer WJ, Carbone J, Gauthier DW, Gottmann DA. Early gestational glucose screening and gestational diabetes. *J Reprod Med* 1996; 41(9):675-679.
- (22) Banerjee S, Ghosh US, Banerjee D. Effect of tight glycaemic control on fetal complications in diabetic pregnancies. *J Assoc Physicians India* 2004; 52:109-113.
- (23) Verhaeghe J, Gestational diabetes mellitus: pathophysiology, screening and diagnosis, and management. *Diabetes and Pregnancy. European Practice in Gynecology and Obstetrics* .2004. Page (15-27).
- (24) Fuchtenbusch M, Ferber K, Standl E, Ziegler AG. Prediction of type 1 diabetes postpartum in patients with gestational diabetes mellitus by combined islet cell
-

autoantibody screening: a prospective multicenter study. *Diabetes* 1997; 46(9):1459-1467.

- (25) Haig D. Genetic conflicts in human pregnancy. *Q Rev Biol* 1993; 68(4):495-532.
- (26) American College of Obstetricians and Gynecologists. *Gestational Diabetes, Practice Bulletin no. 30.* 2001.
- (27) Coustan DR. Diagnosis of gestational diabetes. What are our objectives? *Diabetes* 1991; 40 Suppl 2:14-17.
- (28) WHO Ad Hoc Diabetes Reporting Group. Diabetes and impaired glucose tolerance in women aged 20-39 years. *World Health Stat* 1992; 45: 321-327.
- (29) Beischer NA, Oats JN, Henry OA, Sheedy MT, Walstab JE. Incidence and severity of gestational diabetes mellitus according to country of birth in women living in Australia. *Diabetes* 1991; 40 Suppl 2:35-38.
- (30) Jervell J. *An Update on Diabetes Including HbA1c and microalbumin.* August 2000, First edition.
- (31) Berkowitz GS, Lapinski RH, Wein R, Lee D. Race/ethnicity and other risk factors for gestational diabetes. *Am J Epidemiol* 1992; 135(9):965-973.
- (32) Di Cianni G, Volpe L, Lencioni C, Miccoli R, Cuccuru I, Ghio A et al. Prevalence and risk factors for gestational diabetes assessed by universal screening. *Diabetes Res Clin Pract* 2003; 62(2):131-137.
- (33) Chan LY, Wong SF, Ho LC. Diabetic family history is an isolated risk factor for gestational diabetes after 30 years of age. *Acta Obstet Gynecol Scand* 2002; 81(2):115-117.
- (34) Davey RX, Hamblin PS. Selective versus universal screening for gestational diabetes mellitus: an evaluation of predictive risk factors. *Med J Aust* 2001; 174(3):118-121.
- (35) Toms GC, Fairbank J, Day SL, Fisher M, Beedham T, Monson JP. Outcome of gestational diabetes in Bengali Asians living in an east London health district. *Diabetes Res Clin Pract* 1992; 18(1):55-60.
- (36) Begum S, Huda SN, Musarrat N, Ahmed S, Banu LA, Ali SM. Nutritional status and birth outcomes of the diabetic and non-diabetic pregnant women. *Bangladesh Med Res Counc Bull* 2002; 28(3):97-103.
- (37) Nasrat AA, Augensen K, Abushal M, Shalhoub JT. The outcome of pregnancy following untreated impaired glucose tolerance. *Int J Gynaecol Obstet* 1994; 47(1):1-6.

-
- (38) Ramtoola S, Home P, Damry H, Husnoo A, Ah-Kion S. Gestational impaired glucose tolerance does not increase perinatal mortality in a developing country: cohort study. *BMJ* 2001; 322(7293):1025-1026.
- (39) Moses RG, Calvert D. Pregnancy outcomes in women without gestational diabetes mellitus related to the maternal glucose level. Is there a continuum of risk? *Diabetes Care* 1995; 18(12):1527-1533.
- (40) Dunne FP, Brydon PA, Proffitt M, Smith T, Gee H, Holder RL. Fetal and maternal outcomes in Indo-Asian compared to caucasian women with diabetes in pregnancy. *QJM* 2000; 93(12):813-818.
- (41) Dornhorst A, Nicholls JS, Welch A, Ali K, Chan SP, Beard RW. Correcting for ethnicity when defining large for gestational age infants in diabetic pregnancies. *Diabet Med* 1996; 13(3):226-231.
- (42) Crowther CA, Hiller JE, Moss JR, McPhee AJ, Jeffries WS, Robinson JS. Effect of treatment of gestational diabetes mellitus on pregnancy outcomes. *N Engl J Med* 2005; 352(24):2477-2486.
- (43) Szilagyi A, Feledi E, Csaba I, Pejtsik B. [Early screening of gestational diabetes in high risk pregnancy cases]. *Orv Hetil* 1989; 130(16):839-842.
- (44) Ramachandran A, Snehalatha C, Clementina M, Sasikala R, Vijay V. Foetal outcome in gestational diabetes in south Indians. *Diabetes Res Clin Pract* 1998; 41(3):185-189.
- (45) Rizvi JH, Rasul S, Malik S, Rehamatuallah A, Khan MA. Experience with screening for abnormal glucose tolerance in pregnancy: maternal and perinatal outcome. *Asia Oceania J Obstet Gynaecol* 1992; 18(2):99-105.
- (46) Khan KS, Hashmi FA, Rizvi JH. Are non-diabetic women with abnormal glucose screening test at increased risk of pre-eclampsia, macrosomia and caesarian birth? *J Pak Med Assoc* 1995; 45(7):176-179.
- (47) Ahkter J, Qureshi R, Rahim F, Moosvi S, Rehman A, Jabbar A et al. Diabetes in pregnancy in Pakistani women: prevalence and complications in an indigenous south Asian community. *Diabet Med* 1996; 13(2):189-191.
- (48) Vangen S, Stoltenberg C, Holan S, Moe N, Magnus P, Harris JR et al. Outcome of pregnancy among immigrant women with diabetes. *Diabetes Care* 2003; 26(2):327-332.
- (49) Definition, Diagnosis and Classification of Diabetes Mellitus and its Complication Report of a WHO Consultation Part 1: Diagnosis and Classification of Diabetes Mellitus World Health Organization ,Department of Noncommunicable Disease Surveillance ,Geneva, 1999.
-

-
- (50) Salam AKMA, Alam MS, Choudhury KK. Inequalities in the Utilisation of Safe Delivery Services in Bangladesh: BARRIERS TO REDUCING MATERNAL MORTALITY. Bangladesh Health Equity Watch Dhaka, Bangladesh March 2003; Equity Watch Paper No.2. Available at <http://www.icddr.org/images/EWR2-safedelivery.pdf#search='Hospital%20delivery%20in%20Bangladesh'>. Accessed on 27.10.05.
- (51) Altman D.G. Practican Statistics For Medical Research. 1st .1991. United Kingdom, Published by Chapman and Hall
- (52) GUIDELINES FOR CARE OF TYPE 2 DIABETES MELLITUS IN BANGLADESH BIRDEM Clinical Research Group, Ibrahim Memorial Diabetes Centre, Dhaka, Bangladesh Available at <http://www.whoban.org/pdf/diabetes.pdf>, Accessed at 26.10.05.
- (53) Jawad F and Irshaduddin P.K. Prevalence of gestational diabetes and pregnancy outcome in Pakistan Eastern Mediterranean Health Journal .1996;2(2) :268-273
- (54) Khan KS, Rizvi JH, Qureshi RN, Mazhar R. Gestational diabetes in a developing country, experience of screening at the Aga Khan University Medical Centre, Karachi. J Pak Med Assoc 1991; 41(2):31-33.
- (55) Seshiah V, Balaji V, Balaji MS, Sanjeevi CB, Green A. Gestational diabetes mellitus in India. J Assoc Physicians India 2004; 52:707-711.
- (56) Versi E, Liu KL, Chia P, Seddon G. Obstetric outcome of Bangladeshi women in east London. Br J Obstet Gynaecol 1995; 102(8):630-637.
- (57) Zargar AH, Sheikh MI, Bashir MI, Masoodi SR, Laway BA, Wani AI et al. Prevalence of gestational diabetes mellitus in Kashmiri women from the Indian subcontinent. Diabetes Res Clin Pract 2004; 66(2):139-145.
- (58) Weijers RN, Bekedam DJ, Smulders YM. Determinants of mild gestational hyperglycemia and gestational diabetes mellitus in a large dutch multiethnic cohort. Diabetes Care 2002; 25(1):72-77.
- (59) Xiong X, Saunders LD, Wang FL, Demianczuk NN. Gestational diabetes mellitus: prevalence, risk factors, maternal and infant outcomes. Int J Gynaecol Obstet 2001; 75(3):221-228.
- (60) Siribaddana SH, Deshabandu R, Rajapakse D, Silva K, Fernando DJ. The prevalence of gestational diabetes in a Sri Lankan antenatal clinic. Ceylon Med J 1998; 43(2):88-91.
-

-
- (61) Sunsaneevithayakul P, Boriboohirunsarn D, Sutanthavibul A, Ruangvutilert P, Kanokpongsakdi S, Singkiratana D et al. Risk factor-based selective screening program for gestational diabetes mellitus in Siriraj Hospital: result from clinical practice guideline. *J Med Assoc Thai* 2003; 86(8):708-714.
- (62) Bangladesh and Family Planning: An Overview .The Department of Family and Community Health World Health Organization Regional Office for South-East Asia. Available at [http://w3.whoasia.org/LinkFiles/Family_Planning_Fact_Sheets_bangladesh.pdf#search='Bangladesh%20and%20Family%20Planning%3A%20An%20Overview'](http://w3.whoasia.org/LinkFiles/Family_Planning_Fact_Sheets_bangladesh.pdf#search='Bangladesh%20and%20Family%20Planning%3A%20An%20Overview'.). Accessed on 25.10.05(Six Screens).
- (63) Strehlow SL, Mestman JH. Prevention of T2DM in women with a previous history of GDM. *Curr Diab Rep* 2005; 5(4):272-277.
- (64) Sayeed MA, Hussain MZ, Banu A, Rumi MA, Azad Khan AK. Prevalence of diabetes in a suburban population of Bangladesh. *Diabetes Res Clin Pract* 1997; 34(3):149-155.
- (65) Cheung NW, Wasmer G, Al Ali J. Risk factors for gestational diabetes among Asian women. *Diabetes Care* 2001; 24(5):955-956.
- (66) Kale SD, Yajnik CS, Kulkarni SR, Meenakumari K, Joglekar AA, Khorsand N et al. High risk of diabetes and metabolic syndrome in Indian women with gestational diabetes mellitus. *Diabet Med* 2004; 21(11):1257-1258.
- (67) Ramachandran A, Snehalatha C, Shyamala P, Vijay V, Viswanathan M. Prevalence of diabetes in pregnant women--a study from southern India. *Diabetes Res Clin Pract* 1994; 25(1):71-74.
- (68) Shamsuddin K, Mahdy ZA, Siti R, I, Jamil MA, Rahimah MD. Risk factor screening for abnormal glucose tolerance in pregnancy. *Int J Gynaecol Obstet* 2001; 75(1):27-32.
- (69) Kale SL, Kulkarni SR , Lubree HG L , Meenakumari K , Deshpande VU , Rege SS ,Deshpande J , Coyaji KJ, Yajnik CS , Characteristics of Gestational Diabetic Mothers and Their Babies in An Indian Diabetes Clinic JAPI o VOL. 53 o OCTOBER 2005 Available at .www.japi.org Accessed on 26.10.05
- (70) Abu SM, Mahtab H, Akter KP, Abul AK, Banu A, Rashid AN et al. Diabetes and impaired fasting glycemia in the tribes of Khagrachari hill tracts of Bangladesh. *Diabetes Care* 2004; 27(5):1054-1059.
- (71) Chaudhury RH. The influence of female education, labor force participation, and age at marriage on fertility behavior in Bangladesh. *Soc Biol* 1984; 31(1-2):59-74.
-

-
- (72) Pardhan S, Mahomed I. Knowledge, self-help and socioeconomic factors in South Asian and Caucasian diabetic patients. *Eye* 2004; 18(5):509-513.
- (73) Huidobro A, Fulford A, Carrasco E. [Incidence of gestational diabetes and relationship to obesity in Chilean pregnant women]. *Rev Med Chil* 2004; 132(8):931-938.
- (74) Keshavarz M, Cheung NW, Babaee GR, Moghadam HK, Ajami ME, Shariati M. Gestational diabetes in Iran: incidence, risk factors and pregnancy outcomes. *Diabetes Res Clin Pract* 2005; 69(3):279-286.
- (75) Wagaarachchi PT, Fernando L, Premachadra P, Fernando DJ. Screening based on risk factors for gestational diabetes in an Asian population. *J Obstet Gynaecol* 2001; 21(1):32-34.
- (76) Wood SL, Jick H, Sauve R. The risk of stillbirth in pregnancies before and after the onset of diabetes. *Diabet Med* 2003; 20(9):703-707.
- (77) Swenson I, Harper PA. High risk maternal factors related to fetal wastage in rural Bangladesh. *J Biosoc Sci* 1979; 11(4):465-471.
- (78) Barbhuiya MA, Hossain S, Hakim MM, Rahman SM. Prevalence of home deliveries and antenatal care coverage in some selected villages. *Bangladesh Med Res Counc Bull* 2001; 27(1):19-22.
- (79) Harris SB, Caulfield LE, Sugamori ME, Whalen EA, Henning B. The epidemiology of diabetes in pregnant Native Canadians. A risk profile. *Diabetes Care* 1997; 20(9):1422-1425.
- (80) Gaudier FL, Hauth JC, Poist M, Corbett D, Cliver SP. Recurrence of gestational diabetes mellitus. *Obstet Gynecol* 1992; 80(5):755-758.
- (81) Lao TT, Ho LF. Impact of iron deficiency anemia on prevalence of gestational diabetes mellitus. *Diabetes Care* 2004; 27(3):650-656.
- (82) Ahmed F. Anaemia in Bangladesh: a review of prevalence and aetiology. *Public Health Nutr* 2000; 3(4):385-393.
- (83) Hyder SM, Persson LA, Chowdhury M, Lonnerdal BO, Ekstrom EC. Anaemia and iron deficiency during pregnancy in rural Bangladesh. *Public Health Nutr* 2004; 7(8):1065-1070.
- (84) Munim S, Chaudhury N, Jamal K, Khan FA. Outcome of abruptio placentae in normotensive and hypertensive patients in Aga Khan University Hospital, Pakistan. *J Obstet Gynaecol Res* 1997; 23(3):267-271.
-

-
- (85) El Mallah KO, Narchi H, Kulaylat NA, Shaban MS. Gestational and pre-gestational diabetes: comparison of maternal and fetal characteristics and outcome. *Int J Gynaecol Obstet* 1997; 58(2):203-209.
- (86) Khatun N, Latif SA, Uddin MM. Pregnancy associated complications of mothers with gestational diabetes mellitus. *Mymensingh Med J* 2005; 14(2):196-198.
- (87) Care of the pregnant diabetic women, *Diabetes and Pregnancy. European Practice in Gynecology and Obstetrics* .2004. Page (85-95).
- (88) Peled Y, Perri T, Chen R, Pardo J, Bar J, Hod M. Gestational diabetes mellitus--implications of different treatment protocols. *J Pediatr Endocrinol Metab* 2004; 17(6):847-852.
- (89) Dhar B, Mowlah G, Nahar S, Islam N. Birth-weight status of newborns and its relationship with other anthropometric parameters in a public maternity hospital in Dhaka, Bangladesh. *J Health Popul Nutr* 2002; 20(1):36-41.
- (90) Ostlund I, Hanson U, Bjorklund A, Hjertberg R, Eva N, Nordlander E et al. Maternal and fetal outcomes if gestational impaired glucose tolerance is not treated. *Diabetes Care* 2003; 26(7):2107-2111.
- (91) Coustan DR, Imarah J. Prophylactic insulin treatment of gestational diabetes reduces the incidence of macrosomia, operative delivery, and birth trauma. *Am J Obstet Gynecol* 1984; 150(7):836-842.
- (92) Khanum S, Noor K, Kawser CA. Studies on congenital abnormalities and related risk factors. *Mymensingh Med J* 2004; 13(2):177-180.
- (93) Simmons D, Thompson CF, Conroy C. Incidence and risk factors for neonatal hypoglycaemia among women with gestational diabetes mellitus in South Auckland. *Diabet Med* 2000; 17(12):830-834.
- (94) Yogev Y, Ben Haroush A, Chen R, Glickman H, Kaplan B, Hod M. Active induction management of labor for diabetic pregnancies at term; mode of delivery and fetal outcome--a single center experience. *Eur J Obstet Gynecol Reprod Biol* 2004; 114(2):166-170.
- (95) Simpson RW, Kast SJ. Management of gestational diabetes with a conservative insulin protocol. *Med J Aust* 2000; 172(11):537-540.
- (96) Drexel H, Bichler A, Sailer S, Breier C, Lisch HJ, Braunsteiner H et al. Prevention of perinatal morbidity by tight metabolic control in gestational diabetes mellitus. *Diabetes Care* 1988; 11(10):761-768.
-

-
- (97) Bartha JL, Martinez-Del-Fresno P, Comino-Delgado R. Early diagnosis of gestational diabetes mellitus and prevention of diabetes-related complications. *Eur J Obstet Gynecol Reprod Biol* 2003; 109(1):41-44.
- (98) Bartha JL, Martinez-Del-Fresno P, Comino-Delgado R. Gestational diabetes mellitus diagnosed during early pregnancy. *Am J Obstet Gynecol* 2000; 182(2):346-350.
- (99) Barahona MJ, Sucunza N, Garcia-Patterson A, Hernandez M, Adelantado JM, Ginovart G et al. Period of gestational diabetes mellitus diagnosis and maternal and fetal morbidity. *Acta Obstet Gynecol Scand* 2005; 84(7):622-627.

Appendices

Appendix - 1 (Questionnaire)

Date of interview:

Hospital

BIRDEM:

Others:

Place of Interview:

Interview taken by:

Questionnaire checked by: Date:

Name:

Contact Address:

Telephone No:

Demographic Characteristics

| | | Record | Interview | Clinical investigation |
|-------------------------------------|---------------------|--------|-----------|------------------------|
| Age | (in years) | | | |
| Ht | (m) | | | |
| Wt | (kg) | | | |
| Highest level of education attained | Years of schooling | | | |
| Main occupation | House wife | | | |
| | others | | | |
| Monthly expenditure | Local currency (TK) | | | |

Family and Obstetric History

| | | | | |
|--|--------------------|--|--|--|
| | | | | |
| Diabetes in the family (first, second and third degree relation) | Yes | | | |
| | No | | | |
| | Unknown | | | |
| EDD | | | | |
| LMP | | | | |
| Previous history of GDM | Yes | | | |
| | No | | | |
| | Unknown | | | |
| | Not applicable | | | |
| Previous bad obstetric history | Miscarriage | | | |
| | Still born | | | |
| | Premature Birth | | | |
| | Gravida | | | |
| | Not applicable | | | |
| Time of diagnosis of GDM | Weeks of gestation | | | |
| | Not diagnosed | | | |
| | Not applicable | | | |
| Main treatment till delivery | Diet and exercise | | | |
| | Insulin | | | |
| | No treatment | | | |
| Blood sugar level On diagnosis | Mmol/L | | | |
| Range of blood glucose level during pregnancy | Mmol/l | | | |
| RBS During Pregnancy | | | | |
| RBS within 24 hours before delivery | | | | |
| Hypertension | yes | | | |
| | No | | | |
| Hb mg/dl | | | | |

Pregnancy Outcome

| | | | | |
|-----------------------|------------------------------|--|--|--|
| Gestation at delivery | <32 wks | | | |
| | 32-36 wks | | | |
| | 37-39 wks | | | |
| | Full term | | | |
| | Post dated | | | |
| | Post term | | | |
| Mode of delivery | Normal vaginal | | | |
| | Assisted | | | |
| | Caesarean | | | |
| Outcome Of delivery | Live birth | | | |
| | Live birth with injury | | | |
| | Live birth with birth defect | | | |
| | Still born | | | |
| | IUD | | | |

Newborn Status

| | | | | |
|----------------|------|--|--|--|
| | | | | |
| Birth weight | (gm) | | | |
| APGAR at 1 min | | | | |
| APGAR at 5 min | | | | |

Appendix - 2 (Antenatal Card-shown partly, BIRDEM)

GDM
3776
DAB Form No. 192

**DIABETIC ASSOCIATION OF BANGLADESH
IBRAHIM MEMORIAL DIABETES CENTRE**
122 Kazi Nazrul Islam Avenue
Dhaka- 1000, Bangladesh
Telephone : 8616641 -50, 9661551-60, Extn-2235

ANTENATAL CARD

Name Mrs Saleha Akter Age 34 yrs
Address 18/P Engineering staff quarter, Eng. university
BUET, Dhaka Telephone _____
Relevant Medical History GDM
Family History Father is diabetic, mother hypertens
Personal History Married for 19 yrs
Menstrual History MP/MC - 4-5 day
28±2 day
L.M.P. 26.01.04 E.D.D. 02.11.04

Previous Obstetric History

| Date | Pregnancy | Labour | Puerpericum | Body notes |
|------|----------------------|----------------|-------------|------------|
| | <u>1st</u> | <u>NVD</u> | | <u>♀</u> |
| | <u>2nd</u> | <u>NVD</u> | | <u>♂</u> |
| | <u>3rd</u> | <u>MR done</u> | | |
| | <u>Gr - 4th</u> | | | |
| | <u>ALC - 12 hrs.</u> | | | |

BOOKING EXAMINATION Date 14.08.04
General condition _____ Height _____ Weight _____
Heart & Chest _____ Breasts _____
Height of the fundus _____
Vaginal Examination _____


Blood Group B (D)ve Husband's Blood Group _____
Haemoglobin 11.2 gm/dl (29.7%) Blood sugar _____
10.0 (159.24)
Urinalysis _____ VDRL _____
Toxoplasma antibody _____ Rubella antibody _____
Pap Smear _____

Appendix - 2 (Antenatal Card -shown partly, BIRDEM)

ANTENATAL RECORD

| Date | Maturity (Weeks) | Fundal Height | Presentation Position | Relation to Brim | Fetal Heart | Weight in kg | Oedema | Urine | | Blood Pressure | HIB% | Comments | Next visit | Signature |
|----------|----------------------|---------------|-----------------------|------------------|--------------|--------------|--------|-------|--------|----------------|------|---------------------------------|------------|-----------|
| | | | | | | | | Port | Glucos | | | | | |
| 14-08 | 28 th wks | 30cms | | | Fm + F15+ | 59kg | (-) | | | 120/80 | | | 13-09-04 | A. C. |
| 09-09 | 30 wks | 33cms | | | | 49 | | | | 110/70 | | Acetone Ketonuria albumen | 20-09-04 | Z. S. D. |
| 10/10/04 | 32 wks | 32cms | | | Fm + | 59kg | | | | 110/80 | | no Ketonuria albumen | 15/10/04 | Z. S. D. |
| 10-09-04 | 34 wks | 32cms | | | Fm + | 59kg | | | | 110/80 | | | 18-09-04 | Z. S. D. |
| 22-09-04 | 35+ | 36cms | | | Fm + | 59kg | | | | 120/80 | | | 06-10-04 | Z. S. D. |
| 01/10/04 | 36+ | 36cms | | | Fm + | 57kg | | | | 120/80 | | | 06/10/04 | Z. S. D. |

Appendix - 3 (Antenatal Card-shown partly, MCHTI)



গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
পরিবার পরিকল্পনা অধিদপ্তর
আজিমপুর, ঢাকা

126/80
9/10
W-55
H-125cm

গর্ভবতী মায়ের কার্ড

ক্রমিক নম্বর : 62-৯৪ তারিখ 24/10/08

প্রেরণকারী : বিজ
কেন্দ্র : 100/109

নাম : *[Signature]* বয়স : 26 ধর্মের নাম : (মুসলিম) জেলা : *[Signature]*

ঠিকানা - গ্রাম : *[Signature]* উপজেলা : *[Signature]*

পূর্ববর্তী গর্ভ প্রসব ও গর্ভপাত সংক্রান্ত ইতিহাস

| তারিখ | প্রসবের ধরন | ভেলে | মেয়ে | জীবিত | মৃত | সমস্যা (কি ধরনের) |
|-------|-------------|------|-------|-------|-----|----------------------|
| ১ ১২০ | ৫৫ | ✓ | | ✓ | | |
| ২ ১৩০ | ৫ | ✓ | | ✓ | | |
| ৩ | | | | | | |
| ৪ | | | | | | |
| ৫ | | | | | | |
| ৬ | | | | | | |
| ৭ | | | | | | |
| ৮ | | | | | | |

মেডিক্যাল ইতিহাস

হৃৎস্পন্দন : স্বাভাবিক আছে কিনা -
কাশি (৪ সপ্তাহের বেশী) -
জ্বর (৪ সপ্তাহের বেশী) -
কার্ডিও ভাসকুলার : অল্পতেই ইতিহাস উঠেন -
বুক ধড়ফড় করে -
শরীরের নিমাংশে পানি এসেছে -
উচ্চ রক্তচাপ আছে -
স্তন : স্তনে ব্যথা আছে -
স্তনে চাকা আছে -
মূত্রতন্ত্র : ঘন ঘন প্রস্রাব / প্রস্রাবে জ্বালা পোড়া আছে -
প্রস্রাবে রক্ত যায় -
তলপেটে (রেনাল এঙ্গেল) ব্যথা আছে -

প্রতিষেধক টিকি
টিটেনাস ভ্যাকসিন
ডোজ তারিখ
১ম
২য়
বুটোর

মাসিকের ইতিহাস - চক্র 24/10/08
শেষ মাসিকের তারিখ : 24/10/08
প্রসবের তারিখ : 24/10/08

Appendix - 3 (Antenatal Card-shown partly, MCHTI)

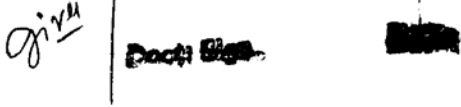
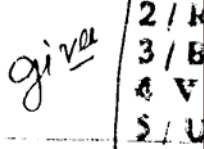
হৃদপিণ্ড: 2 / KHS → 4' 3' 100 // L
 স্তন: 3 / Bl. pr & Rh factor → O (+ve)
 4 VDR L → NR
 5 / Uric R/M/B → NAD
 MBS → (-ve)

গর্ভকালীন রেকর্ড

| সিমেফাইসিস পিউবিস ওভার ডায়গনস্টিক | শিশুর তপ্তন | শিশুর নড়াচড়া (+/-) | শিশুর অঙ্গপন্দন (+/-) | উপসর্গ / অসুবিধা | চিকিৎসা | ধাককা |
|--|----------------|----------------------------|-----------------------------|------------------|--------------------------------|-------|
| 28 hrs. | | | | | | |
| 29 hrs. | + | + | + | | Tab Calco 0+0+2 = 6মাস | |
| 30 hrs. | | | | Refer to doctor | | |
| | | | | Urgent USG | Syr. Magni 0+0+2 6 to 10 | |

৪। হাত, পা ফেলা
 ৫। অনবরত জ্বর (১০০ ডিগ্রি-ফার্নহাইট উপরে)
 ৬। দুর্গন্ধযুক্ত মে নিস্রাব
 ৭। ১২ মন্টার অধিক প্রসব বেদনা।
 ৮। মাথা ব্যতীত শিশুর কোন অংগ দেখা গেছে

Appendix - 3 (Antenatal Card-shown partly, MCHTI)

| সাধারণ : উচ্চতা : | |  | | হৃদপিণ্ড : | |  | | | | |
|-------------------|----------------|--|----------|-------------|-------------------------|---|-----------------|---|-----------|--------------------|
| ফুসফুস : | | | | স্তন : | | | | | | |
| গর্ভকালীন রেকর্ড | | | | | | | | | | |
| তারিখ | গর্ভের সময়কাল | ওজন | রক্ত চাপ | হেমোগ্লোবিন | প্রসূতি পরীক্ষা (+ / -) | | ইউডিয়া (+ / -) | সিমফাইসিস পিউডিস ২০০৩ ভরাফুর উচ্চতা | শিশুর ওজন | শিশুর নড়া (+ / -) |
| | | | | | সুপার | এলবুমিন | | | | |
| ২৫/১০/০৮ | | ৫৬ | ১২০/৮০ | | | | | ২৪ cm | | |
| ২৫/১০/০৮ | | | | | | | | | | |
| ৩১/১০/০৮ | | ৫৫ | ১১০/৯০ | | | | | ২৭ cm | ৭ | + |
| ৩১/১০/০৮ | | ৫৭ | ১২০/৮০ | | | | | ৩০ cm | ৭ | + |

গর্ভবতী মায়ের বিপদজনক অবস্থা :

| | |
|--|-----------------------------|
| ১। প্রসবের পূর্বে যোনীপথের রক্তক্ষরণ | ৪। হাত, পা ফোঁসা |
| ২। গর্ভপাত / প্রসবের পর অতিরিক্ত রক্তক্ষরণ | ৫। অনবরত জ্বর (১০০ ডিগ্রি) |
| ৩। অতিরিক্ত মাথা ব্যথা / খিঁচুনি | ৬। দুর্গন্ধযুক্ত বে নীস্রাব |

■ উপরোক্ত কোন একটি বিপদজনক অবস্থা দেখা দিলে রোগীকে হাসপাতালে রেফার করতে হবে।

(*) UNFPA জাতিসংঘ জনসংখ্যা তহবিলের আর্থিক সহযোগিতায় এম সি এইচ সার্ভিসেস ইউনিট কর্তৃক মুদ্রিত

Appendix - 4 (Diadetic Book-shown partly, BIRDEM)

কেস হিষ্টি

নাম Mrs. Saleha. Akter.

রেফারেন্স নং GDM 3776.

তারিখ 29/7/04

LMP 26-7-04
EOD 1-11-04

রোগের লক্ষণ Routine m.
014. Pan-2 ¹² + 1MR
2. 44. mo 18
ডায়াবেটিস কতদিনের
14/7/04.

পূর্বে চিকিৎসা Diet control.

বয়স 34 yrs.

পুরুষ/মহিলা

উচ্চতা 176cm

ওজন 55kg

বাঞ্ছিত ওজন

Pregnancy
বিএমআই
41-51kg

তাপমাত্রা নাকের গতি 80%
apish

রক্তচাপ: 120/70

শোয়া অবস্থায়

দাঁড়ানো অবস্থায়

অর্থপিণ্ড (mm) ফুসফুস (mm) মকুৎ hp প্লীহা mm স্নায়ুতন্ত্র

দৃষ্টিশক্তি: ডানচোখ 6/9
বাম চোখ 6/9.

ফাভোফোপিক পরীক্ষা hnz. Report after 6
পায়ের রঙ চলাচল ad. ref.

ওষুধের প্রতি এলার্জি unkm.

ল্যাবরেটরী পরীক্ষা

তারিখ 29/12/04 . রক্ত . প্রস্রাব

• ওজিটিটি মিলিমোল/লিটার শর্করা/এলবুমিন
 অভুক্ত 4.0 . 4.2
11.2 . 10.3 } 14.7 . 04 আপেক্ষিক গুরুত্ব
 গ্লুকোজের দুই ঘন্টা পর 7.6 . এসিটোন
 খাওয়ার দুই ঘন্টা পর 7.0 .

হিমোগ্লোবিন এ_{1c} (HbA_{1c})

হিমোগ্লোবিন 11.2 % , টিসি 12600 . সিএমএম, ইএসআর 36 মিমি ১ম ঘন্টার

ডিসি: পলি 76 % , লি 18 % , ম 04 . % , ই 02 % কোলেস্টেরল 210 .

এইচডিএল এলডিএল ট্রাইগ্লিসারাইড এসজিপিটি 12
 সি, ক্রিয়েটিনিন ব্লাড ইউরিয়া সি, এমাইলেজ ব্লাড গ্রুপ B+

অন্যান্য ল্যাবরেটরী পরীক্ষা: H₂, A₁ - repeat

ইসিজি এসসি রে: বুক (পিএ ভিউ) পেট

পেটের অন্ত্রাসনোগ্রাম: 5/5/04 . 13 ± 1 cm . lim

রোগ নির্ণয়: DM .

অন্যান্য পরীক্ষা:

অন্যান্য রোগ:

রক্তের গ্লুকোজ গ্লুকোজ* অক্সিডেজ পদ্ধতি (১ মিলিমোল/লি = ১৮ মি.গ্রা./ডিএল)

উপদেশ ৪

Pregnancy Diet. (2200 calories)

31.7-04.

~~Pregnancy diet~~

✓ Cup Glory

0+1+0.

✓ 1 lb seal 500
1+0+1

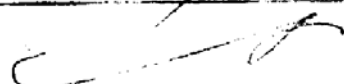
14/8/04 ⑧
FIELD
V-DAL

H6M L
W 17/171E

দ্বিতীয় ভিজিটে করণীয় ৪

ক) রক্ত পরীক্ষার জন্য সময়মতো রক্ত দিন।

খ) সকাল ৯টায় ২২৭ নং কক্ষে দেখা করুন।



DR. MUNEEN ZAMAN
M. B. S. & Obs. Dept.
BIRDE

৫৫

Appendix - 5 (Consent Form)

Patient Information Sheet/ Consent form:

Dear participants,

You have been asked to take part in a research project on Gestational diabetes. The researcher will explain the purpose of the project in details. You are free to ask questions.

Purpose of the study:

- 1.This research will identify the risk factors for gestational diabetes in Bangladeshi women.
- 2.It will also focus on the outcome of the gestational diabetic pregnancies (GDM) in terms of complications, mode of delivery and health of newborn babies born to these mothers.

Who are doing this:

It's a joint project undertaken by the University of Oslo, Norway and BIRDEM, Bangladesh. The person who is responsible for the fieldwork is Dr. Ruhina Tasmin Biswas who is a medical doctor of Bangladesh and is investigating this research .

How will the research be done:

A total of 400 women with GDM pregnancies and 400 women of Non GDM pregnancies will be asked to allow researcher to look on their antenatal and delivery record cards and answer some questions on their demographic, health and pregnancy status for the necessary information required for this study.

What is the benefit coming from this study:

True to say, it may not give any direct benefit instantly but the findings of this research may help to identify women who are at risk of getting GDM and find out the effect of GDM pregnancy which has been noticed as a growing problem in Bangladesh. Thereby it may help to formulate a prevention strategy and screening protocol for GDM pregnancy.

Your right in the study:

Participation in this study will be voluntary and you have full right to withdraw at any period of the investigation. No penalty will be attached to such decisions. On the other hand you can ask question anytime during the study or later and you are asked to feel free to call Ruhina Tasmin Biswas , the person mainly responsible for the field work of this study.(Phone 02 9870671, email . kakon_geology@hotmail.com) The findings will be treated with highest possible degree of confidentiality. Your answers or information will be anonymously documented in this study.

After knowing all these about the research if you still have some other questions you should feel free to ask. If you don't like to participate, you have the full right to do that.

If you agree, your verbal consent will be taken.

Do you agree to take part in this study? Yes. No.

Signature of the interviewer:-

Signature of the witness:-

Participant's code no.-