maternal and perinatal outcome of pregnancy complicated with diabetes among women who give birth in five referral hospitals in Addis Ababa, Ethiopia.

by Mulugeta Desalegn

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Addis Ababa University College of Health Sciences

To assess maternal and perinatal outcome of pregnancy complicated with diabetes among women who give birth in five referral hospitals in Addis Ababa, Ethiopia.

By Mulugeta Desalegn (MD)

September, 2024

Addis Ababa, Ethiopia

A Thesis Report Will Be Submitted To The Department Of Obstetrics And Gynecology, School Of Medicine, College of Health Sciences, Addis Ababa University In Partial Fulfillment Of The Requirements For The Specialty Certificate In Obstetrics And Gynecology.

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The full title of a research project	**To assess maternal and perinatal outcome of pregnancy complicated with diabetes among women who give birth in five referral hospital Addis Ababa, Ethiopia: - Institution based cross sectional study.**
Duration of study	**January / 2023 – May /2024**
Study area	**SPMMC, TASH, ZMH, ALERT Hospital and Abebech Gobena MCH Hospital**
Study cost	**43,375birr**
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APPROVAL SHEET

Addis Ababa University College of Health Sciences, School of Medicine

Department Of Obstetrics and Gynecology

I declare that I have submitted my original work on a title to assess maternal and perinatal outcome of pregnancy complicated with diabetes among women who give birth in five referral hospitals in Addis Ababa, Ethiopia for the examination.

Submitted by:

_____	_____	_____
Name of student	Signature	Date

This thesis work has been submitted for examination with my approval as an advisor.

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Name of First Advisor	Signature	Date

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ABBREVIATIONS AND ACRONYM

A.A: Addis Ababa

AAU: Addis Ababa University

ACOG: American College of Obstetricians and Gynecologists ADA: The American Diabetes Association

ADA: American Diabetic Association

APH: Antepartum Hemorrhage

BMI: Body Mass Index

BSc: Bachelor of Science

CDC: Centers for Disease Control and Prevention

CI: Confidence Interval

CNS: Central Nervous System

CS: Caesarean Section

DIP: Diabetes in Pregnancy

DKA: Diabetic ketoacidosis

DM: Diabetes Mellitus

FBS: Fasting Blood Sugar

FIGO: International Federation of Gynecology and Obstetrics

FMOH: Federal Minster of Health

GA: Gestational Age

GDM: Gestational Diabetes Mellitus

HIP: Hyperglycemia in Pregnancy

HTN: Hypertension

IADPSG: International Association of Diabetes and Pregnancy Study Group

IDF: International Diabetes Federation

IUC: Intensive Care Unit

IUFD: Intra Uterine Fetal Death

LBW: Low Birth Weight

LGA: Large for gestational age

LMCs: Low- and Middle-income Countries

MAS: Meconium Aspiration Syndrome

MD: Doctor of Medicine

MPH: Master of Public Health

MUAC: Mid Upper Arm Circumference

NDDG: National Diabetes Data Group

NICU: Neonatal intensive care unit

OGTT: Oral Glucose Tolerance Test

OR: Odds Ratio

PGDM: Pregestational Diabetes Mellitus

PIH: Pregnancy induced hypertension

PPH: Postpartum hemorrhage

RBS: Random blood sugar

RD: Respiratory Distress

RDS: Respiratory Distress Syndrome

SPHMMC: Saint Paul's hospital millennium medical college

T1DM: Type 1 diabetes mellitus

T2DM: Type 2 diabetes mellitus

TASH: Tikur Anbsa specialized Hospital,

UK: United Kingdom

US: United States

UTI: Urinary Tract Infection

VVC: Vulvovaginal Candidiasis

WHO: World Health Organization

ZMH: Zewditu Memorial Hospital ANC- Antenatal Care

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ABSTRACT

Background – Globally, it is estimated that 16.7% of live births in 2021 had some form of hyperglycemia in pregnancy. Of these, 80.3% were due to gestational diabetes mellitus (GDM). The majority of diabetes cases in pregnancy (87.5%) occur in low- and middle-income nations where access to healthcare is limited. Diabetes adversely affects women and their babies during pregnancy, labor, delivery and postpartum period.

Objectives – The aim of this study is to assess the Maternal and perinatal outcome of Pregnancy complicated with Diabetes mellitus in five referral hospitals in Addis Ababa, Ethiopia, 2024.

Methods – Institutional based cross-sectional study was conducted at TASH, ZMH, ALERT Hospital, Abebech Gobena MCH Hospital and Saint Paul's hospital millennium medical college (SPHMMC). A total of 236 mothers with diabetes were included in the study.

Result- The overall prevalence of diabetes among pregnant women was 1.8%. The prevalence of PGDM, DIP, and GDM in this study was 0.3%, 0.5%, and 0.9% respectively. The most common Antepartum complications seen in this study were Polyhydraminos (15.7%), hypertensive disorder of pregnancy (11.4%) and Hypoglycemia (7.6%). In this study Cesarean delivery was 55.1% and 27.1% underwent Induction of labor. Preterm delivery, NICU admission and macrosomia were 7.6%, 8.9%, and 18.6% respectively. Determining factor for maternal outcome were having history of abortion(AOR = 4.11, 95% CI: 1.29, 13.08), being diagnosed with FBS only(AOR = 4.48 95% CI: 1.02, 19.60), and excessive weight gain during pregnancy(AOR = 4.13 95% CI: 1.13, 15.15). Having poor glycemic control for both GDM and PGDM (AOR=9.53, 95%CI: 2.65, 31.90 and AOR=6.8, 95%CI: 1.35, 34.40 respectively), and being government employee were the determining factor for perinatal outcome (AOR=0.21, 95%CI: 0.05, 0.92).

Conclusion -Maternal and perinatal composite outcome of pregnancy complicated with diabetes in pregnancy is high.

Keyword: – Diabetes, pre-gestational DM, and GDM

1. INTRODUCTION

1.1. Background

Diabetes mellitus (DM) refers to a group of common metabolic disorders that share the phenotype of hyperglycemia. It is caused by a complex interaction of genetics and environmental factors. [1]

ADA classified Diabetes into the following general categories:

1. Type 1 diabetes (due to autoimmune b-cell destruction, usually leading to absolute insulin deficiency, including latent autoimmune diabetes of adulthood)
2. Type 2 diabetes (due to a non-autoimmune progressive loss of adequate b-cell insulin secretion frequently on the background of insulin resistance and metabolic syndrome)
3. Specific types of diabetes due to other causes, e.g., monogenic diabetes syndromes, diseases of the exocrine pancreas, and drug- or chemical-induced diabetes
4. Gestational diabetes mellitus (diabetes diagnosed in the second or third trimester of pregnancy that was not clearly overt diabetes prior to gestation). [2]

According to WHO hyperglycemia in pregnancy (HIP) can be classified as pre-gestational diabetes (includes women with known type 1, type 2, or rarer forms of diabetes before pregnancy), gestational diabetes mellitus (GDM), or diabetes in pregnancy (DIP), abandoning the terminology of overt DM suggested by International Association of the Diabetes and Pregnancy Study Groups (IADPSG).[3] DIP applies to pregnant women with hyperglycemia who were first diagnosed during pregnancy and meet WHO criteria for diabetes in the non-pregnant state. It has been estimated that most cases of HIP are GDM. [3]

According to International Diabetes Federation (IDF) 2021, there are 537 million individuals globally who have diabetes, and 783 million are expected to have diabetes by 2045. In 2021, nearly one in two persons with diabetes was found to be unaware of their condition. Africa has the highest rate of undiagnosed diabetes (53.6%). Despite having the lowest estimated incidence of 4.5% among IDF Regions, Africa is anticipated to have the largest rise in the number of diabetics, 129%, to 55 million by 2045. In terms of the number of adults with diabetes, Ethiopia ranks fourth with 1.9 million, after South Africa, Nigeria, and the United Republic of Tanzania.[4]

According to IDF estimates, 21.1 million live births to women in 2021 had hyperglycemia in some form. 80.3% of these were caused by gestational diabetes mellitus (GDM). The prevalence of HIP varies by Region, with the Southeast Asia Region having the greatest age-adjusted comparative prevalence at 28.0%. The majority of diabetes cases in pregnancy (87.5%) occur in low- and middle-income nations where access to Healthcare is limited. In Africa age adjusted comparative prevalence is 11.4% and 1 in 8 live births are affected by hyperglycemia in pregnancy.[4] There is limited data on the Prevalence of Diabetes in Ethiopia but in one facility-based retrospective cross-sectional study done in 2017 the prevalence of DM in pregnancy where 2.6% (54.6% had gestational diabetes and 45.4% had pre-gestational diabetes). [5]

The diagnosis of Diabetes can be made in four ways in non-pregnant women using WHO and American Diabetic Association (ADA) criteria's:- FBS≥ 126mg/dl or 2-hr Postprandial glucose level≥200mg/dl or HbA1c≥ 6.5% or, RBS ≥200mg/dl with symptoms of Hyperglycemia.[2, 3] But the screening and diagnosis of GDM is unclear despite the introduction of this concept in 1957GC. Who should be screened and methods of screening still unclear but One step method and Universal screening is currently recommended by WHO, IADPSG and FIGO at GA of 24-28weeks but those at increased risk for T2DM should be screened in first trimester best before 12weeks of gestations. Whereas two step approach is recommended by ACOG, and Canadian Diabetes Association.[3, 6-9]

The diagnostic criteria for GDM vary and remain controversial, complicating the comparison of research data. There has been a move towards the diagnostic criteria advocated by the IADPSG/WHO and this has resulted in a general increase in the overall prevalence of GDM.[10, 11] Typically, an OGTT is performed by measuring the plasma glucose concentration while fasting and one and two hours after ingesting 75-grams of glucose. Some of the commonly used diagnostic criteria's for GDM are listed below in table-1. Ethiopian Minster of health recommends universal 75gm OGTT screening in 2020 updated guidelines.

Commonly reported risk factors for GDM are Previous pregnancy history of GDM, delivery of an infant weighing 4000 g or more, women with a history of impaired glucose metabolism or cardiovascular disease, those with Pre-pregnancy BMI ≥30 kg/m2, significant weight gain in early adulthood or between pregnancies, or excessive gestational weight gain during the

first 18 to 24 weeks of pregnancy, sedentary lifestyle, women with a history of hypertension or polycystic ovary syndrome, or a first-degree relative with diabetes, and race or ethnicity.[12, 13]

Diabetes adversely affects women and their babies during pregnancy, labor, delivery and postpartum period. Maternal complications can be antepartum, like pregnancy-induced Hypertension, Preterm delivery, maternal infections (UTI, vulvovaginitis), Polyhydraminos, DKA, hypoglycemia, and progression of vasculopathy. Intrapartum complications like Cesarean delivery, Labor induction, Birth trauma, shoulder dystocia, PPH, and labor abnormalities postpartum complications like Interruption of breast feeding, Mental illness, and T2DM.

Perinatal outcomes commonly associated with diabetes in pregnancy are Congenital anomalies, stillbirth, Macrosomia and Large for Gestational age, Fetal Growth restriction, Birth trauma, Low 5th min APGAR Score, Neonatal Hyperglycemia and Hypoglycemia, Polycythemia, RDS, Prematurity, neonatal Jaundice, NICU admission, and perinatal Mortality. Long term complications like increased risk of T2DM and impaired neurocognitive functions were also reported.

However, some of the adverse pregnancy outcomes associated with DM can be prevented. Preconception counseling for women with established DM, maintenance of tight glycemic control during pregnancy with lifestyle modification and hypoglycemic agents, a medical team approach to care, and close surveillance during the antepartum, intrapartum, and postpartum periods can reduce the incidence of adverse outcomes. Optimal care has considerably decreased the perinatal mortality rate for pregnancies complicated by DM. [14]

Table 1.Common Screening and diagnostic criteria for Diabetes in pregnancy

Serial Number	Organization	Screening test	Diagnostic Criteria Plasma or serum: mg/dL (mmol/L)		Remark
1	IADPSG and ADA	two-hour 75-gram oral glucose tolerance test	Fasting	92 (5.1)	A positive test is generally defined as ≥1 glucose values at or above these thresholds.
			One hour	180(10)	
			Two hour	153 (8.5)	
2	Carpenter/Coustan	three-hour 100 gram oral GTT	Fasting	95 (5.3)	A positive test is generally defined as ≥2 glucose values at or above these thresholds.
			One hour	180 (10)	
			Two hours	155 (8.6)	
			Three hours	140 (7.8)	
3	National Diabetes Data Group	three-hour 100 gram oral GTT	Fasting	105 (5.8)	A positive test is generally defined as ≥2 glucose values at or above these thresholds.
			One hour	190 (10.6)	
			Two hours	165 (9.2)	
			Three hours	145 (8)	
4	World Health Organization (WHO) (2013)	two-hour 75 gram oral GTT	Fasting	92 to 125 (5.1 to 6.9)	A positive test is generally defined as ≥1 glucose values at or above these thresholds.
			One hour	≥180 (10)	
			Two hours	153 to 199 (8.5 to 11)	

1.2. Statement of the problem

According to the 2009 World Health Organization study, high blood pressure (13% of deaths worldwide), tobacco use (9%), high blood glucose (6%), physical inactivity (6%), and overweight and obesity (5%) are the top global risks for mortality. [15]

Despite having the lowest estimated incidence of diabetes (4.5%) in IDF Regions, Africa has the highest rate of undiagnosed diabetes (53.6%). Africa is anticipated to have the largest rise in the number of diabetics by 2045. In terms of the number of adults with diabetes, Ethiopia ranks fourth with 1.9 million. [4] Diabetes mellitus is one of the most common medical disorders during pregnancy and the majority of diabetes cases in pregnancy (87.5%) occur in low- and middle-income nations where access to healthcare is limited.[16] In Africa, the age-adjusted comparative prevalence is 11.4%, and 1 in 8 live births are affected by hyperglycemia in pregnancy. [4]

Pregnancy complications for a diabetic mother and her fetus include miscarriage, pre-eclampsia, infections, abnormal labor, and postpartum hemorrhage for the mother. Preterm births, stillbirths, congenital abnormalities, macrosomia, fetal growth restriction, birth traumas, and, in the worst-case scenario, stillbirths are common fetal problems. Perinatal complications have been linked to pre-existing diabetes and GDM. These include an increased NICU admission rate and a low 5-minute APGAR score. Birth injury and metabolic complications like newborn hypoglycemia, hyperbilirubinemia, and hypocalcemia. Gestational diabetes mellitus contributes to the rising type 2 diabetes epidemics, both in mothers and children. It is a momentary phenomenon for the pregnant mother, but they are at higher risk for developing type 2 diabetes in their future lives, and the tendency of their children to develop obesity as young children and type 2 diabetes later on is found to be higher.

Appropriate diagnosis, care, and management of diabetes mellitus in the pre-pregnancy, antepartum, intrapartum, and post-partum periods are important to minimize short- and long-term complications for the mother and her baby.[14] Therefore, this study will assess the maternal and perinatal outcome of pregnancy complicated by diabetes in Addis Ababa, Ethiopia.

1.3. Significances of the study

DM in pregnancy adversely affects the woman and the newborn. While it was studied extensively in developed countries, the literature in our country is limited, and the characteristics of obstetrics and the perinatal outcome of DM in pregnancy are unclear in our setup.

A better understanding of the obstetric and perinatal statistics of DM in pregnancy is needed so that both clinical and public health efforts can be appropriately directed.

The FMOH guideline was updated in 2020 and adopted the recent WHO/IADPSG diagnostic criteria. Studies are limited after this guideline changes. Hence, these study will evaluated the prevalence, characteristics, and outcomes of pregnancies complicated with DM in the three teaching hospitals in A.A. to this guideline change.

Since the three teaching hospitals selected for the study are tertiary hospitals with multi-Subspecialty teams like Maternal and fetal medicine subspecialists, endocrinologists, and neonatologists, the result of this study shows our current practices and may be used as input to identify gaps and help improve our practices. It can also be used as a base for future research and can be generalized to other tertiary hospitals. And finally, alert health care providers, and policymakers to the problem.

2. Literature review

2.2. Prevalence

The International Diabetes Federation estimates that 16.7% of live births to women in 2021 had some form of Hyperglycemia in Pregnancy. Of this, GDM accounts for 80.3%, Diabetes first detected in pregnancy accounts for 9.1%, and the remaining 10.6% are pre-gestational Diabetes. In this report, the highest prevalence was detected in Southeast Asia with an age-adjusted prevalence of 28%, and the lowest prevalence was in the Middle East and North Africa countries (8.6%). In Africa, there were 4.1 million live births affected (13%).[4]

Pre-gestational Diabetes

In the CDC report on trends for pre-gestational DM in the United States from 2016 to 2021, the overall rate was 10.9% per 1000 births; there was a 27% increase in prevalence from the 2016 report. [17] Population-based Studies done in Canada, Spain, the UK, Australia, and Italy found the prevalence of Pre-gestational Diabetes to be 1.5%, 0.52%, 0.85%, 0.3%, and 0.48%, respectively. T2DM is more common than T1DM, except in the study done in Australia, where T1DM accounts for 57% of Pre-gestational Diabetes.[18-22]

RAHMA, the first large multicenter cohort study that investigates prevalence and pregnancy outcomes in pregnancy complicated with Diabetes in Saudi Arabia, found that in 2017, the prevalence of Pre-gestational diabetes was 4.3% and that of GDM was 24.2%.[23]

There are Limited studies on Pre-gestational Diabetes in Africa, but in one study done to assess the burden of Diabetes in low and middle-income countries; the prevalence of Pre-gestational diabetes was 0.2% to 0.7%.[16] In a retrospective case review done in from 1990 to 1999, the prevalence of Diabetes in pregnancy was 1.7%, and pre-gestational diabetes accounted for 39%.[24]

In studies done in Addis Ababa and southern Ethiopia, the prevalence of pre-gestational diabetes is 0.4% and 2.8% respectively.[13, 25] In another institution-based retrospective cross-sectional study done in TASH, the prevalence of Diabetes in pregnancy was 2.6%, and pre-gestational diabetes accounted for 45.4% of the cases.[5]

Gestational Diabetes mellitus

Comparing the prevalence of GDM across nations has proven challenging due to variations in screening methods and diagnostic standards.

In the CDC 2021 report, the prevalence of GDM was 8.3%. In another CDC report that assesses the trend in prevalence of GDM in 2020, the prevalence of GDM in the US shows an increase of 30% from 2016.[26] In a systematic review and meta-analysis done to determine the prevalence and risk factors of gestational diabetes mellitus in Turkey, More than 50,000 pregnant women were included in the 41 studies that were analyzed, and the pooled GDM prevalence was 7.7% (range: 1.9%–27.9%). The Central Anatolian Region had the lowest total GDM prevalence (5.1%), while the Black Sea Region had the highest (17.6%). In population-based Cohort Studies done in Spain and Denmark, the prevalence of GDM ranged from 2.3% to 6.53%, and both studies showed an increase in the prevalence of GDM over the study period.[27]

More than 2.3 million pregnant women from 20 different countries were included in a systematic review and meta-analysis evaluating the incidence and risk factors of gestational diabetes mellitus in Asia. The pooled prevalence of GDM in Asia was 11.5%. Taiwan (38.6%), Hong Kong (32.5%), and Saudi Arabia (22.9%) had the greatest incidence rates. The countries with the lowest rates of GDM were Nepal (1.5%) and Japan (2.8%). [28]

In a systematic review and meta-analysis done to assess the prevalence of GDM involving studies in 13 African countries, the pooled prevalence of GDM was 13.61%, and in a sub-analysis of the study, the prevalence of GDM in sub-Saharan Africa was 14.28%.[29] Another systematic review and meta-analysis were done to assess the burden, risk factors, and maternal and offspring outcomes of GDM in sub-Saharan Africa. 23 studies from 10 countries were reviewed, and the overall prevalence of GDM was 9%. The prevalence increased from 3% in 1969 to 2009 to 13% in 2010 to 2018. In sub-analysis, the prevalence increased to 16% if WHO 2013/IADPSA criteria were used to diagnose GDM.[30] In another study done in SSA to assess the different diagnostic criteria for GDM implementing universal screening, the

prevalence of GDM was 8.1% using WHO 2013 criteria, and 20% of GDM cases would be missed if Selective screening was implemented.[10]

In other studies, done in Kenya, Rwanda, Nigeria, and Tanzania, the prevalence of GDM was 2.9%, 8.3%, 11%, and 19.5%, respectively.[31-34]

A systematic review and meta-analysis were done in Ethiopia to assess the prevalence and determining factors of GDM. The pooled prevalence of GDM was 12.04%, the highest rate seen in Addis Ababa.[35] In a prospective cohort study done in Goba town, the cumulative incidence rate was 15.7%.[36] Other studies done at Hadiya Zone, Gondar, and St. Paul Hospital showed 26.2%, 12.8%, and 16.9%, respectively.[37-39]

2.2 Maternal and Perinatal Outcome

Maternal hyperglycemia leads to fetal hyperglycemia and is responsible for the significantly increased likelihood of complications seen in pregnancies complicated by diabetes.

Some of the determining factors or adverse pregnancy outcomes are Pre-pregnancy BMI > 30kg/m^2, weight gain during pregnancy, poor glycemic control, early diagnosis of GDM (Before 24week of gestation), Pre-pregnancy Diabetes, Gestational age at delivery and Pregnancy induced HTN.[40-45]

There are multiple studies that state Pre-pregnancy DM is associated with a poorer adverse pregnancy outcome than GDM. But there is conflicting evidence comparing T1DM to T2DM.

- Systemic review and meta-analysis done worldwide from 1987 to 2008 Thirty-three studies worldwide were evaluated to evaluate maternal and fetal outcomes in women with T2DM verses T1DM. Women with type 2 DM had a higher risk of perinatal mortality (odds ratio (OR) 1.50, 95% confidence interval (CI) 1.15–1.96) and less diabetic ketoacidosis (OR 0.09, 95% CI 0.02–0.34) and cesarean section (OR 0.80, 95% CI 0.59–0.94). Without significant differences in the rates of major congenital malformations, stillbirth, and neonatal mortality.[45]

- A retrospective study involving 206,917 singleton live births was conducted in Tuscany, Italy, from 2010 to 2018 to evaluate pregnancy outcomes and maternal characteristics in women with pre- and gestational diabetes. Fetal anomalies (1.6% vs 0.9%), LGA(14.7% vs 12.5%), Macrosomia(9.9% vs 7.1%), a 5-min-Apgar score <7(5.4% vs 2.5%), preterm births(51.2% vs 25.6%), and cesarean sections (68.2% vs. 48.2%) were considerably more common in pregnancies with pre-gestational T1DM.[22]
- Multi-centric Cohort study involving near to 10,000 women to assess the prevalence and Complications of Pre-gestational and Gestational Diabetes in Saudi Women, pregnancy outcomes except for preterm delivery (32% vs 21.2%) were comparable between T1DM and T2DM.[23]
- In a retrospective cohort study done at King Khalid University Hospital in 2008, there were no significant differences in the outcomes between pregnancies complicated by T1DM and T2DM except for the previous miscarriage (31.95 vs 14.7%), which was significantly more frequent among women with T2DM.[46]

2.2.1Maternal Outcome

A Scoping Review of Gestational Diabetes Mellitus in Southeast Asia: Several studies reported high cesarean-section rates (3 studies) and an increase in hypertensive disorders (4 studies) compared to non-GDM women. The incidence of shoulder dystocia has been reported in Thailand. Another GDM-related complication that is widely observed is postpartum Diabetes (4 studies). It is common in obese mothers, multigravida, high FBS at diagnosis, age > 35 years, insulin treatment, and an abnormal HbA1c level. The interruption of breastfeeding has also been considered a complication among Southeast Asian women with GDM. Women with GDM had the highest prevalence of anxiety symptoms (39.9%), followed by depressive symptoms (12.5%) and stress symptoms (10.6%). Factors such as young age, being asthmatic, and having a family history of depression and anxiety had significant associations with antenatal anxiety symptoms in women with GDM.[40] But a large population-based cohort study done in Canada did not find an increase in risk for new-onset mental illness during pregnancy or postpartum.[47]

A multi-ethnic cohort study involving 4,873 women attending a university hospital antenatal diabetes clinic between 1991 and 2011 in Sydney, New South Wales, Australia, was examined in Gestational Diabetes Mellitus in Early Pregnancy: Evidence for Poor Pregnancy Outcomes Despite Treatment Outcomes: Hypertensive disorders in pregnancy, including pre-eclampsia (34.6% vs 26.3%), preterm delivery (25.9% vs 16.7%), and cesarean section (57.9% vs 30.7%), were more prevalent in women with pre-existing diabetes and early GDM. Postpartum OGTT: Performed 3 months postpartum, early GDM is associated with higher persisting postpartum dysglycemia (impaired glucose tolerance and diabetes) than Late GDM (diagnosed after 24 weeks)(21% vs 15%).[42]

Population-based cohort study including all singleton pregnancies in Denmark and California They are at higher risk for preeclampsia (8.2%) and pyelonephritis (2.82 times). In terms of delivery-related risks, subjects with PGDM had a higher chance of undergoing cesarean delivery (31%), a failed induction (1.18 times), or shoulder dystocia (1.4 times). PGDM subjects had a slightly longer mean length of stay than those with GDM (3.73±3.9 days). In the Denmark study, postpartum hemorrhage was similar in the two groups, and dividing the risk of hemorrhage into vaginal and cesarean births did not alter this conclusion. Whereas in the California report, teenagers with PGDM compared to those with GDM were found to have higher adjusted rates of thyroid dysfunction (3.33 times), preterm delivery (2.21 times), preeclampsia (4.98 times), chronic hypertension (1.39 times), and cesarean delivery (1.39 times). PGDM teenagers had lower rates of post-term delivery (OR 0.27, 95% CI 0.15–0.48) and postpartum hemorrhage (OR 0.53, 0.30–0.94).[48, 49] Also, a study done in China didn't find statistical significance for the risks of postpartum hemorrhage, APH, and Labor dystocia.[41] Other studies done in Italy, Spain, Sweden, and Africa support the above findings.[19, 22, 30, 44, 50-52]

In Studies done in Ethiopia, the commonest maternal complications were PIH (28.5%), increased C/D (61.8%), Preterm delivery (17.9%), and Birth trauma (2%), whereas DKA(2.5%), Polyhydramnios (1.4%), hypothyroidism (1.7%), and IUC admission(32.1%) were less commonly reported complications.[5, 13, 25, 53]

2.2.3. Perinatal Outcome

The incidence of major malformations in the fetuses of women with Pre-gestational Diabetes is higher than in non-diabetic mothers. In a population-based cohort study involving more than 1.1 million women who delivered in Ontario, Canada, women with pre-GDM and GDM had a higher risk of offspring with congenital anomalies, and women with pre-GDM experienced the greatest risk (62.4 per 1,000 births in women with pre-GDM, 37.5 per 1,000 births in women with GDM, and 29.04 per 1,000 births in non-diabetic women). Over the study period, the rate of congenital anomalies declined by 23% in women with pre-GDM and by 20% in women with GDM. In 2010, offspring of women with pre-GDM experienced an almost twofold increased risk of congenital anomalies, and women with GDM were at a 26% increased risk of having an offspring with a congenital anomaly compared with women without diabetes.[18] Another study conducted in England found that 90 per 1,000 live births had a major congenital anomaly, with 72% surviving the neonatal period. In a report from an Italian study, pre-existing T1Diabetes patients had a roughly threefold increased incidence of fetal abnormalities.[22] Fetal CNS abnormalities, Cardiac anomalies (cyanotic heart disease, interatrial and ventricular septal defects), Cleft Lip and Palate, Cleft Palate Alone, Hypospadias, and Limb Reduction Defects are common anomalies linked to Pre-gestational Diabetes. Malformations of the digestive system, Genito-urinary system, and chromosomal anomalies were also described.[54]

A population-based cohort study in Germany, and Denmark Neonates of women with diabetes were more often delivered prematurely (12%) and were at increased risk of being macrosomia (8%), hypoglycemia (20.3%) and NICU admission were higher (46.4%). GDM didn't influence the prevalence of Low Apgar score at 5 minutes, intrauterine death, congenital malformations, respiratory distress syndrome, premature labor, or premature rupture of membranes. [55, 56]An institution-based cross-sectional study has demonstrated that the newborns of Fijian mothers with GDM had significant negative outcomes, notably macrosomia, hypoglycemia, and Low Apgar scores. Women who are overweight or obese, those who had a prior child that weighed more than 4 kg, those who delivered prematurely, those who had pre-eclampsia, and those who scheduled their pregnancies later than 13 weeks are at higher risk.[43]

There is some evidence that gestational diabetes mellitus (GDM) increases the risk that a child would become obese and have impaired glucose tolerance as adults, and that poorly managed maternal diabetes during pregnancy may have an influence on the newborn's neurodevelopment outcome. However, the data is weak and of poor quality.[14, 57]Similar studies done in Europe (Spain, Italy, and Sweden), Asia, Saudi Arabia, and Nigeria report similar findings.[19, 22, 23, 28, 33, 44, 50, 58, 59]In studies done in Ethiopia, the commonly reported fetal outcomes are Macrosomia (17.6%) low 5th minute Apgar score (23.7%), RDS (9.2%), Low Birth weight (10.1%), and stillbirth (2.7%), and NICU admission (65%). [5, 25, 60] One prospective follow-up study done in three teaching hospitals in Addis Ababa reported more than half of neonates (53.4%) were referred to neonatal intensive care unit because of prematurity. Hypoglycemia, Jaundice, RDS and birth injury were seen in 6.8%, 4.1%, 10.9% and 1.4% respectively.[25]

2.3. Conceptual framework

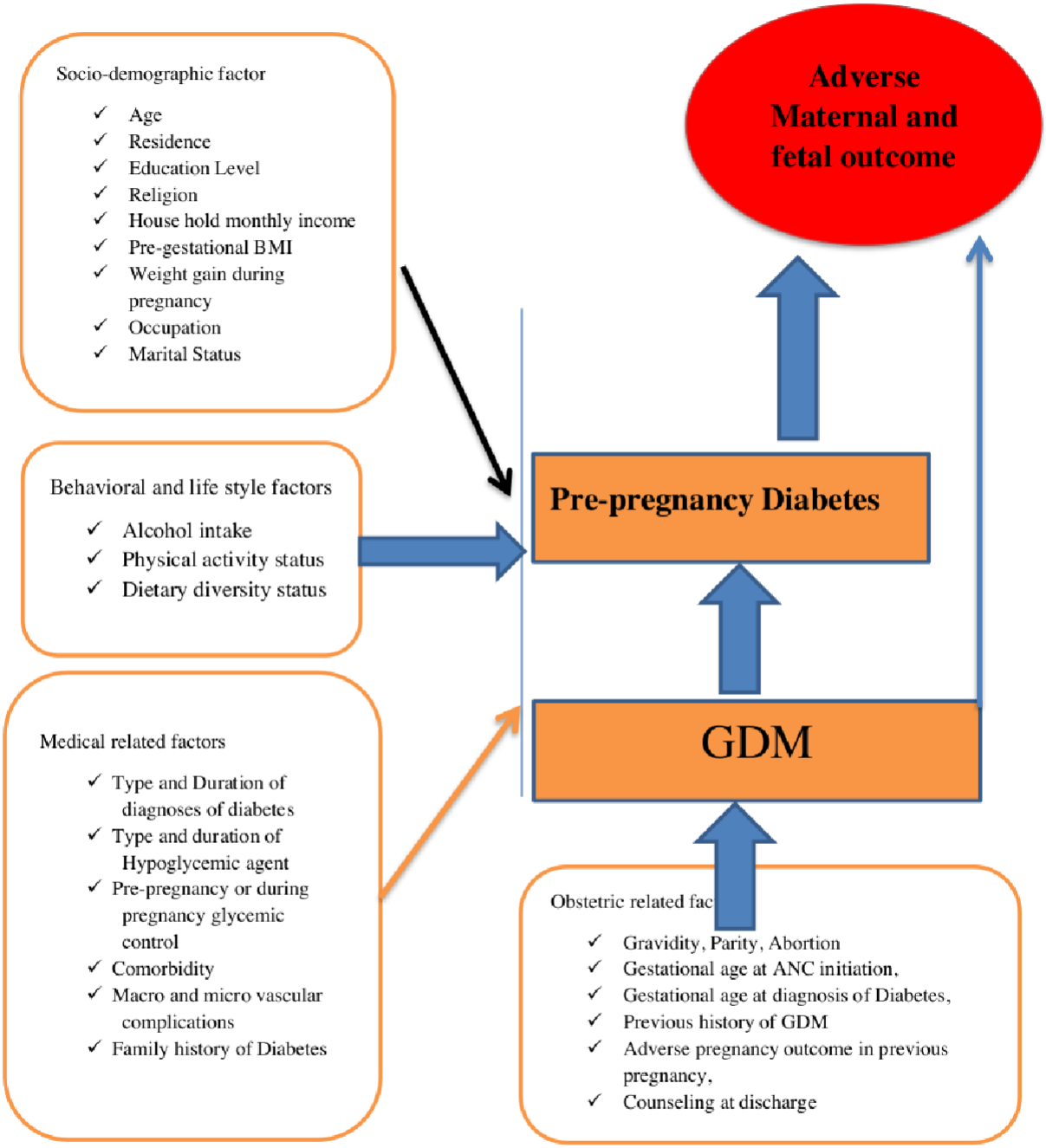

Figure 1 .Conceptual Framework of factors affecting maternal and perinatal outcome of pregnancy complicated with diabetes

3. Objective

General objective

- To assess the Maternal and perinatal outcome of Pregnancy complicated with Diabetes who delivered in five referral hospitals in Addis Ababa, Ethiopia.

Specific objective

- To determine the prevalence of Diabetes among pregnant women who delivered in five referral hospitals in Addis Ababa, Ethiopia.
- To assess the maternal complications and determinant factors of Pregnancy complicated with diabetes among pregnant women who delivered in five referral hospitals in Addis Ababa, Ethiopia.
- To assess the perinatal outcome and determinates of Pregnancy complicated with diabetes among pregnant women who delivered in five referral hospital in Addis Ababa, Ethiopia.
- To compare maternal and perinatal outcomes between pregnancies complicated with GDM, DIP and pre-gestational diabetes among pregnant women who delivered in five referral hospitals in Addis Ababa, Ethiopia.

4. Method

4.1. Study design

Institutional based cross-sectional study design was conducted to assess the Maternal and perinatal outcome of Pregnancy complicated with Diabetes in five referral hospitals in Addis Ababa, Ethiopia.

4.2. Study area and period

The study area was conducted in Labor ward and postnatal wards (TASH, ZMH, ALERT hospital Abebech Gobena MCH Hospital and SPHMMC) in Addis Ababa, Ethiopia. Addis Ababa is the capital city of Ethiopia, a country in the horn of Africa. The capital city holds 527 kilometers of area and is at an elevation of 2,355 meters above sea level. Addis Ababa's 2023 population is estimated at 5,461,000 according to United Nations World Urbanization Prospects.[61]

Regarding medical service, currently the city has more than 41 hospitals, 28 health centers, 35 health posts and more than 500 clinics. There are more than 12 publics and more than 25 private hospitals in the city. Of the total 12 public hospitals TASH, ZMH , ALERT hospital Abebech Gobena MCH Hospital and SPHMMC, which are the leading referral hospitals with multiple Sub-specialization programs like Maternal and Fetal Medicine, Neonatologist and Endocrinologist. They are selected due to high number of annual delivery and give antepartum, intrapartum and postpartum care including cesarean delivery service for 24hours of the day.

The study was conducted from January 2024 to May 2024.

4.3. Source Population

All mothers who delivered in five referral hospitals of Addis Ababa during the study period

4.4. Study population

All mothers who diagnosed with pre-gestational, DIP or GDM and delivered in five referral hospitals of Addis Ababa during the study period

4.5 Eligibility criteria

4.5.1. Inclusion Criteria

All mothers who diagnosed with pre-gestational, DIP, or GDM, and delivered in five referral hospitals of Addis Ababa in the study period

- With largely complete data for the study.
- With gestational age of 28 or more weeks from date or early ultrasound.
- Was willing to participate.

4.5.2. Exclusion criteria

- Multiple gestations with all type of diabetics
- Those mothers who were not consenting for study
- Mothers who were critically sick

4.6. Sample size determination

The sample size required for this study was calculated based on a single population proportions formula as follows.

$$n = \frac{Z^{\alpha}/_{2}{}^{2} P(1-P)}{d^2}$$

Where: n = desired sample size

z = z value at 95% confidence interval (CI)

p = prevalence of Diabetes in Pregnancy

d = margin of error

The Z value at 95% CI is 1.96 (from significance level α = 5%). Since, there is no similar recent study done on prevalence Diabetes in pregnancy at country level, so I used the IDF estimated prevalence making the P value 16.7 %, the tolerated margin of error is 5%. Therefore

$$n = \frac{(1.96)^2 0.167(1-0.167)}{0.05^2}$$

= 214

Adding 10% non-response rate the total sample size calculated was 236 participants

4.7 Sampling Procedure

The calculated sample size was proportionally allocated to the hospitals based on the number of cases delivered for the past 3 month.

Simple consecutive sampling technique was used to include all diabetic pregnant mothers who fulfill the inclusion criteria and who come for the delivery service in the five referral hospitals were selected till the required sample size is assured.

4.8 Study Variables and measurement

4.8.1 Dependent variable

Maternal Outcome;

- Antepartum:- HTN, APH, preterm delivery ,polyhydramnios, oligohydramnios, infection(types UTI,VVC), disease progression, DKA, hypoglycemia
- Intrapartum :- Shoulder dystocia, birth injury ,labor dystocia, induction and augmentation of labor ,
- Postpartum: - PPH (tear/atony), mental illness, interruption of breast feeding, hypo/hyperglycemia,

Fetal and Neonatal outcome:

- Gross/Congenital anomaly or prenatal US , IUFD, macrosomia /LGA, FGR ,low 5^{th} min APGAR score, hypoglycemia, hyperglycemia neonatal jaundice, birth injury, prematurity, NICU admission,

4.8.2 Independent Variables

- Socio-demographic factor --age, residence, education level, house hold monthly income, pre-gestational BMI, weight gain during pregnancy, occupation, marital status,
- Obstetric related factor -gravidity, parity, abortion, gestational age at anc initiation, gestational age at diagnosis of diabetes, previous history of gdm, adverse pregnancy outcome in previous pregnancy

- Medical related factors -Duration of diagnoses of diabetes, type of DM ,type and duration of treatment , pre-pregnancy or during pregnancy glycemic control ,comorbidity, macro and micro vascular complications

4.9 Operational definitions

- Diabetes types, diagnosis, clinical finding and management are based on the clinical record findings entered by the attending Physician/s. Some variables not included in the clinical record will be sought by interviewing the participants.
- NICU admission is considered if the neonate is kept for a day or more & managed for other than observation.
- Interruption of breast feeding is considered, if only not done for medical reason only.
- Maternal composite of outcomes is HTN, APH, polyhydramnios, oligohydramnios, infection(types UTI,VVC), disease progression, DKA, hypoglycemia, shoulder dystocia, birth injury ,labor dystocia, induction and augmentation of labor, PPH (tear/atony), mental illness, interruption of breast feeding, hypo/hyperglycemia,
- Neonatal composit of outcomes includes Gross/Congenital anomaly or prenatal US , IUFD, Macrosomia /LGA, FGR ,low 5th min APGAR score, hypoglycemia, hyperglycemia neonatal jaundice, birth injury, prematurity, NICU admission, RD due to RDS/MAS.

4.10 Method of data collection

The socio demographic and clinical variables was collected using a semi structured questionnaire (attached annex III) after taking written informed consent (attached annex II); data was collected through both face-to-face interview while the participants are comfortable and maternal chart review. Newborns sent for evaluation or admitted to NICU data was collected from NICU admission logbook and review of newborn chart. For those mother who lost their children was interviewed & consent is taken empathetically when they were comfortable (if needed by the principal researcher). If any one of the participants were found to be depressed or emotionally disturbed, the interview (including consent ascertainment) won't be undertaken and she was linked to the hospital psychiatry service available in each hospital after discussing with attending physician/s. The participants were interviewed before day of discharge.

The questionnaire was taken from different literatures and modified and were pretested 5% of the sample size in a health facility outside the five referral hospital. It was first prepared in English and translated in to Amharic language by language experts, and then translated back to English by a third person to check for consistency.

The data was gathered by 5 BSc midwives who are not part of the managing team for the mother and supervised by Resident with MPH. The five data collectors were trained for 2 day about the contents of the questionnaire and on how to collect the data properly in order to minimize errors. They were also trained about the consent process and identifying participants with emotional problem. Principal investigator was present on the spot to check and review all the completed questionnaires; and to ensure completeness and consistency of the information collected then questionnaires were daily filled after reviewed by the principal investigator.

4.11 Data quality control

All of the questionnaires were checked for completeness and accuracy before the period of data entry by Principal investigator. Throughout the course of the data collection, interviewers were supervised, regular meetings was held between the data collectors and the principal investigator together in which problematic issues arising from interviews during the data collection and mistakes found during editing were considered. The collected data had been again reviewed and checked for completeness before data entry.

4.12Data analysis and interpretation

The collected data was checked EPIINFO for completeness and any incomplete or misfiled questions were excluded from the study. Then, the clean and complete data was entered and analysis was made by using SPSS version 25.0 software. Descriptive statistics was done and presented using tables and figures. Initially, bivariate logistic regression was carried out to see the association of each of the independent variables with the outcome variable. All the independent variable having a p-value<0.25 were transferred to multivariate logistic regression and P- Value of <0.05 and 95% confidence level was used to assure statistical significance in the multivariable analysis. Odds ratio with 95% confidence interval was reported as a measure of association. Data entry format template was prepared and filled by principal investigator.

4.13 Ethical consideration

Ethical clearance was first obtained from DRPC of the obstetrics and gynecology department, Addis Ababa University, College of Health Science. Then, the ethical clearance and support letter was taken to the selected hospitals to obtain permission and cooperation during the data collection process.

Informed consent: All mothers were informed about the purpose, benefits, and risks of the study being the anonymity and the right to refuse at any stage of the interview and procedure (using the information sheet, ANNEX I). We collected written consent (ANNEX II) from all mothers before starting any component of data collection using.

Benefits: There was no direct benefit to the facility or participants in participating in this study. However, the information we gained is expected to help service providers and policy makers working in maternal and newborn health to have information for service and program improvement which in turn is important to ensure better health of mothers and newborns. For those mother who were not counseled on danger signs, follow up and diabetes care the interviewer communicated with the managing physician to provide the care.

Possible Risks: There was no risk related to involvement in this study except for a few minutes devoted to respond the questions.

Confidentiality: During data extraction, the names of mothers were not included so that information obtained was kept confidential. The information was used only for the study purpose. The hard copy of the data is kept in a locked cabinet and the soft copy is password protected.

Privacy: All possible measures was taken to assure the privacy of mothers during data collection.

4.14 Dissemination plan and use of findings

The result of the study will be presented to TASH, department of obstetrics and gynecology. The final report will be submitted to TASH, St Paul Medical College, ALERT hospital, Abebech Gobena MCH Hospital and ZMH. Moreover, efforts will be done to publish the findings of the study and disseminate through different journals and scientific publications.

4.15. Limitation of the study

The study is Institution based study in tertiary hospital in Addis Ababa making it difficult to generalize for the general population and non-referral Hospitals. Also the study is cross sectional, causal relationship could not be established.

5. Result

A total of 236 pregnant women having DM and delivered were selected from a total of 13, 248 mother (TASH=1984 , ALERT hospital=3044 , Abebech Gobena MCH hospital = 3110, St Paul's Hospital Millennium Medical College=3049, ZMH= 2061) who delivered at the five referral hospitals in Addis Ababa during the study period . All the recruited participants gave their consent & included in the study (100% response).

The overall prevalence of DM among all the deliveries was 7.6%. Forty (16.9%), 71(39.1%), and 196 (53%) of the participants had PGDM, DIP & GDM, respectively.

5.1. Study Setting

The majority are from Tikur Anbessa Specialized Hospital and Alert Hospital accounting for 26.7% and 22.9% respectively; whereas Zewditu Memorial Hospital, St Paul's Hospital Millennium Medical College and Abebech Gobena MCH Hospital account for 21.2%, 18.6%, and 10.6%, respectively. (Table.2)

Table 2.Study setting and distribution in type of Diabetes of the study participants

Variable	Category	PGDM	GDM	DIP	Total
		No (%)	No (%)	No (%)	No (%)
Study setting	TASH	9(14.3)	41(65.1)	13 (20.6)	63(26.7)
	ZMH	5(10)	31(62)	14(28)	50(21.2)
	St Paul	5(11.4)	35(79.5)	4(9.1)	44(18.6)
	Alert	21(38.9)	1(1.9)	32(59.3)	54(22.9)
	Abebech Gobena	0(0)	17(68)	8(32)	25(10.6)
Total		40(16.9)	125(53)	71(30.1)	236(100)

The 75gm OGTT was the major screening method used in all hospitals except Alert Hospital that used FBS only in most of the DM diagnosis (n=27, 81.8%). The majority of the participants were managed with dietary modification and exercise in all hospitals but Oral hypoglycemic agents where used more frequently in ALERT hospital (n=5, 15.2%) and St Paul's hospital millennium medical college (n=4, 10.3%).While maternal composite outcome the poorest at St Paul's hospital millennium medical college (n=22, 50%) and ALERT hospital (n=36, 66.7%), the perinatal outcome was the poorest at ZMH (n=22, 44%). ALERT Hospital had the lowest poor perinatal outcome (n=8, 14.8%) . (Table 2)

Table 3.Comparison between screening method, treatment and pregnancy outcome in the Study setting

Variable	Category	Screening Methods			Main treatment during pregnancy for GDM and DIP			Composite Outcome	
		75gm OGTT	100gm OGTT	FBS	Oral Hypoglycemic Agent	Insulin	dietary modification and exercise	Poor maternal composite outcome	Poor perinatal composite outcome
		No (%)	No(%)	No(%)	No (%)	No (%)	No (%)	No (%)	No (%)
Study setting	TASH	50(92.6)	0(0)	4(7.4)	0(0)	16(29.6)	38(70.4)	30(47.6)	21(33.3)
	ZMH	40(88.9)	0(0)	5(11.1)	1(2.2)	19(42.2)	25(55.6)	19(38)	22(44)
	St Paul	35(89.7)	3(7.7)	1(2.6)	4(10.3)	6(15.4)	29(74.4)	22(50)	16(36.4)
	Alert	6(18.2)	0(0)	27(81.8)	5(15.2)	3(9.1)	25(75.8)	36(66.7)	8(14.8)
	Abebech Gobena	18(72)	6(24)	1(4)	0(0)	9(36)	16(64)	9(36)	8(32)

5.2 Sociodemographic characteristics of the study participants

Most of the participants were 35years old and above (n=138, 58.5%), Addis Ababa residents (n=223, 94.5%), married (n=226, 95.8%) and had above secondary school education (n=85, 36%). For the study participants, 57.2 %(n=135) were housewives and 78.4 %(n=185) had a monthly income above 7000ETB. There was no significant statistical difference in the sociodemographic characteristics considered except age, occupation, and marital status.

The average ages of the participants were 30.54± 4.21 years, and PGDM (31.68yrs) groups had a slightly higher average age group compared to GDM (30.65yrs) and DIP (29.72yrs) groups. Age 35years and above showed a significant increasing poor maternal and perinatal composite outcome in bivariate analysis with P-value of 0.04 and 0.15, respectively. Being a government employee and non-married were also associated with perinatal and maternal outcomes with p-value of 0.24 and 0.23, respectively.

Table 4.The sociodemographic characteristics of the study participants who give birth in the selected hospital in Addis Ababa, Ethiopia, 2024.

Variable	Category	PGDM	GDM	DIP	Total	Maternal composite outcome	Perinatal composite outcome
		No(%)	No (%)	No (%)	No (%)	P-value(95%CI)	P-value(95%CI)
Age in	<30	14(14.3)	49(50)	35(35.7)	98(41.5)	1	1
	>=30	26(18.8)	76(55.1)	36(26.1)	138(58.5)	0.04(0.34,0.97)	0.15(0.86,2.69)
Residency	Addis Ababa	38(17)	118(52.9)	67(30)	223(94.5)	1	1
	Outside Addis Ababa	2(15.4)	7(53.8)	4(30.8)	13(5.5)	0.36(0.54,5.37)	0.60(0.43,4.33)
Marital	Married	39(17.3)	121(53.5)	66(29.2)	226(95.8)	1	1
	Non-Married	1(10)	4(40)	5(50)	10(4.2)	0.23(0.11,1.70)	0.90(0.23,3.65)
Level of education	No formal education	7(21.9)	15(46.9)	10(31.3)	32(13.6)	0.87(0.48,2.42)	0.52(0.56,3.18)
	Primary	9(18)	26(52)	15(30)	50(21.2)	0.80(0.45,1.84)	0.35(0.68,3.02)
	Secondary	13(18.8)	35(50.7)	21(30.4)	69(29.2)	0.63(0.620,2.21)	0.62(0.60,2.38)
	Collage and above	11(12.9)	49(57.6)	25(29.4)	85(36)	1	1
Occupation	Housewife	21(15.6)	75(55.6)	39(28.9)	135(57.2)	1	1
	Government Employee	9(19.6)	22(47.8)	15(32.6)	46(19.5)	0.47(0.66,2.51)	0.24(0.29,1.35)
	Merchant	6(26.1)	7(30.4)	10(43.5)	23(9.7)	0.46(0.57,3.41)	0.79(0.34,2.28)
	Non-governmental employee	3(12.5)	16(66.7)	5(20.8)	24(10.2)	0.34(0.27,1.58)	0.69(0.49,2.95)
	Daily Laborer	1(12.5)	5(62.5)	2(25)	8(3.4)	0.92(0.26,4.48)	0.81(0.27,5.25)
Household	<7000	13(25.5)	22(43.1)	16(31.4)	51(21.6)	0.77(0.59,2.04)	0.68(0.44,1.71)
	>=7000	27(14.6)	103(55.7	55(29.7)	185(78.5	1	1

The mean weight gain during the pregnancy of 189 study participants was 11.66 kg, and it was higher in the GDM group (12.19kg) when compared with other groups. The majority of the participants were overweight (n=93, 49.2%) and had adequate weight gain during pregnancy (n=72, 38.1%).

Being overweight and those who gained more than the recommended weight for their pre-pregnancy BMI mother were associated with poor maternal and perinatal outcome on bivariate analysis with P- value of 0.02& 0.17 and 0.20 & 0.18, respectively. Also, those mothers who had inadequate weight gain during pregnancy (n=55, 29.1%) were associated with poor maternal outcomes with P-value of 0.02 on bivariate analysis.

Table 5. The Body habitus of the study participants who give birth in the selected hospital in Addis Ababa, Ethiopia, 2024.

Variable	Category	GDM	PGDM	DIP	Total	Maternal composite outcome	Perinatal composite outcome
		No (%)	No (%)	No (%)	No (%)	P-value(95%CI)	P-value(95%CI)
Pre-pregnancy BMI(n=189)	Underweight	3(75)	0(0)	1(25)	4(2.1)	0.70(0.20,3.54)	0.999
	Normal	48(52.2)	12(13)	32(34.8)	92(48.7)	1	1
	Overweight	50(53.8)	20(21.5)	23(24.7)	93(49.2)	0.02(1.10,3.54)	0.17 (0.83,2.88)
Weight gain(n=189)	Inadequate	26(47.3)	8(14.5)	21(38.2)	55(29.1)	0.02(1.2,4.83)	0.95(0.44,2.14)
	Adequate	40(55.6)	15(20.8)	17(23.6)	72(38.1)	1	1
	Excessive	35(56.5)	9(14.5)	18(29)	62(32.8)	0.20(0.79,3.12)	0.18(0.80,3.39)
Mean weight gain (n=189)		12.19kg	10.88kg	11.14kg	11.66kg		

5.2 Obstetric characteristics of the study participants

About twelve percent (n = 29) of the study participants were primigravida, and 32.4% (n = 67) of the participants had a history of abortion, and the majority of them were in the GDM group (n = 32, 47.8%). Of those having a history of abortion, 70.2% of them had only one abortion. Having a history of abortion was associated with a 2.69-fold higher poor maternal outcome on bivariate analysis but not associated with perinatal composite outcome. When we compare whose had two and more abortions, it was more common in the DIP group (n = 8, 11%) than in the GDM (n = 11, 8.8%) and PGDM (n = 4, 5%) groups.

From those having a history of previous delivery (n = 197), 40.6% and 34.8% of the participants had a history of CS delivery and delivery of babies with a birth weight of 4 kg and above. Both c/s delivery and history of macrosomic baby delivery were associated with good maternal outcomes with P-values of 0.04 and 0.01, respectively, on bivariate analysis. Whereas having a history of preterm birth, stillbirth, and previous pregnancy complicated with hypertension were associated with poor maternal composite outcomes on bivariate analysis with p-values of 0.14, 0.23, and 0.003, respectively. On bivariate regression analysis of past obstetric history for perinatal composite outcome, only participants with a history of macrosomic baby delivery had an association with a p-value of 0.22.

In the current pregnancy, eighty-four percent of the participants initiated antenatal care before 24 weeks of gestation. Preterm delivery was 7.6%, whereas 50% of the participants delivered at full term.

Table 6.Obstetric characteristics of the study participants

Variable	Category	GDM	PGDM	DIP	Total	Maternal composite outcome	Perinatal composite outcome
		No (%)	No (%)	No (%)	No (%)	P-value(95%CI)	P-value(95% CI)
Parity	PG	15(51.7)	1(3.4)	13(44.8)	29(12.3)	1	1
	Multigravida	88(54.3)	29(17.9)	45(27.8)	162(68.6)	0.39(0.32,1.57)	0.18(0.74,4.99)
	Grand multigravida	22(48.9)	10(22.2)	13(28.9)	45(19.1)	0.12(0.18,1.22)	0.24(0.64,5.71)

Past Obstetrics History	History of Abortion(n=207)		32(47.8)	18(26.9)	17(25.4)	67(32.4)	0.001(1.47,4.91)	0.83(0.58,1.98)
	Preterm Birth(n=197)		3(37.5)	3(37.5)	2(25)	8(3.9)	0.14(0.67,17,35)	0.32(0.50,8.51)
	Stillbirth(n=197)		7(43.8)	5(31.3)	4(25)	16(7.7)	0.23(0.67,5.47)	0.36(0.58,4.55)
	Birth Defect(n=207)		3(50)	2(33.3)	1(16.7)	6(2.9)	0.48(0.10,2.99)	0.40 (0.05,3.42)
	Caesarian Delivery (n=197)		45(53.6)	18(21.4)	21(25)	84(40.6)	0.04(0.25,0.77)	1 (0.55,1.80)
	Macrosomia Delivery(n=197)		41(56.9)	14(19.4)	17(23.6)	72(34.8)	0.01(0.24,0.79)	0.22(0.80,2.66)
	History of PIH (n=207)		15(57.7)	2(7.7)	9(34.6)	26(12.6)	0.003(1.65,11.22)	0.30(0.67,3.60)
	History of GDM(n=207)		6(28.6)	6(28.6)	9(42.9)	21(10.1)	0.63(0.32,1.99)	0.63(0.50,3.20)
	Other (n=197)		2(66.7)	0(0)	1(33.3)	3(1.2)		
Current Obstetrics History	GA at ANC initiation	≤24	117(58.8)	29(14.6)	53(26.6)	199(84.3)	1	1
		>24	8(21.6)	11(29.7)	18(48.6)	37(15.7)	0.77(0.55,2.24)	0.15 (0.24,1.26)
	GA at delivery	<37	6(33.3)	7(38.9)	5(27.8)	18(7.6)		
		37-38+6	37(50)	12(16.2)	25(33.8)	74(31.4)		
		39-40+6	73(61.9)	14(11.9)	31(26.3)	118(50)		
		41-41+6	7(35)	5(25)	8(40)	20(8.5)		
		>=42	2(33.3)	2(33.3)	2(33.3)	6(2.5)		

5.3 Diabetics related characteristics of the study participants

The majority of the participants had GDM (n = 125, 53%), and DIP accounts for 39.1% (n=71).The most commonly used screening method was 75gram OGTT, which accounts for 76% (n = 109) and is followed by FBS only (n = 7, 19.4%). The mean gestational age at diagnosis of GDM and DIP was 34 weeks and 31 weeks, respectively. Only 8.9% (n = 21) of the participants were diagnosed between 24 to 28+6weeks of gestation.

The majority of the participants with GDM (n = 100, 80%) were treated with diet modification and exercise. From the DIP group, 46.5% (n = 33) and 7% (n = 5) were treated with insulin and oral hypoglycemic agents, respectively. About 69% (n = 49) and 81.6% (n = 102) of the participants had good glycemic control, according to the treating physician in the DIP and GDM groups, respectively.

Pre-gestational DM accounts for 16.9% of the participants from this T2DM account, 72.5% of PGDM. The diagnosis of PGDM was within 5 years of pregnancy in 75% of the participants, and 95% used insulin as the mainstay of treatment during the pregnancy. From the PGDM group, 10% (n = 4) of the participants have diabetic-related complications, of which two have diabetic kidney disease and the other two have diabetic retinopathy.

Table 7.Diabetics related characteristics of the study participants

Variables			Number	Percent
Type of DM		GDM	125	53
		DIP	71	39.1
		PGDM	40	16.9
GDM(n=125)	Diagnostic method	FBS only	7	5.6
		75gm OGTT	109	87.2
		100mg OGTT	9	7.2
	GA at diagnosis	<24weeks	6	4.8
		24-28+6	7	5.6
		29-36+6weeks	80	64
		≥37 weeks	32	25.6
	Main treatment till delivery	Oral Hypoglycemic Agent	5	4
		Insulin	20	16
		Diet Modification and Exercise	100	80
	Glycemic control	Good	102	81.6
		Suboptimal	23	18.4
DIP(n=71)	Screening method	FBS	31	56.3
		75gm OGTT	40	43.7
	GA at diagnosis	<24weeks	5	7
		24-28+6	14	19.7
		29-36+6weeks	43	60.6
		≥37 weeks	9	12.7
	Main treatment till delivery	Oral Hypoglycemic Agent	5	7
		Insulin	33	46.5
		Diet Modification and Exercise	33	46.5
	Glycemic control	Good	49	69
		Suboptimal	22	31

Pre-gestational DM(n=40)	Type of DM	T1DM	11	27.5	
		T2DM	29	72.5	
	Category		Type of PGDM		
			T1DM	T2DM	Total
			Number (Percent)	Number (Percent)	Number (Percent)
	Duration of diagnosis in years(n=40)	1-5	8(26.7)	22(73.3)	30(75)
		>5	3(30)	7(70)	10(25)
	Main treatment during pregnancy	Oral hypoglycemic agent	0(0)	2(100)	2(5)
		Insulin	11(28.9)	27(71.1)	38(95)
	Glycemic control	Good	6(23.1)	20(76.9)	26(65)
		Poor	5(35.7)	9(64.3)	14(35)
	Known diabetic complication	Yes	2(50)	2(50)	4(10)
		No	9(25)	27(75)	36(90)

5.4 Maternal outcome related characteristics of the study participants

The overall composit maternal outcome was 49.2% (Figure 2). The most common antepartum complication is an abnormality in amniotic fluid, accounting for 19.9%, whereas HTN diagnosed during pregnancy and hypoglycemia account for 11.4% and 7.2%, respectively. There was one mother who developed DKA in the PGDM group.

When we see the mode of delivery in his study, 42.4% delivered vaginally and 36.9% of the participants delivered by elective C/D, whereas 27.1% of mothers in this study underwent labor induction. On postpartum period, 0.8% (n = 2) of them developed postpartum hemorrhage, and there was one shoulder dystocia in the vaginal delivery group.

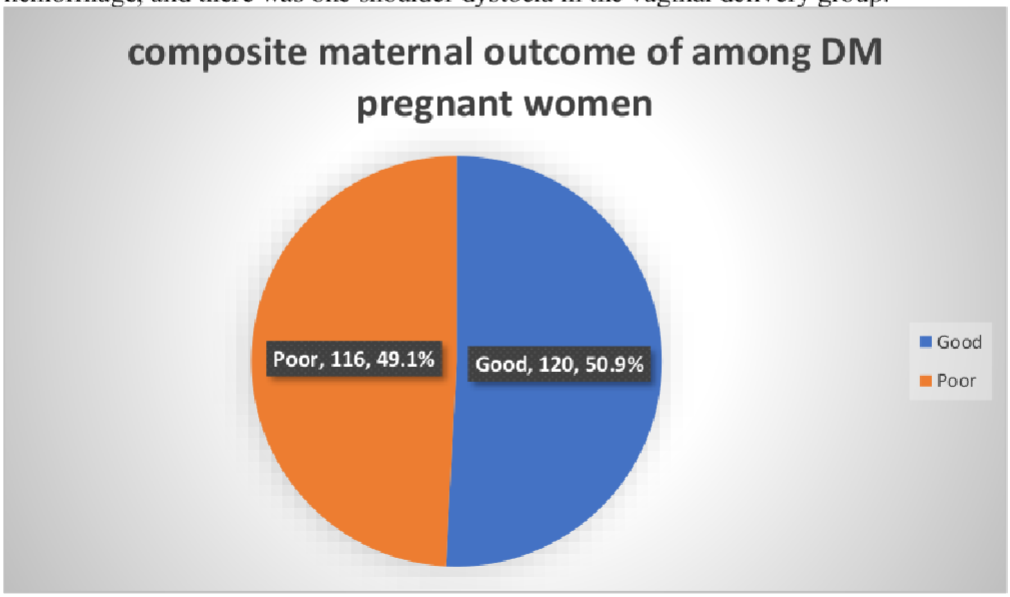

Figure 2 .Composite maternal outcome of women having DM in the selected hospitals of Addis Ababa, 2024.

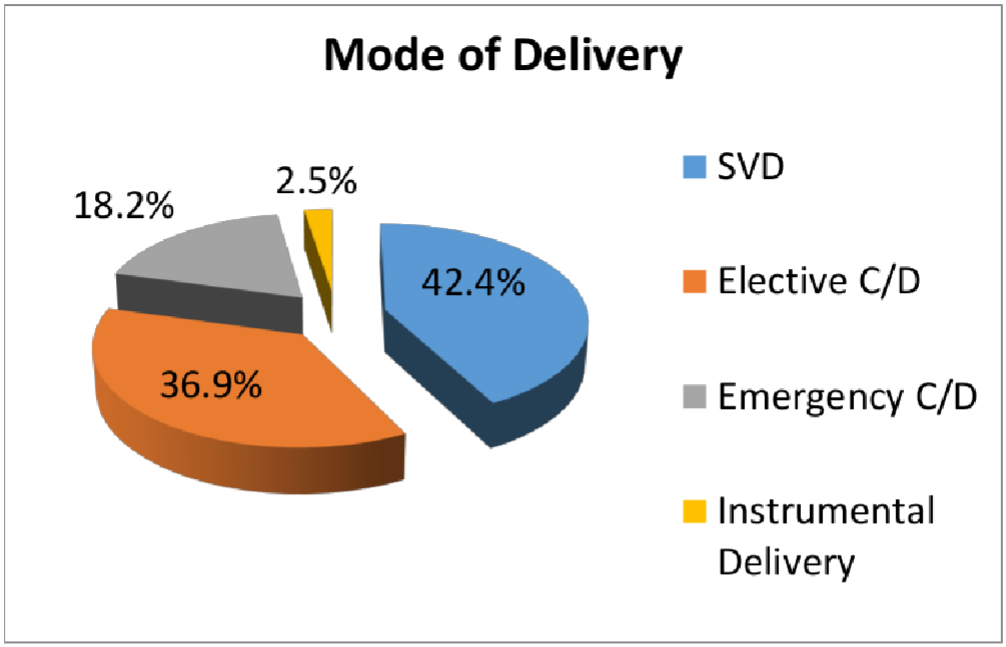

Figure 3.mode of delivery among pregnant mother with Diabetes in five referral hospital in Addis Ababa 2024

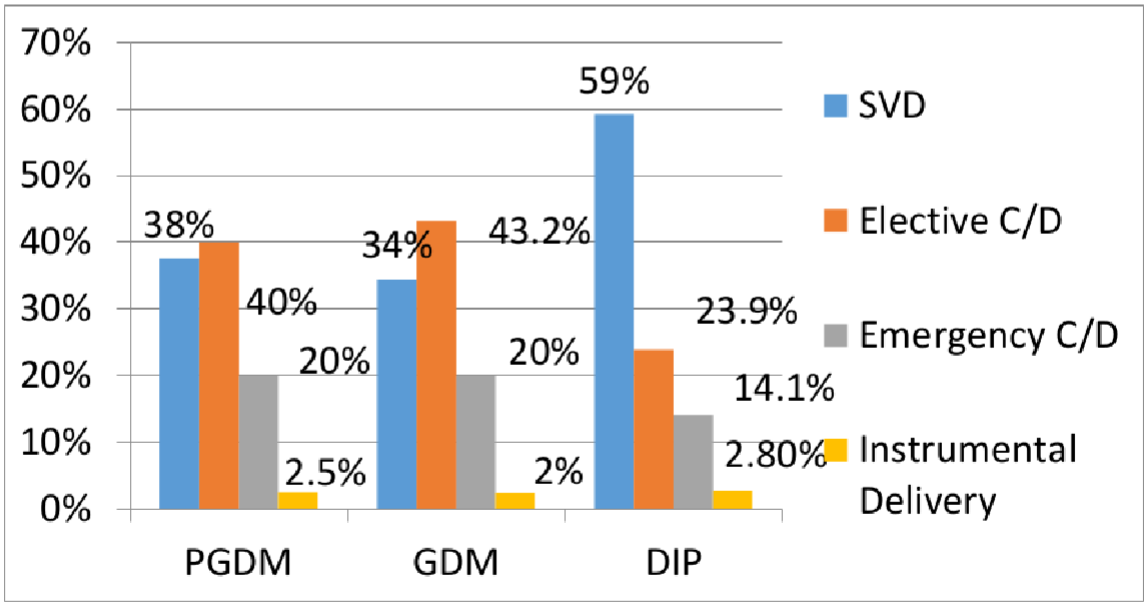

Figure 4.mode of delivery of in type of Diabetes of the study participants

Table 8.Maternal outcome related characteristic of the study participants.

Variables			GDM	PGDM	DIP	Total
			Number (Percent)	Number (Percent)	Number (Percent)	Number (Percent)
Antepartum Complication	PIH		14(51.9)	4(14.8)	9(33.3)	27(11.4)
	APH		1(20)	0(0)	4(80)	5(2.1)
	Polyhydraminos		19(51.4)	8(21.6)	10(27)	37(15.7)
	Oligohydraminos		5(50)	1(10)	4(40)	10(4.2)
	Infection		0(0)	1(25)	3(75)	4(1.7)
	DKA		0(0)	1(100)	0(0)	1(0.4)
	Hypoglycemia		3(16.7)	9(50)	6(33.3)	18(7.6)
Mode of delivery	SVD		43(43)	15(15)	42(42)	100(42.4)
	Instrumental		3(50)	1(16.7)	2(33.3)	6(2.5)
	C/D	Elective	54(62.1)	16(18.4)	17(19.5)	87(36.9)
		Emergency	25(58.1)	8(18.6)	10(23.3)	43(18.2)
Intra-partum Complications	Induction of Labor		32(50)	10(15.6)	22(34.4)	64(27.1)
	Labor Abnormalities		4(66.7)	1(16.7)	1(16.7)	6(2.5)
	Shoulder Dystocia		1(100)	0(0)	0(0)	1(0.4)
Post-partum complications	PPH		1(50)	0(0)	1(50)	2(0.8)
	Interruption of Breast feeding		5(45.5)	3(27.3)	3(27.3)	11(4.7)

5.5 The determinant factor for composite maternal outcome

In this study, the strength of association was measured using an odd ratio and 95% CI. On bivariate logistic regression analysis, age, marital status, and household monthly income are the demographic factors that show association, whereas pre-pregnancy BMI and pattern of weight gain were the lifestyle characteristics that were associated with outcome in bivariate analysis. On reproductive characteristics being primigravid, having a history of abortion, stillbirth, and preterm delivery, and those who had hypertension during prior pregnancy are associated with increased risk for poor maternal composite outcome. Those mothers who had delivery of a macrosomic baby and had prior C/S scar were associated with a good maternal outcome.

On diabetic-related factors, type of diabetes, gestational age at diagnosis of GDM and DIP, methods used for screening for GDM and DIP, and glycemic control were associated with maternal outcomes on bivariate logistic regression. Analysis of multivariate was done to manage potential cofounders, consequently whose mothers who had macosomic baby delivery and prior c/s scar were associated with good maternal outcomes, whereas whose who had a history of abortion, whose who was diagnosed with FBS only, and those mothers who had excessive weight gain during pregnancy were associated with poor maternal composite outcome.

Whose mothers who delivered macrosomic babies were 75% less likely to have poor maternal composite outcomes compared with those who had no delivery of macrosomic babies (AOR = 0.25, 95% CI = 0.08, 0.76). Prior history of delivery by C/D was less likely to develop poor maternal outcomes compared to its opposite compartment (AOR=0.31, 95%=0.31, 0.94). A multivariate model indicated that mothers with a history of abortion were associated with a

4.11-fold higher risk of poor maternal outcome compared to mothers with no history of abortion (AOR = 4.11, 95% CI: 1.29, 13.08). The study also documented whose mother who was diagnosed with FBS only had 4.48 fold higher incidence of poor maternal outcome when compared with mother who was diagnosed with 75 gm OGTT (AOR = 4.48 95% CI: 1.02, 19.60) and whose mother who gained more than the recommended weight for their pre-pregnancy BMI had 4.13 fold higher poor maternal composite outcome compared with those mothers who had adequate weight during their pregnancy (AOR = 4.13 95% CI: 1.13, 15.15).

Table 9.Bivariate and multivariate logistic regression of association between composted maternal outcome and independent variable of the study participants

Variable	Category	Maternal composite outcome		Bivariate Regression		Multivariate Regression	
		Poor	Good	P-value	COR with 95% CI	P-value	COR with 95% CI
Age in years	<30	56(57.1)	42(42.9)	1			
	>=30	60(43.5)	78(56.5)	0.04	0.58(0.34,0.97)	0.72	0.84(0.31,2.25)
Marital status	Married	113(50)	113(50)	1			
	Non-Married	3(30)	7(70)	0.23	0.43(0.11,1.70)	0.99	000(0.00)
Household monthly income	<7000	26(51)	25(49)	0.77	1.1(0.59,2.04)		
	>=7000	90(48.6)	95(51.4)	1			
Pre-pregnancy BMI	Underweight	2(50)	2(50)	0.70	1.49(0.20,3.54)	0.99	1.02(0.10,10.65)
	Normal	37(40.2)	55(59.8)	1			
	Overweight	53(57)	40(43)	0.02	1.97(1.10,3.54)	0.42	1.63(0.50,5.34)
Pattern of weight gain	Inadequate	33(60)	22(40)	0.02	2.36(1.15,4.83)	0.07	3.03(0.92,9.92)
	Normal	28(38.9)	44(61.1)	1			
	Excessive	31(50)	31(50)	0.20	1.57(0.79,3.12)	0.03	4.13(1.13,15.15)
Gravidity	PG	17(58.6)	12(41.4)	1			
	MP	81(50)	81(50)	0.39	0.71(0.32,1.57)	0.08	0.26(0.06,1.19)
	GMP	18(40)	27(60)	0.12	0.471(0.182,1.216)		
History of	yes	43(64.	24(35.8	0.00	2.69(1.47,4.91)	0.02	4.11(1.29,13.

abortion		2)	)	1			08)
	No	56(40)	84(60)	1			
History of Stillbirth delivery	Yes	10(62.5)	6(37.5)	0.23	1.91(0.67,5.47)	0.57	1.70(0.28,10.37)
	No	89(46.6)	102(53.4)	1			
History of Preterm Birth	Yes	6(75)	2(25)	0.14	3.42(0.67,17,35)	0.33	3.84(0.25,58.38)
	No	93(46.7)	106(53.3)	1			
History of C/S delivery	Yes	30(35.7)	54(64.3)	0.04	0.44(0.25,0.77)	0.04	0.31(0.10,0.94)
	No	69(56.1)	54(43.9)	1			
History of Macrosomic	Yes	25(34.7)	47(65.3)	0.01	0.44(0.24,0.79)	0.015	0.25(0.08,0.76)
	No	74(54.8)	61(45.2)	1			
History of PIH	Yes	20(76.9)	6(23.1)	0.003	4.30(1.65,11.22)	0.101	2.78(0.82,9.42)
	No	79(43.6)	102(56.4)	1			
Type of DM	GDM	51(40.8)	74(59.2)	1			
	PGDM	24(60)	16(40)	0.04	2.18(1.05,4.50)	0.39	0.62 (2.14,1.814)
	DIP	41(57.7)	30(42.3)	0.02	1.98(1.10,3.58)		
Diabetes Screening	75gm OGTT	61(40.9)	88(59.1)	1			
	100gm OGTT	5(55.6)	4(44.4)	0.39	1.80(0.47,6.99)	0.34	0.34(0.039,3.06)
	FBS	26(68.4)	12(31.6)	0.003	3.13(1.47,6.67)	0.047	4.48(1.02,19.60)
GA at diagnosis of GDM and DIP	<24	6(54.5)	5(45.5)	0.73	1.26(0.33,4.79)	0.08	6.26(0.81,48.18)
	24-28+6	15(71.4)	6(28.6)	0.09	2.63(0.85,8.11)	0.35	2.42(0.38,15.38)
	29-36+6	51(41.5)	72(58.5)	0.41	0.74(0.37,1.51)	0.95	1.00(0.29,3.76)
	>=37	20(48.8)	21(51.2)	1			
Glycemic Control for GDM and DIP	Good	65(43)	86(57)	1			
	Suboptimal	27(60)	18(40)	0.05	1.985(1.01,3.91)	0.07	2.86(0.92,8.89)

5.6 Perinatal composite outcome of the study participants

In this study, 31.8% of the participants had poor composite perinatal outcomes, as shown in the figure below.

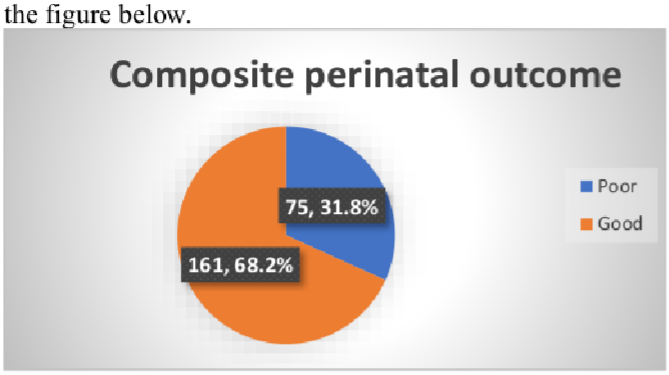

Figure 5 .The perinatal composite outcome of the study participants.

In this study, 1.7% (n = 4) of the newborns are born with congenital anomalies, and 2.1% (n = 2.1) of the neonates developed hypoglycemia. Seventy-eight percent of the neonate had normal birth weight, and 97.5% of them had ≥7 APGAR score at five minutes. Almost nine percent of the neonates were admitted to the NICU, and of those, 85.7% were discharged within the seventh day of life.

Table 10.Perinatal outcome related characteristic of the study participants.

Variables			GDM	PGDM	DIP	Total
			Number (Percent)	Number (Percent)	Number (Percent)	Number (Percent)
Neonatal Outcome	Congenital Anomaly		2(50)	1(25)	1(25)	4(1.7)
	IUFD	Antepartum	2(40)	2(40)	1(20)	5(2.1)
	Birth weight	<2500	2(28.6)	3(42.9)	2(28.6)	7(3)
		2500 -3999	95(51.4)	29(15.7)	61(33)	185(78.4)
		>= 4000	28(63.6)	8(18.2)	8(18.2)	44(18.6)
	5^{th} min APGAR Score <7		3(50)	2(33.3)	1(16.7)	6(2.5)
	Neonatal Hypoglycemia		2(40)	2(40)	1(20)	5(2.1)
	Birth Injury		1(100)	0(0)	0(0)	1(0.4)
	NICU Admission		9(42.9)	5(23.8)	7(33.3)	21(8.9)
	Outcome of NICU Stay	Discharged	8(44.4)	5(27.8)	5(27.8)	18(85.7)
		Still in NICU	1(33.3)	0(0)	2(66.7)	3(14.3)

5.7 Admission diagnosis of the admitted Neonate

The most common reasons for NICU admission were respiratory distress and sepsis, accounting for 38.1% and 28.6%, respectively. Of those admitted for respiratory distress, one of them has meconium aspiration syndrome, and the other seven have respiratory distress syndrome. The third common reason for admission was hypoglycemia, but all of them discharged with one day of admission to the NICU.

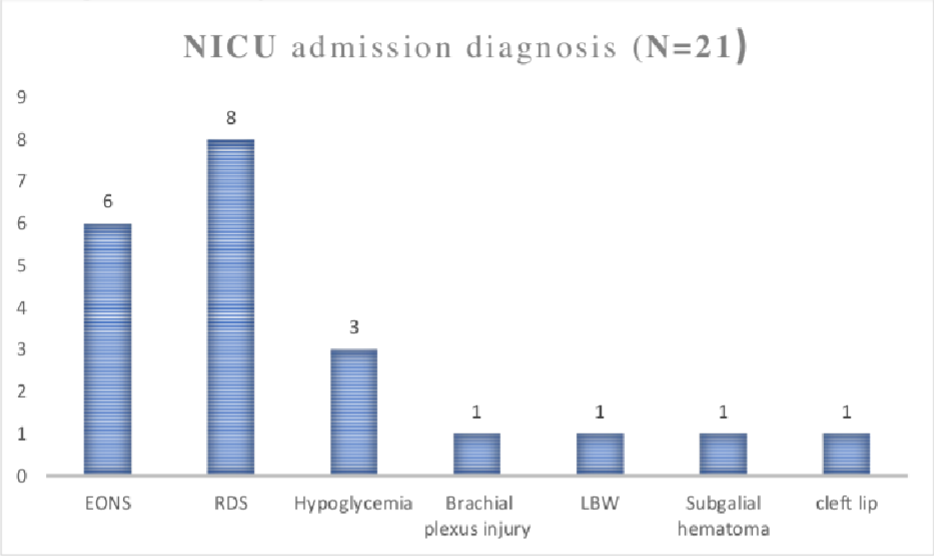

Figure 6.Reason for NICU admission of newborns referred to NICU

5.8 The determinate factor of composite perinatal outcome

The findings of the study showed that age, occupation, pre-pregnancy BMI, pattern of weight gain, gravity, previous delivery of macrosomic baby, Gestational age at ANC initiation, Type of diabetes GDM Screening method, gestational age at Diagnosis, glycemic control for both GDM and PGDM, main treatment option for GDM and DIP, Duration of diagnosis for PGDM and presence of known DM Complications were an association with composite perinatal outcome by bivariate logistic regression analysis.

The multivariate logistic regression indicated that study participants who were government employees were 79% less likely to develop poor composite perinatal outcome when compared with mothers who were housewives (AOR=0.21, 95%CI: 0.05, 0.92), and study participants who were diagnosed with GDM at gestational age of 24 to 28+6 weeks and 29 to 36+6 weeks compared to those diagnosed after 37 weeks were 94% (AOR=0.06, 95%CI=0.01, 0.59) and 83% (AOR=0.17, 95%CI=0.05, 0.59) less likely to develop poor perinatal composite outcome, respectively. Having poor glycemic control for both GDM and PGDM was associated with 9.53 fold (AOR=9.53, 95%CI: 2.65, 31.90) and 6.8 fold (AOR=6.8, 95%CI: 1.35, 34.40) more likely to develop poor perinatal outcomes compared to whose who has good glycemic control on multivariate logistic regression.

Table 11.The bivariate and multivariate logistic regression of association between composted perinatal outcome and independent variable of the study participants.

Variable	Category	Perinatal composite outcome		Bivariate Regression		Multivariate Regression	
		Poor	Good	P-value	COR with 95% CI	P-value	COR with 95% CI
Age in years	<30	26(26.5)	72(73.5)	1			
	>=30	49(35.5)	89(64.5)	0.15	1.53(0.86,2.69)	0.87	1.09(0.37,3.20)
Occupation	Housewife	45(33.3)	90(66.7)	1			
	Government Employee	11(23.9)	35(76.1)	0.24	0.63(0.29,1.35)	0.04	0.21(0.05,0.92)
	Merchant	7(30.4)	16(69.6)	0.79	0.88(0.34,2.28)	0.16	4.57(0.55,38.16)
	Non-governmental employee	9(37.5)	15(62.5)	0.69	1.20(0.49,2.95)	0.84	0.88(0.24,3.24)
	Daily Laborer	3(37.5)	5(62.5)	0.81	1.20(0.27,5.25)	0.28	3.80(0.33,43.65)
Pre-pregnancy BMI	Underweight	0(0)	4(100)	0.99	000(000)	0.99	000(000)
	Normal	25(27.2)	67(72.8)	1			
	Overweight	34(36.6)	59(63.4)	0.17	1.54(0.83,2.88)	0.96	1.03(0.34,3.14)
Pattern of weight gain	Inadequate	15(27.3)	40(72.7)	0.95	0.98(0.44,2.14)	0.27	1.99(0.58,6.84)
	Normal	20(27.8)	52(72.2)	1			
	Excessive	24(38.7)	38(61.3)	0.18	1.64(0.80,3.39)	0.06	3.34(0.97,11.52)
Gravidity	Prim gravid	6(20.7)	23(79.3)	1			
	Multigravida	54(33.3)	108(66.7)	0.18	1.92(0.74,4.99)	0.44	0.60(0.16,2.18)
	Grand Multigravida	15(33.3)	30(66.7)	0.24	1.92(0.64,5.71)		

	No	41(33.3)	82(66.7)	1			
History of Macrosomic baby delivery	Yes	28(38.9)	44(61.1)	0.22	1.46(0.80,2.66)	0.56	0.72(0.25,2.13)
	No	41(30.4)	94(69.6)	1			
ANC Initiation	Before 24weeks	67(33.7)	132(66.3)	1			
	After 24weeks	8(21.6)	29(78.4)	0.15	0.54(0.24,1.26)	0.88	1.13(0.22,5.79)
Type of DM	GDM	43(34.4)	82(65.6)	1			
	PGDM	16(40)	24(60)	0.52	1.27(0.61,2.64)		
	DIP	16(22.5)	55(77.5)	0.08	0.55(0.2.8,1.08)	0.84	0.88(0.26,2.99)
Diabetes Screening	75gm OGTT	49(32.9)	100(67.1)	1			
	100gm OGTT	2(22.2)	7(77.8)	0.51	0.58(0.12,2.91)	0.98	0.97(0.05,20.65)
	FBS	8(21.1)	30(78.9)	0.16	0.54(0.23,1.28)	0.69	0.73(0.15,3.56)
GA at diagnosis of GDM and DIP	<24	5(45.5)	6(54.5)	0.70	1.30(0.34,4.99)	0.33	0.33(0.04,3.02)
	24-28+6	5(23.8)	16(76.2)	0.24	0.49(0.15,1.60)	0.01	0.06(0.01,0.52)
	29-36+6	33(26.8)	90(73.2)	0.14	0.57(0.27,1.21)	0.01	0.17(0.05,0.59)
	>=37	16(39)	25(61)	1			
Main treatment for GDM and DIP	Oral Hypoglycemic	1(10)	9(90)	0.28	0.31(0.04,2.55)	0.99	000(000)
	Insulin	23(43.4)	30(56.6)	0.03	2.15(1.10,4.18)	0.13	2.48(0.77,8.02)
	Dietary modification	35(26.3)	98(73.7)	1			
Glycemic Control for GDM	Good	36(23.8)	115(76.2)	1			
	Suboptimal	23(51.1)	22(48.9)	0.001	3.34(1.67,6.69)	0.00	9.53(2.85,31.90)

Duration of Diagnosis for PGDM	<=5yrs	10(33.3)	20(66.7)	1			
	>5yrs	6(60)	4(40)	0.14	3.00(0.69,13.12)	0.82	1.23(0.20,7.45)
Glycemic Control for PGDM	Good	6(23.1)	20(76.9)	1			
	Suboptimal	10(71.4)	4(18.6)	0.01	8.333(1.91,36.44)	0.02	6.80(1.35,34.40)
Know Diabetic related Complication	Yes	3(75)	1(25)	0.17	5.31(0.50,56.39)	0.4	2.73(0.20,38.21)
	No	13(36.1)	23(63.9)	1			

6. Discussion

The overall prevalence of diabetes among all parturient women was 1.8%. It is comparable when compared with the facility-based retrospective study done in TASH in 2019 (2.5%), the unpublished institution-based cross-sectional study done in three teaching hospitals in Addis Ababa (2.1%), and the retrospective case review done from 1990 to 1999 (1.7%), but it is lower than the institution-based retrospective document review done in the Wolita Zone (7%).[5, 24, 60, 62] It is also lower when compared with the IDF estimated prevalence for Africa (13%). [4] The main reason can be the difference in screening and diagnosis method used; in our study, 75 g OGTT was used for screening only 76% of the participants. Another possible reason can be a difference in the study participant characteristics and study setting. In this study, there was a significant difference in prevalence of diabetes in the studied hospitals (TASH = 3.2%, ALERT Hospital = 1.8, Abebech Gubena Hospital = 0.8%, St. Paul Hospital = 1.4, and ZMH = 2.4%), and there was also a difference in the screening method used in these hospitals.

The prevalence of PGDM in this study was 0.3%, accounting for 16.9% of the participants, which is comparable with a prospective follow-up study done in three teaching hospitals (0.4%) but lower than the study done in Wolaita (2.8%).[13, 25] It is also comparable with studies done in low and middle-income countries (0.2 to 0.7), Spain (0.52), Australia (0.3%), and Italy (0.48%), but lower than the CDC 2021 report (10.9%) and RAHMA (4.3%).[16, 17, 19, 21-23, 63]

The prevalence of DIP and GDM was 0.5% and 0.9%, respectively. This is significantly lower than the systemic review and meta-analysis done to assess the prevalence of GDM in Ethiopia (12%), the study done in Goba (15.7%), and Wolaita (4.2%). [35, 36, 60] It is also significantly lower than the CDC 2020 report (8.3%), systematic review and meta-analysis done in Asia (11.5%), and systematic review and meta-analysis done in Africa (13.6%).[26, 28, 29]In this study, they didn't use the WHO classification of diabetes in pregnancy and only assessed GDM but not DIP.

The most common antepartum complications seen in this study were polyhydraminos (15.7%), hypertensive disorder of pregnancy (11.4%), and hypoglycemia (7.6%). When

PGDM group compared with GDM and DIP group, incidence of polyhydraminos and maternal hypoglycemia is higher in PGDM group (20% vs. 15.2% vs. 14% and 22.5% vs. 2.4% vs. 8.5%), but HTN diagnosed during pregnancy is higher in GDM and DIP group (11.2% vs. 12.7% vs. 10%).

Our finding in this study, Polyhydraminos, is significantly high when compared with the study done in TASH in 2019, where the prevalence of polyhydraminos was 1.4%, but it is comparable with the study done in Pakistan, which was 20%. [5, 64] This difference may be due to a diagnosis difference in polyhydraminos and study design.

The second common antepartum complication in this study were hypertensive diseases of pregnancy, which were higher compared with studies done in Woliyta (5.7%), Denmark (8.2%), and RAHMA (9.3%).[23, 48, 60] But it was comparable with studies done in low and middle-income countries (4.5% to 16.3%) and our finding was lower when compared with studies done in St. Paul (28.5%) and Addis Ababa (26%). [5, 16, 25]This difference in incidence may be due to differences in the study participant's characteristics like age, co-morbidity, and the diagnosis criteria for HTN diagnosis during pregnancy. In our study, we only included that mother who was diagnosed with HTN for the first time after 20 weeks of gestation, but some studies included whose mother was diagnosed with chronic HTN.

In this study, vaginal delivery accounts for 42.4% of deliveries, and cesarean delivery was 55.1%. When we compare the C/D rate across the types of DM, the GDM groups (63.2%) has a higher incidence compared with the PGDM (60%) and DIP (38%) groups. This can be explained by the fact that by the fact that DIP groups had higher induction of labor (31% vs. 25% and 25.6% for PGDM and GDM groups), and prior histories of C/D scar were higher in GDM and PGDM groups (40.9% and 46.2% vs. 36.2%). Also, LBW and macrosomic delivery were higher in PGDM (27.5%) and GDM (24%) compared with the DIP group (14.1%). A high level of C/D in the PGDM group was also seen in studies done in systematic reviews and meta-analyses done worldwide, in Australia, and in retrospective studies done in Italy. [22, 42, 45] Studies done on Ethiopia also show an increased C/D rate (57.8% to 61.8%). [5, 13, 25, 53]

In this study, preterm delivery was 7.6%, and it was threefold higher in the PGDM group (17.5% vs. 5.1%). The prevalence of preterm delivery is lower when compared with a

retrospective study conducted in Tuscany, Italy, which may be due to differences in study method and study population.[22] The higher prevalence of preterm delivery in the PGDM group may be due to poor glycemic control in the PGDM group and higher LBW and macrosomic delivery prevalence than in the GDM and DIP groups.

In this study, 18.6% of deliveries were macrosomic babies, and it was comparable in both groups (20% vs. 18.4%). But it was higher when compared to population-based cohort studies in Germany and Denmark. Neonates of women with diabetes had an incidence of macrosomia of 8%, but it is comparable to a study done in Ethiopia, which was 17.6%. [5, 25, 55, 56, 60]

NICU admission in this study was 8.9% (PGDM = 12.5% and GDM = 8.2%). When we compare NICU admission to other studies, it is significantly lower than studies done in Germany, where NICU admission was as high as 46.4%, and lower than studies done in Ethiopia, which were 65% and 53.4%.[5, 25, 55, 56, 60] But the main diagnoses for NICU admission were similar in the three studies done in Ethiopia, being RDS, hypoglycemia, and prematurity. This difference in NICU admission may be due to NICU admission criteria. In this study, only those newborns admitted were included, whereas those kept for observation and sent to the NICU for workup were not included.

The determining factors for adverse pregnancy outcomes identified in this study were excessive weight gain during pregnancy, having a history of abortion, being diagnosed with FBS only, and poor glycemic control, but early diagnosis of GDM and DIP and being a government employee were identified as protective factors.

In our study, mothers who gained more than the recommended weight for their pre-pregnancy BMI had a 4.13-fold higher poor maternal composite outcome compared with those mothers who had adequate weight during their pregnancy (AOR = 4.13, 95% CI: 1.13, 15.15). This is also shown in a study done in Ireland where excessive weight gain during pregnancy had additive risk for LGA birth weight, macrosomia, and gestational hypertension. Also, a study done in Beijing showed excessive weight gain is positively associated with risk for overall adverse pregnancy outcomes (AOR = 1.72, 95% CI = 1.50–1.97).[65, 66]

In this study, mothers who were diagnosed with FBS only had a 4.48-fold higher incidence of poor maternal outcome when compared with mothers who were diagnosed with 75 gm OGTT

(AOR = 4.48, 95% CI: 1.02, 19.60). A scoping review done in Southeast Asia showed maternal fasting glucose was associated with an increase in postpartum diabetes, LGA.[40]

In this study, study participants who were government employees were 79% less likely to develop poor composite perinatal outcomes when compared with mothers who were housewives (AOR = 0.21; 95%CI: 0.05, 0.92). A study done in TASH in 2018 also showed being a housewife increased the risk of adverse fetal outcomes 2.1 fold when compared with being employed (AOR = 2.1, 95%CI: 1.32, 3.41).[5]

In our study, having poor glycemic control for both GDM and PGDM was associated with 9.53 fold (AOR=9.53, 95%CI: 2.65, 31.90) and 6.8 fold (AOR=6.8, 95%CI: 1.35, 34.40) likelihood to develop poor perinatal outcome. This is also the same in studies done in Nigeria, China, England, Wales, and the Isle of Man, UK.[24, 41, 54]

8. Conclusion

Maternal and perinatal composite outcome of pregnancy complicated with diabetes in pregnancy is high. The most common antepartum maternal complications were polyhydraminos, hypertensive disorder during pregnancy, and hypoglycemia. In the postpartum period, the most common complications were interruption of breast feeding and PPH, whereas the most common perinatal complications were delivery of a macrosomiac and low birth weight baby. NICU admission also was higher.

The determinant factor of poor maternal outcome was being diagnosed with FBS only, history of abortion, and excessive weight gain during pregnancy. Having prior C/S delivery and delivery of macrosomic baby in previous pregnancy were protective for poor maternal composite outcome. The determinants of poor perinatal outcome were occupation, poor glycemic control, and the diagnosis of GDM at later gestational age

9. Recommendation

This recommendation aims to address the key findings of the study and improve maternal and perinatal outcomes for women with diabetes mellitus during pregnancy.

- Improve Glycemic Control and Further studies needed to address the reson for higher rate of poor glycemic control
- Prevention and management of complications:
    - Develop institution based protocols for early detection of complications like polyhydraminos, HTN, and maternal hypoglycemia, as these were the most common maternal poor outcomes.
- Follow national protocol for screening and diagnosis of GDM to avoid difference seen in diferrent referral hospital

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Annexes

I. INFORMATION SHEET

Greeting: Hello, my name is_____I am one of the data collectors for the study entitled "Maternal and perinatal outcome of pregnancy complicated with Diabetes in three teaching hospital, A.A, Ethiopia" **Research project**: assess maternal and perinatal outcome of pregnancy complicated with diabetes among women who give birth in three teaching hospital Addis Ababa, Ethiopia.

Name of principal investigator: Mulugeta Desalegn

Introduction: This information sheet and consent form is prepared by the investigator whose main aim is to assess maternal and perinatal outcome of pregnancy complicated with diabetes among women who give birth in three teaching hospital Addis Ababa, Ethiopia. The investigator is a gynecology and obstetrics resident at black lion specialized comprehensive hospital.

Purpose: to determine maternal and perinatal outcome of pregnancy complicated with diabetes among women who give birth in three teaching hospital Addis Ababa, Ethiopia.

Procedures: you are kindly invited to take part in our research because we believe you can provide the necessary information for the research. Participation into the study is on voluntary basis. If you are willing to participate in the study, I will interview you about your pregnancy especially as related to diabetes mellitus. You are consenting is for the interview and allowing me to review your (& your babies) clinical records.

Risk and/or discomfort: participation in the study has minimal risk of recalling all what has happened to you including some difficulties you may have.

Benefits: the information you will provide is very important to know the prevalence of diabetes among pregnant women and its pregnancy outcome. It is also important to mitigate the problem in the future and to improve maternal and newborn health by government and other organizations accordingly.

Confidentiality and anonymity: the information that we will collect from

this research project will be kept confidential. Information about you that will be collected from the study will be stored in a file, which will not have your name on it, and it will not be revealed to anyone except the principal investigator.

Right to refuse or withdraw: you have the full right to refuse from participating in this research (you can choose not to respond some or all of the questions) if you do not wish to participate; and this will not affect you. You have also the full right to withdraw from this study at any time you wish to, without losing any of your rights as a resident of this site.

If you have any questions regarding the study at the beginning or mid of the interview or at the end of interview, you can do so and you can ask the principal investigator.

Address of the principal investigator:

Dr. Mulugeta Desalegn

Mobile phone: 0913481398

E-mail: abuzer.md18@gmail.com

Are you willing to participate in this study?

1. Yes……continue with the interview

2. No…….. (If not consenting, enquire politely for her reason. If it is based on a wrong perception, try to explain politely but do not pressurize her. All participants declining to participate are reported, if possible with their reasons)

I. INFORMED CONSENT

I am informed of a study done to assess maternal and perinatal outcome of pregnancy complicated with diabetes in three teaching hospital, A.A, Ethiopia, that is undertaken by obstetrics and gynecology Resident, Addis Ababa University College of Health Sciences School of Medicine. My participation in this study is completely voluntary, with no risk in not participating and with no unique gain in answering the questions. I am informed it may take up to 40minutes to complete the interview. I have been assured that I can withdraw my consent at any time without penalty. All the needed information has been explained to me in the language I understand. I am willing to participate in the interview.

By signing below, I confirm that I have read and understood this consent form and agree to participate in this research study.

Signature of Data collector: _____

Date: _____

II. Data Collection tool

Part I: socio demographic and economic characteristics

	Question		Response
1	How old are you?		years
2	Where is your residence?	Addis Ababa	
		Outside Addis	
3	What is your marital status	Single	
		Married	
		Divorced	
		Separated	
		Widowed	
		Others : mention_____	
4	What is your religion?	Protestant	
		Orthodox	
		Catholic	
		Muslim	
		other(specify)	
5	Mother's ethnicity	Amara	
		Oromo	
		Tigery	
		Gurage	
		Other, specify	
6	What was the last year of schooling that you finished?	No formal education	
		read and write only	
		Primary	
		Secondary	
		above secondary	
		Vocational	
7	What is your	House wife	

	occupation?	Gov't employee	
		Merchant	
		Non-government employee	
		Daily laborer	
		Other(specify)	
8	What is your monthly house hold income?		Birr
9	Pre-pregnancy weight in KG	She knows	Kg
		She doesn't know	
10	Weight gain during pregnancy in KG during delivery	She knows	Kg
		She doesn't know	
11	Height in Meter _____		Cm

Part II: Maternal Obstetric history

	Question		Response
1	Reproductive history	G_____P_____A_____	
2	Gestational age (from chart physician diagnosis)	At ANC initiation	
		At Delivery	
3	Past obstetric outcome (tick right if the mother has the listed complication)	Still birth	
		Preterm born…	
		Birth defect…	
		Caesarean section delivery	
		Live birth born Wt.>4kg	
		Pregnancy induced hypertension	

		Previous history of gestational DM	
		Others(specify)	

Part III: Maternal Medical and Family history

	Question			Response
GDM	1	Screening	Method 1. 75 gram 2. 100 gram 3. FBS	
			Result 1. FBS__ 2. 1 hr ----- 3. 2hrs 4. 3hrs	
	2	GA at diagnosis		
	3	Main treatment till delivery?(multiple answers are possible)	Oral Hypoglycemic agent	
			Insulin injection	
			Diet adjustment and exercise	
	4	Glycemic control 1/ good 2/suboptimal		
Pre-gestational Diabetes	1	Type of Diabetes	T1DM	
			T2DM	
			Other (specify)	
	2	Duration of diagnosis		

	3	Main treatment during pregnancy	Oral Hypoglycemic agent	
			Insulin injection	
			Diet adjustment and exercise	
	4	Known diabetic complication 1. Yes 2. No	If yes, List	
Family history	1	Self or family history of any comorbidity	No	
			Yes,(specify)	

Part IV: Maternal and Perinatal Complication

Outcomes			Questions		Response
Maternal Outcomes	Antepartum	1	PIH(specify)		
		2	APH		
		3	Polyhydraminos,		
		4	Oligohydraminos,		
		5	Infection, (specify)		
		6	Disease progression,		
		7	DKA		
		8	Hypoglycemia		
	Intrapartum	1	Mode of delivery	SVD	
				Instrumental(specify)	
				ABD	
				C/D(specify Elective	

				indication)	Emergency	
		2	Shoulder dystocia			
		3	Birth injury			
		4	Labor dystocia			
		5	Induction of labor			
	Postpartum	1	PPH (specify the cause)			
		2	Mental illness(specify)			
		3	Interruption of breast feeding,			
Neonatal Outcome		1	Congenital anomaly(specify)			
		2	IUFD	Antepartum		
				Intrapartum		
		5	Birth weight			
		6	1st and 5th min APGAR Score			
		7	Hypoglycemia /Hyperglycemia			
		9	Birth injury			
		10	NICU admission	Reason for referral		
				Admission diagnosis		
				Hospital stay and outcome		
		11	Perinatal Mortality(specify possible cause of death)			
Counseling given to the mother on possible post-partum complications			Yes			
			No			

maternal and perinatal outcome of pregnancy complicated with diabetes among women who give birth in five referral hospitals in Addis Ababa, Ethiopia. Dr.Mulugeta Desalegn

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