ADVERSE PREGNANCY OUTCOMES AND GESTATIONAL DIABETES: A DESCRIPTIVE STUDY IN EASTERN ETHIOPIA

***Elias Bekele Wakwoya**
***Correspondence:** Haramaya University, Ethiopia
Email: eliasbekele183@gmail.com

ABSTRACT

Background: *A pregnant woman with diabetes and her unborn child are at increased risk of pregnancy complications and adverse neonatal outcomes. The aim of this study was to assess the association of gestational diabetes mellitus and adverse birth outcomes among women who gave birth in Eastern Ethiopia.*

Methods: *Institution based cross sectional study design was conducted in HiwotFana Specialized University Hospital and Dilchora Hospital from December 2015 to April 2017. This study involved a total of 1,834 mothers and their babies. Adverse birth outcomes were observed and registered after delivery. Multivariate logistic regression analysis was employed to identify predictors of adverse birth outcome. P value less than 0.05 was considered to decide statistical significance.*

Results: *In binary logistic regression analysis macrosomia and stillbirth were found to have an association with gestational diabetes, COR=11[95% CI = 5.7-21.2] and COR= 2.9[95% CI = 1.02-8.5] respectively. Macrosomia was independently associated with GDM and babies born to mothers with gestational diabetes. Babies born from mothers with gestational diabetes were 8.5 times more likely to have macrosomia than babies born to non-diabetic mothers, AOR = 8.5 [95% CI = 5.7-21.4].*

Conclusion: *This study revealed that only macrosomia was strongly associated with gestational diabetes and this finding is coherent with studies done at different parts of the world. Routine screening service for pregnant women who are at risk of developing gestational diabetes must exist at all health facilities in Ethiopia.*

Key words: *Gestational diabetes, adverse birth outcome, macrosomia*

INTRODUCTION

Diabetes mellitus is the common medical complication of pregnancy and it carries high risk to the fetus and the mother. Gestational diabetes mellitus is defined as being any degree of glucose intolerance at onset or first recognition during pregnancy and should include glucose readings that fall within the impaired glucose tolerance (IGT) diagnostic range, as well as those within the diagnostic range for diabetes[1,2]. The American Diabetes and Association also define GDM as diabetes diagnosed during pregnancy that is not clearly overt diabetes[3].

The number of people with diabetes is increasing globally. As the incidence of diabetes continues to rise and increasingly

affects individuals of all ages, pregnant women and their babies are at increased risk of diabetes[4]. The prevalence of gestational diabetes mellitus ranges from 2% - 14% of all pregnancies worldwide and 0 % - 13.9%in Africa[5, 6]. Even though there is no data for the total prevalence of GDM in Ethiopia, according to the study done in northern part of Ethiopia it was 3.7 percent[7].

Gestational diabetes can negatively affect the pregnancy and may be associated with many maternal, fetal and neonatal complications, both short and long term. A woman with GDM have an increased risk of adverse neonatal outcomes as compared to women without GDM. As different studies indicated, GDM is associated with a greater risk of neonatal fetal macrosomia, shoulder dystocia, neonatal trauma, respiratory distress, increased admission to neonatal intensive care units[8-12].

Adverse outcomes in pregnancies among women with diabetes are in most cases preventable by optimizing glycemic control. Early screening and treatment of mothers with GDM can minimize the complications for both mothers and their babies. Addressing GDM also constitutes a window of opportunity for early intervention and reduction of the future burden of type 2 diabetes[13]. However, in some of the poorest countries of the world, difficulties in accessing and receiving both maternity and general medical care increase the risks pregnant women face complications of diabetes in pregnancy.

There was no information on the association of gestational diabetes with adverse neonatal outcome in our study area. Therefore this study was conducted with the intention of assessing the association of GDM and adverse birth outcomes.

METHODS AND MATERIALS

Study Area

This study was conducted in the labour wards of HiwotFana Specialized University Hospital and Dilchora Referral Hospital from June 2016 to April 2017. HiwotFana University Hospital is found in Harar city which is located 526km from Addis Ababa in the eastern part of Ethiopia. According to the Central Statistics Authority of Ethiopia in 2007, Harari regional state has population of 183,415 of which 92,316 were male and 91,099 were female[14]. HiwotFana specialized University Hospital was established in 1941. It is referral hospital for both Harar town and its surroundings.

Dilchora Referral Hospital is found in Dire Dawa city administration council, located 501 km to the east of Addis Ababa. The hospital is serving an estimated population of 2 million, coming from Dire Dawa City administration and nearby Oromia and Somali regions. The hospital has a total number of 268 beds distributed between medical, paediatrics, surgical, gynaecology and obstetrics wards. Monthly, an estimated 582 clients visit the antenatal clinic found in the hospital. In addition, an estimated 194 clients visit the clinic for antenatal care(ANC) each month.

Study Design and Population

This was institution based comparative cross sectional study design which compared the adverse birth outcome between babies delivered from gestational diabetic women and babies born from non-gestational

diabetic women. Mothers who were known diabetic before pregnancy and who were severely ill during data collection period were excluded from the study.

Sample Size Determination and Sampling Procedure

The sample size of the study was 1834 women and their babies of which 47 babies born from gestational diabetic women and 1787 babies born from non-gestational diabetic women. This was determined by using the minimum number per group of babies required for the study using the standard formula sample size in a comparative study and setting the study power at 90%. To derive the sample size we used prevalence data from the previous study done in Northern Ethiopia on the prevalence of gestational diabetes[15]. To recruit study participants all mothers came to both hospitals during the study period were interviewed by using the structured questionnaire until the required sample size was obtained.

Variables and Measurement

Birth outcome were categorized as adverse birth outcomes if the babies had either of macrosomia, prematurity, admission to NICU, respiratory distress and congenital anomalies.

Pregnant women are considered as at risk for GDM if she had a history of delivery of previous macrosomic baby, history of stillbirth, family history of DM, obesity (BMI > 30kg/m^2), previous congenital abnormal fetus and glucosuria. The babies were considered as macrosomic if their birth weight were greater than 4000gm.

Gestational Diabetes is any degree of glucose intolerance detected for the first time during pregnancy after 20 weeks of gestation and must fulfil criteria listed by WHO (If RBS ≥ 140 mg/dL the patients will undergo a 3 hours 100 gm oral glucose tolerance test and GDM will be diagnosed if ≥ 2 values met or exceed the following cut-off point; blood sugar level at 1 hour - 190 mg/ dl, at 2 hours - 165 mg/ dl, and at 3 hours - 145 mg/dl). OGTT is a test to examine the efficiency of the body to metabolize glucose and it distinguishes metabolically healthy individuals from people with impaired glucose tolerance and those with diabetes. Random Blood Sugar is the amount of glucose dissolved in circulating blood, recorded irrespective of when food was last ingested. The diagnostic criteria used in this study was the two-step process, those mothers who had a risk factor for diabetes were screened by a 50 g - glucose challenge test and the serum glucose level was measured one hour later. Those mothers with the positive test result underwent a 3-hours, 100 gm - oral glucose tolerance test (OGTT). Finally the diagnosis was made if the mothers' serum level was in the recommended range[16].

Data Collection Procedure

Socio-demographic data of the mothers were obtained on a face-to-face interviews. Screenings for GDM were performed for mothers who were identified at risk for developing GDM. For the mothers who had a RBS ≥ 140 mg/dl, 50 gm glucose challenge test were given orally to the mothers with the serum glucose measured one hour later. To ensure the quality of data a pretest was performed before actual data collection started and two days training was given for two days. All data were checked for

completeness, clarity and consistency immediately after data collection.

Data Management and Statistical Analysis

Data were entered into EPI-info version 3.5.1 and then exported to SPSS version 20.0 software for analysis. After cleaning, frequencies and percentages were calculated. Bivariate and multivariate logistic regression analysis was used to ascertain any significant difference in any of adverse birth outcome among mother with GDM and without GDM. The adverse birth outcome includes preterm birth, respiratory distress, macrosomia, stillbirth and congenital anomalies. P value of less than 0.05 was considered statistically significant.

Ethical Approval

The protocol was approved by the Haramaya University Institutional Health Research Ethical Review Committee. Written and signed informed consent was obtained from each study participant prior to interview. Those mothers who were diagnosed with gestational diabetes were linked with the service where the treatment was given and all babies who had adverse birth outcomes were also managed accordingly.

RESULTS

Demographic and Obstetric Characteristics

A total of 1834 women who came to HiwotFana and Dilchora Hospitals for delivery service were included in the study. The mean age of mothers with and without GDM was 25.6 4.83 and 26.8 4.59 respectively. The magnitude of married women were 42(89.4%) in GDM and 1702(95.2%) in non GDM. From the total participants 29(61.7%) of GDM mothers and 1067(59.7%) of non GDM mothers were educated. The proportion of mothers who had family history of DM was 34% in GDM group and 2.4% in non GDM group. Among non GDM group 644 (36%) and 15 (32%) of GMD group gave birth for the first time.(Table 1)

Table 1: Socio demographic and selected obstetrics characteristics of women who gave birth in Hiwotfana and Dilchora hospitals from June 2016 to April 2017 G.C

Variables	Gestational diabetes	
	GDM N (%)	Non GDM N (%)
Age of mothers		
<18	0 (0%)	21 (1.2%)
18-34	2 (4.3%)	33 (1.9%)
>35	45 (95.7%)	1733 (96.9%)
Marital status		
Single	0 (0%)	19 (1.1%)
Married	42 (89.4%)	1702 (95.2%)
Divorced	4 (8.5%)	38 (2.1%)
Widowed	1 (2.1%)	28 (1.6%)
Ethnicity		
Oromo	33 (70.2%)	1171 (65.6%)
Amahara	8 (17.0%)	351 (19.6%)
Others	6 (12.8%)	265 (14.8%)
Religion		
Christian	15 (31.9%)	544 (30.4%)
Muslim	32 (68.1%)	1243 (69.6%)
Occupation		
Employee	9 (19.1%)	456 (25.5%)
Housewife	32 (68.1%)	1048 (58.7%)
Merchant	6 (12.8%)	283 (15.8%)
Educational status		
Uneducated	18 (38.3%)	720 (40.3%)
Educated	29 (61.7%)	1067 (59.7%)
Income		
<1000	11 (23.4%)	606 (33.9%)
> 1000	36 (76.6%)	1181 (66.1%)
Gravidity		
Primigravida	8 (17.0%)	531 (29.7%)
Multigravida	39 (83.0%)	1256 (70.3%)
Parity		
Primipara	15 (32.0%)	644 (36.0%)
Multipara	32 (68.0%)	1143 (64.0%)
Family history of DM		
No	31(66.0%)	1745 (94.5%)
Yes	16 (34.0%)	42 (5.5%)

Birth Outcomes

Preterm delivery among babies born from GDM and non GDM mothers was 10.6%and 11.2% respectively. Stillbirth was presented in 8.5% of babies of GDM women and 3.1%

non GDM women. The proportion of malpresentation among babies born from GDM and non GDM women was 17% and 13.5% respectively. The proportion of macrosomia was higher among GDM babies (31.9%) than non GDM babies (4.1%). From the total study participants 15% of neonates of GDM mothers were admitted to NICU while 10.7% of neonates of non GDM mothers were admitted to NICU. Only 6.4% and 2.9% of neonates were born with congenital anomalies among GDM and non GDM groups respectively. From the total participants, 8 (17%) of neonates born from GDM mothers and 205 (11.5%) of neonates born from non GDM had developed neonatal respiratory distress. (Fig 1).

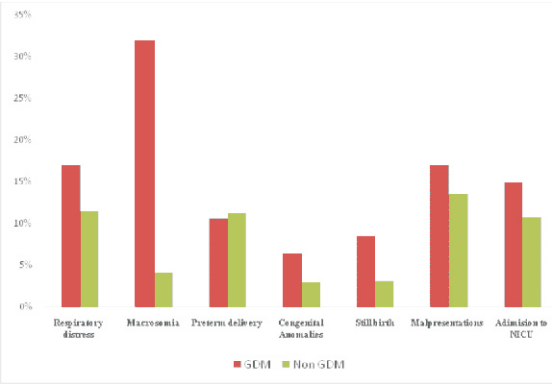

Fig 1: Adverse birth outcomes among mothers with and without gestational diabetes who gave birth in HiwotFana and Dilchora hospitals, Eastern Ethiopia, from June 2016 to April 2017

Binary logistic regression was done to assess the association of GDM and birth outcomes. In binary logistic regression analysis Macrosomia COR=11[95% CI = 5.7-21.2]and still birth COR= 2.9[95% CI = 1.02-8.5] were significantly associated with gestational diabetes. However only macrosomia was significantly associated in multivariate analysis. Babies born to mothers with gestational diabetes were 8.5 times more likely to have macrosomia than babies born to non-diabetic mothers AOR = 8.5 [95% CI = 5.7-21.4] (Table 2).

Table 2: Bivariate and multivariate logistic regression analysis showing relation between adverse birth outcomes and gestational diabetes among women who gave birth in HiwotFana and Dilchora Hospitals from June 2016 to April 2017

Variables	Gestational diabetes		COR [95% CI]	AOR[95% CI]
	Case (%)	Control (%)		
Respiratory distress				
Yes	8 (17.0%)	205 (11.5%)	1	
No	39 (83.0%)	1582 (88.5%)	1.6[0.73-3.43]	
Macrosomia				
Yes	15 (31.9%)	73 (4.1%)	11[5.71-21.2]*	8.5[5.7-21.4]*
No	32 (68.1%)	1714 (95.9%)	1	1
Preterm				
Yes	5 (10.6%)	211 (11.2%)	1	
No	42 (89.4%)	1576 (88.2%)	1.1[0.44-2.87]	
Congenital anomalies				
Yes	3 (6.4%)	51 (2.9%)	1	1
No	44 (93.6%)	1756 (97.1%)	2.3[0.68-7.72]	1.22[0.33-4.58]
Still birth				
Yes	4 (8.5%)	55 (3.1%)	2.9[1.02-8.44]*	0.34[0.11-1.1]
No	43 (91.5%)	1732 (96.9%)	1	1
Malpresentation				
Yes	8 (17.0%)	242 (13.5%)	1.3[0.6-2.83]	
No	39 (83.0%	1545 (86.5%)	1	
Admission to NICU				
Yes	7 (14.9%)	192 (10.7%)	1	
No	40 (85.1%)	1595 (89.3%)	1.5[0.64-3.3]	

DISCUSSION

If not appropriately managed gestational diabetes may result in serious health complications during pregnancy, delivery and in a long term both mothers and their babies are more likely to develop type 2 diabetes. Gestational diabetes can result in higher maternal and prenatal morbidity. Different studies indicated that GDM is associated with multiple adverse birth outcomes such as; preterm delivery, still birth, respiratory distress, birth trauma and others.

In this study macrosomia was significantly associated with GDM and this finding is in line with a study done in India where macrosomia was significantly higher among women with GDM[17]. This can be explained as maternal hyperglycemia exposes the fetus to either sustained hyperglycemia or intermittent pulses of hyperglycemia and both situations prematurely stimulate fetal insulin secretion[18].

The risk of still birth is higher among pregnant women with GDM. According to the study done by Rosenstein *et al* the overall risk of still birth from 36 – 42 weeks was higher among women with GDM when compared to women without gestational diabetes[19]. Similarly in this study still birth was significantly associated with gestational diabetes in binary logistic regression analysis. This can be explained as the fetus may grow slowly in uterus due to poor circulation or other conditions such as, high blood pressure or microvascular disease which can complicate diabetic pregnancy.

Preterm delivery is one of the major causes of neonatal morbidity and mortality worldwide. In Ethiopia preterm delivery is the major cause of neonatal mortality, in the year 2014 it was the cause of one third of neonatal death[20]. Some studies indicated that gestational diabetes have an association with preterm delivery, study done in Australia and Qatar revealed that preterm delivery was higher among women with GDM[21,22]. Nevertheless, other studies indicated that there is no significant association between preterm delivery and GDM. In the current study also preterm delivery was not associated with GDM.

The study done by Blanc *et al* showed the gestational diabetes was the independent risk factor for severe respiratory distress syndrome after 34 weeks of gestation. Respiratory distress was also significantly associated with GDM in studies conducted in Qatar and Saudi Arabia[22, 23]. However in the current study the neonatal distress was not associated with GDM. The difference might be due to the difference in the study design and number of study participants.

CONCLUSION

This study revealed that macrosomia has a significant association with GDM and the odds of macrosomia was higher among mothers with gestational diabetes. Based on this study we recommend that screening for pregnant women at risk of developing GDM during the second trimester becomes mandatory to prevent macrosomia and to take appropriate interventions. Federal, regional health offices and all stake holders should work together to provide screening materials at ANC units so that the number of pregnant women screened and treated early will be screened. In this study we didn't used the latest WHO's GDM diagnostic criteria (75-g tolerance test) and we consider this as a limitation of our study.

Acronyms or Abbreviations

ANC	Antenatal Care
BMI	Body Mass Index
DM	Diabetes Mellitus
GDM	Gestational Diabetes Mellitus
IGT	Impaired Glucose Tolerance
NICU	Neonatal Intensive Care Unit
OGTT	Oral Glucose Tolerance Test
RBS	Random Blood Sugar
WHO	World Health Organization

Conflicts of Interest

The authors declare that there are no conflicts of interest

Acknowledgments

Our special gratitude goes to Haramaya University for funding this research project. Our deepest gratitude also goes to the data collectors and supervisor for their devotion and effective undertaking of responsibilities throughout data collection and respondents at both hospitals without whom this study would not have been realized.

REFERENCES

1. Organization, W.H., Laboratory diagnosis and monitoring of diabetes mellitus. 2003.
2. Organization, W.H., Definition, diagnosis and classification of diabetes mellitus and its complications: report of a WHO consultation. Part 1, Diagnosis and classification of diabetes mellitus. 1999, Geneva: World health organization.
3. Association, A.D., Standards of medical care in diabetes—2010. Diabetes care, 2010. **33** (Supplement 1): p. S11-S61.
4. Hunt, K.J. and K.L. Schuller, The increasing prevalence of diabetes in pregnancy. *Obstetrics and gynecology clinics of North America,* 2007. **34**: p. 173-199.
5. Obstetricians, A.C.o. and Gynecologists, ACOG Practice Bulletin. Clinical management guidelines for obstetrician-gynecologists. Number 32, November 2001 (replaces Technical Bulletin Number 181, June 1993, and Committee Opinion Number 241, September 2000). Thyroid disease in pregnancy. Obstetrics and gynecology, 2001. 98(5 Pt 1): p. 879.
6. Macaulay, S., D.B. Dunger, and S.A. Norris, Gestational diabetes mellitus in Africa: a systematic review. *PLoS One,* 2014. **9**: p. e97871.
7. Seyoum, B., et al., Prevalence of gestational diabetes mellitus in rural pregnant mothers in northern Ethiopia. *Diabetes research and clinical practice,* 1999. **46**: p. 247-251.
8. Casey, B.M., et al., Pregnancy outcomes in women with gestational diabetes compared with the general obstetric population. *Obstetrics & Gynecology,* 1997. **90**: p. 869-873.
9. Hjalmarson, O., Epidemiology and classification of acute, neonatal respiratory disorders: A Prospective Study 1. *Acta Paediatrica,* 1981. **70**: p. 773-783.
10. Mills, J.L., L. Baker, and A.S. Goldman, Malformations in infants of diabetic mothers occur before the seventh gestational week: implications for treatment. *Diabetes,* 1979. **28**: p. 292-293.
11. Persson, B. and U. Hanson, Neonatal morbidities in gestational diabetes mellitus. *Diabetes care,* 1998. **21**: p. B79.
12. Mcfarland, L.V., et al., Erb/Duchenne's palsy: a consequence of fetal macrosomia and method of delivery. *Obstetrics and Gynecology,* 1986. **68**: p. 784-788.
13. Dabelea, D., The predisposition to obesity and diabetes in offspring of diabetic mothers. Diabetes care, 2007. **30** (Supplement 2): p. S169-S174.
14. Central Statistical Agency, Ethiopia Population and Housing Census Report, Harari Region, 2007. Available from:https://en.wikipedia.org/wiki/Harari_Region
15. Mengesha, H.G., et al., Low birth weight

and macrosomia in Tigray, Northern Ethiopia: who are the mothers at risk? *BMC pediatrics,* 2017. **17**: p. 144.
16. Moyer V.A; U.S. Preventive Services Task Force. Screening for gestational diabetes mellitus: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med.* 2014;**160**:414–420.
17. Bhat, M., et al., Outcome of gestational diabetes mellitus from a tertiary referral Center in South India: a case–control study. *The Journal of Obstetrics and Gynecology of India,* 2012. **62**: p. 644-649.
18. Pedersen, J., Diabetes mellitus and pregnancy: present status of the hyperglycaemia--hyperinsulinism theory and the weight of the newborn baby. Postgraduate medical journal, 1971: p. Suppl: 66.
19. Rosenstein, M.G., et al., The risk of stillbirth and infant death stratified by gestational age in women with gestational diabetes. *American journal of obstetrics and gynecology,* 2012. **206**: p. 309. e1-309. e7.
20. Berhan, Y. and A. Berhan, Perinatal mortality trends in Ethiopia. *Ethiopian journal of health sciences,* 2014. **24**: p. 29-40.
21. Ju, H., et al., Borderline gestational diabetes mellitus and pregnancy outcomes. *BMC Pregnancy and Childbirth,* 2008. **8**: p. 31.
22. Bener, A., N.M. Saleh, and A. Al-Hamaq, Prevalence of gestational diabetes and associated maternal and neonatal complications in a fast-developing community: global comparisons. *International journal of women's health,* 2011. **3**: p. 367.
23. Gasim, T., Gestational diabetes mellitus: maternal and perinatal outcomes in 220 Saudi women. *Oman medical journal,* 2012. **27**: p. 140.