ADDIS ABABA UNIVERSITY

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Prevalence of gestational diabetes mellitus and associated factors among pregnant women following antenatal care at public health facilities in Bule Hora town, Oromia, Southern Ethiopia.

By: Wako Dedecha

Advisors: Mistire Wolde (Associate professor, PhD)

Tatek G/Egziabher (MSc, PhD candidate)

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This is to certify that the thesis prepared by WAKO DEDECHA, entitled: "Prevalence of gestational diabetes mellitus and associated factors among pregnant women following antenatal care at public health facilities in Bule Hora town, Oromia, Southern Ethiopia." and submitted in partial fulfillment of the requirements for Master of Science degree in Clinical Laboratory Sciences (Clinical Chemistry Specialty track) complies with the regulations of the University and meets the accepted standards concerning originality and quality.

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Advisor_____ Signature _____Date _____

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Abbreviations and Acronyms

ALT	Alanine aminotransferase
ANC	Antenatal care
BMI	Body mass index
BHGH	Bule Hora General Hospital
BHTHC	Bule Hora town health center
CVD	Cardiovascular disease
FANTA	Food and Nutrition Technical Assistance
GA	Gestational age
GDM	Gestational diabetes mellitus
IADPSG	International Association of the Diabetes and Pregnancy Study Groups
IFCC	International federation of Clinical Chemistry
IPAQ	International Physical Activity Questionnaire
LNMP	Last normal menstrual period
MDDS	Minimum dietary diversity score
MUAC	Mid-upper arm circumference
OGTT	Oral glucose tolerance test
PCOS	Polycystic ovary syndrome
SPSS	Statistical package for the social sciences
WHO	World health organization

Abstract

Background: Globally, the gestational diabetes mellitus prevalence is increasing. However, it is an overlooked health problem that highly endangers both women and their children in countries of resource-constrained. Little is known about its burden in Ethiopia, particularly there is no study on gestational diabetes in the area of present study.

Objective: To assess the Prevalence of gestational diabetes mellitus and associated factors among pregnant mothers following antenatal care at public health facilities in Bule Hora town, Oromia, Southern Ethiopia, 2021.

Methods: A health facilities based cross-sectional study was conducted from February to April, 2021. 190 pregnant mothers at 24-32 weeks of gestational age were selected by the convenient sampling technique. Measurement of fasting blood glucose level was performed to diagnose gestational diabetes mellitus. Gestational diabetes mellitus was diagnosed using updated 2013 World Health Organization diagnostic criteria. Analyses of bivariate and multivariate were done by using SPSS version 25.0 to recognize factors linked with gestational diabetes mellitus.

Results: The overall prevalence of gestational diabetes mellitus was found to be 7.4%. Family history of diabetes mellitus (AOR = 5.7; 95% CI: 1.28-25.27), Triglycerides (AOR =5.6; 95% CI: 1.258-25.46), History of having macrocosmic baby (AOR =6.8; 95% CI: 1.56-29.59) and History of abortion (AOR = 4.4; 95% CI: 1.09-18.39) were found to be significantly associated with gestational diabetes mellitus.

Conclusion: The overall prevalence of gestational diabetes mellitus was 7.4%. History of abortion, History of having macrocosmic baby, Family history of diabetes and elevated serum triglycerides were independently linked with gestational diabetes mellitus. Universal screening and early diagnosis of gestational diabetes mellitus are strongly recommended.

Keywords: Gestational diabetes mellitus, Prevalence, Lipid profiles, Fasting blood sugar, Bule Hora, West Guji

1. Introduction

1.1 Background

According to the world Health Organization definition Gestational diabetes mellitus is the intolerance of carbohydrate that leads to high blood glucose of varying severity with first detection in gestation[1]. Gestational diabetes mellitus causes a numerous range of adverse maternal and neonatal outcomes[2] and it is a concern to health of mother and infant [3].

Usually, gestational diabetes mellitus is recognized during the late second or third trimester of gestation due to the fact that the placental hormone has a significant role in the adverse outcome on metabolism of blood sugar[4]. Many hormones like leptin, progesterone, placental lactogen, estrogen, cortisol, and placental growth hormone stimulate insulin resistance condition, as gestation advances[5]. Mainly, women placental lactogen elevates concentration of blood sugar and causes a mother's cells to become less sensitive to insulin and result in an elevated above normal concentration of blood sugar and may be gestational diabetes mellitus [6].

Furthermore, the occurrence of gestational diabetes is due to the pancreas does not generate adequate insulin or the insulin it generates cannot be employed properly by the mother's body. Insulin defined as a hormone that regulates blood sugar[7]. Gestational diabetes has various signs and Symptoms such as polyphagia; polyuria; polydipsia; loss of body weight; blurred vision and frequent bladder, vaginal or skin infections[8].

Generally, the fundamental pathophysiology of gestational diabetes is either impaired function of beta cell of pancreas or elevation of insulin resistance that starts at close by mid gestation and continues in the third trimester to the alike degree of those presented with type 2 diabetes mellitus[9,10]. The inability of a determined concentration of insulin to affect expected biological response of metabolism of nutrient at the target tissue level is called Insulin resistance [11]. A combination of elevated mother's adiposity and the effects of insulin-desensitizing of hormonal products of the placenta result in insulin resistance[10]. Gestational diabetes mellitus primarily result from impaired function of beta cell that occurs from secretions that appear in mothers with long lasted insulin resistance and so appear to be connected with type 2 diabetes mellitus[9,10].

There are various health factors that increase the risk of developing gestational diabetes mellitus. These are; older age, previous GDM, body mass index (BMI), family history of diabetes, previous macrosomic baby weighing ≥4.5 kg and ethnicity of high prevalence; particularly South Asian, black Caribbean, and Middle Eastern[12]. Moreover; history of polycystic ovary syndrome (PCOS), glycosuria in the current pregnancy, history of chronic hypertension and previous stillbirth were indicated as significant predictors[13,14,15].

Antenatal depression arises in gestational diabetes in addition to the tension during normal pregnancy[16]. Pregnancy complications like preeclampsia, preterm birth, and also in various cases caesarean delivery of the newborn are increased due to gestational diabetes[17]. About 60% of mothers with a previous case of gestational diabetes develop type2 diabetes mellitus in the future. Furthermore, mothers with a history of gestational diabetes mellitus have annually risk of changing to type 2 diabetes of approximately two to three percent[18]. According to the emerging evidence the vasculature of mothers with a previous case of gestational diabetes is permanently changed and subjecting them to cardiovascular disease (CVD).

Gestational diabetes mellitus also presents short- and long-term effects to the newborn. When the placental transport of amino acids, glucose, and fatty acids are increased, the fetus's endogenous generation of insulin and IGF-1 are triggered. By coming together, these can give rise to overgrowth of fetal, usually leading to macrosomia at delivery[19]. The study also shows that gestational diabetes raises the risk of stillbirth[20]. In the prolonged effect, infants that are born from mothers with gestational diabetes are at elevated risk of CVD, T2 diabetes, obesity, and associated metabolic disorders.

Gestational diabetes mellitus can be diagnosed according to the world health organization 2013 (2013 WHO)[1] or Association of American Diabetes 2017 (2017 ADA)[21], as well as modified International Association of the Diabetes and Pregnancy Study Groups (IADPSG)[22] diagnostic criteria. The same values have been recognized by the world health organization even though there is a little differences in reference ranges[23]. According to the world health organization 2013 the diagnosis of gestational diabetes mellitus is done when **≥1** of the following reference ranges is attained [(Concentration of fasting blood sugar: ≥ 92 mg/d), (1 h: ≥180 mg/dL; 2 h: ≥ 153 mg/dL after two-hour 100g OGTT)].

As to the knowledge of the principal investigator, there are a few studies conducted on the assessment of the prevalence of gestational diabetes mellitus and associated factors in Ethiopia. Thus, the main objective of the present study was to assess the prevalence of gestational diabetes mellitus and associated factors.

1.2. Statement of problem

Worldwide, about 15% of the pregnant mothers are affected by gestational diabetes, 87.6% of the high blood glucose were in resource-constrained countries[24]. With the increasing magnitude in nowadays, gestational diabetes mellitus has become one of the leading causes of child and maternal mortality and morbidity worldwide and has increased health threat. Gestational diabetes is earnestly harmful to both the fetuses and mothers. Pregnant mothers with gestational diabetes mellitus are predisposed to gestational hypertension, premature rupture of membrane, preeclampsia, polyhydramnios and caesarean section, as well as they are at a higher risk of subsequent type 2 diabetes mellitus and cardiovascular diseases. Infants born from women with gestational diabetes mellitus are susceptible to suffer from congenital deformities, macrosomia, hypoglycemia, neonatal trauma and respiratory distress syndrome[25,26].

Various Studies revealed that the prevalence of GDM has escalated by 10 to 100% in various ethnic groups in the past 20 years[27]. A significant rise in gestational diabetes mellitus prevalence was reported in the United states and Australia, where a higher relative raise was observed in young women[28,29]. In urban China, the adjusted prevalence of gestational diabetes mellitus was reported to have increased by 2.8 folds during the years 1999–2008 from 2.4% to 6.8%[30].

Gestational diabetes mellitus has become one of the challenging problems that affects women's health in countries of sub-Saharan African[24]. According to a review, the prevalence of gestational diabetes mellitus in sub-Saharan Africa was 14%[31] and Middle East and North Africa varied from 8.4 to 24.5%[32] even though the investigations employed dissimilar screening and diagnostic criteria. Study results also indicated that the magnitude of gestational diabetes mellitus differed to some rates among regions in Africa. For instance, the reported rate in East Africa was 6%[33] and in West Africa was 14%[34]. Differences in magnitude of GDM were also noted within sub-regions, such as Rwanda which was 8.3%[35] and Tanzania which was 19.5%[36]. Twenty years ago, the incidence of gestational diabetes mellitus in the rural area of North Ethiopia was found to be 3.7%[37]. Besides, a study done in the same part of the country i.e. Northern Ethiopia, reported a magnitude of 13% among urban pregnant women

which was nearly three folds higher than that of rural mothers[38]. But, the investigation employed solely fasting blood sugar test as diagnostic criteria for gestational diabetes mellitus.

The health condition of pregnant mother with diabetes and her fetus can be endangered with different levels of complications. These complications can lead to death in worst circumstances[39]. Gestational diabetes mellitus also leads to long-term public health problem. It comes up with the increasing of type 2 diabetes cases. It is a short-lived phenomenon for the pregnant women, However, above 50% of the mothers develop type 2 diabetes later on in life and the chance of their children to develop type 2 diabetes and obesity as young children in future life was reported to be increased[40].

Nowadays, presence of factors like urbanization, physical inactivity, life style changes, dietary habits, delayed marriage and older mother's age in various regions of the world are causing favorable condition and the magnitude of gestational diabetes mellitus probably very well on the increase[28].

On account of cost, various countries in Africa measure blood glucose level of pregnant mothers to diagnose gestational based on identified risk factors selectively and the percentage of mothers suffering from the case and the magnitude of the problem are unclear[41]. In Ethiopia, Even though diabetes mellitus is identified as one of the serious non-communicable disorders, the magnitude of gestational diabetes mellitus among pregnant mothers and factors associated with it were not well studied.

The recorded data on the assessment of the prevalence of gestational diabetes mellitus and associated factors are limited in Ethiopia, particularly there is no study on GDM and associated factors in the area of present study as per the knowledge of principal investigator. Thus, the main objective of the present study was to assess the Prevalence of gestational diabetes mellitus and associated factors among pregnant women following antenatal care at public health facilities in Bule Hora town, Oromia, Southern Ethiopia.

1.3. Significance of the study

Identifying the magnitude of the GDM and common associated factors among pregnant women following antenatal care at public health facilities in Bule Hora town would be important for health workers to minimize the risk of adverse outcome on timely bases.

The highest raise in the incidence of obesity, diabetes and other non-communicable diseases occurred in low-and middle-income countries especially in Africa, and Gestational diabetes has become one of the challenging problems of pregnant women's health in countries of sub-Saharan African, thus it is necessary to produce further information on prevalence and associated factors of gestational diabetes.

Recognizing about the Prevalence of gestational diabetes mellitus and associated factors at health facilities in Bule Hora town, Southern Ethiopia is important for stakeholders to develop plan for strategic interventions. Additionally, it is helpful for health program improvement.

The study will also serve as a reference for researchers who are interested to conduct similar study.

2. Literature review

Study conducted in Tertiary Care Teaching Hospital in Udaipur of India on the incidence of Gestational Diabetes Mellitus and associated factors among 46 mothers showed that Prevalence of GDM was found to be 10.8%. In addition to this the study result shows that out of 46 pregnant women who participated in the study, 22% were hypoglycemic, 67.2% had normal blood glucose levels and A high prevalence of GDM 3 out of 46, was found in pregnant mothers aged between 21 - 35, 2 out 46 of pregnant mothers were in 36 - 45 age group. Finally, Family history of diabetes and age were found to be risk factors of GDM[42].

According to study conducted in Bangladesh on Prevalence of gestational diabetes and associated risk factors, a cross sectional data was collected from the pregnant mothers from a hospital of Barisal city, Bangladesh and result of the study revealed that 5% of the interviewed mothers suffer from diabetes. Additionally, out of 100 participants, 58% were in 20-30 years age group and 68% subjects married within 21-25 years old. Nearly, half (51%) of pregnant women had above 60 Kg body weight. Maximum (48%) mothers passed their secondary education and 78% were jobless and above half (56%) of the patient's family monthly earned 10000-20000 BD Tk. Not only this but also, among the pregnant mothers, 15% had the family history of diabetes. Correlation matrix showed that, body weight, and blood pressure were positively associated with sugar level. So, it concluded that more attention should be given to late pregnancy to reduce the ill effects of gestational diabetes mellitus on mother and future child, because insulin resistance became maximum in this period. Blood pressure of pregnant mother should be monitored regularly as it is associated with raised incidence of diabetes[43].

Study done in Thamar University, Dhamar, Yemen on risk factors and incidence of GDM indicates that 311 pregnant women aged 15–49 years participated in the study and the mean of age and BMI were 25.14 years and 24.61 kg/m2 respectively. The study also indicates that the most frequent variables were previous stillbirth (29.6%) and DM family history (23.2%). Accordingly, 12.5% of the women were ≥35 years old, 12.2% had previous macrosomic baby, and 10% reported history of PCOS, whereas 5.8% women were obese and 2.9% reported previous GDM. The study revealed that GDM was diagnosed in 16 women, based on the ADA alternative methods of Fasting blood sugar and Random blood sugar. It is concluded as

gestational diabetes mellitus was found to affect ~5% of the population. The results revealed previous GDM, age greater than or equal to 35 years, DM family history, and PCOS history as independent predictors. BMI greater than or equal to 30 kg/m2 and history of having macrosomic newborn elevated the risk of gestational diabetes mellitus but in a dependent manner[44].

Study conducted at three health facilities in Limbe, Cameroon on risk factors and prevalence of gestational diabetes mellitus among pregnant mothers indicated that 200 pregnant mothers were included into the investigation and 20.5% presented with gestational diabetes mellitus. Majority, 13.5% of participants had abnormal RBS alone, while 2% of participants had all blood glucose values abnormal and 3.5% had any two abnormal blood glucose values. Additionally, the study indicated that the mean gestational age of participants was 26.2weeks. Most, 47% of participants were at 27-28 weeks of gestational age, whereas 14.5% were at 24 weeks of gestation age. Three (3) was the mean gravidity and range was 1-6. There were solely 4.5% of respondents with delivery of preterm. 0.6 was the mean number of abortions. Around, 16% of participants had a history of unexplained stillbirth. Besides, 18% of subjects had macrosomic baby previously. 38.8kg/m2 was the mean BMI. Nonetheless, 52% of participants were overweight while 34.5% of participants were obese. It concluded that the factors linked with gestational diabetes were mainly obesity, advanced maternal age, history of having macrosomic baby and history of stillbirths[45].

According to the study conducted in Gondar town public health facilities, Northwest Ethiopia on the associated factors and incidence of GDM among pregnant women indicated that among 1110 pregnant women selected to take part in the investigation, 83 pregnant women were excluded from the study due to different reasons. Furthermore, the mean age of the mothers was 27.22years. Majority of the subjects 91% lived in urban. Besides, mothers who were married, unemployed and had secondary education and above was reported by 92%, 60.5% and 58.2% respectively. 24.77cm was the mean of the MUAC, 112.07mmHg was systolic blood pressure and 71.91mmHg was diastolic blood pressure. It may be concluded as: out of the total 1027 mother, 12.8% were diagnosed with gestational diabetes mellitus. Finally, factors such as DM family history, Obesity, low physical activity, history of gestational diabetes, antenatal

depression and inadequate dietary diversity were found to be significantly linked with gestational diabetes mellitus[38].

Study conducted in Wolaita Zone, Southern Ethiopia on Prevalence of gestational diabetes mellitus and associated factors shows that 4.2% of study participants were diagnosed with gestational diabetes mellitus. The mean of post glucose load level was 160.1 mg/dl, and the magnitude of GDM among urban residents and rural residents was reported by 4% and 4.9% respectively. According to this study the magnitude of gestational diabetes mellitus raises with raise in number of pregnancies. Finally, DM family history, previous caesarean section and history of abortion were significantly linked with GDM[46].

Conceptual frame work

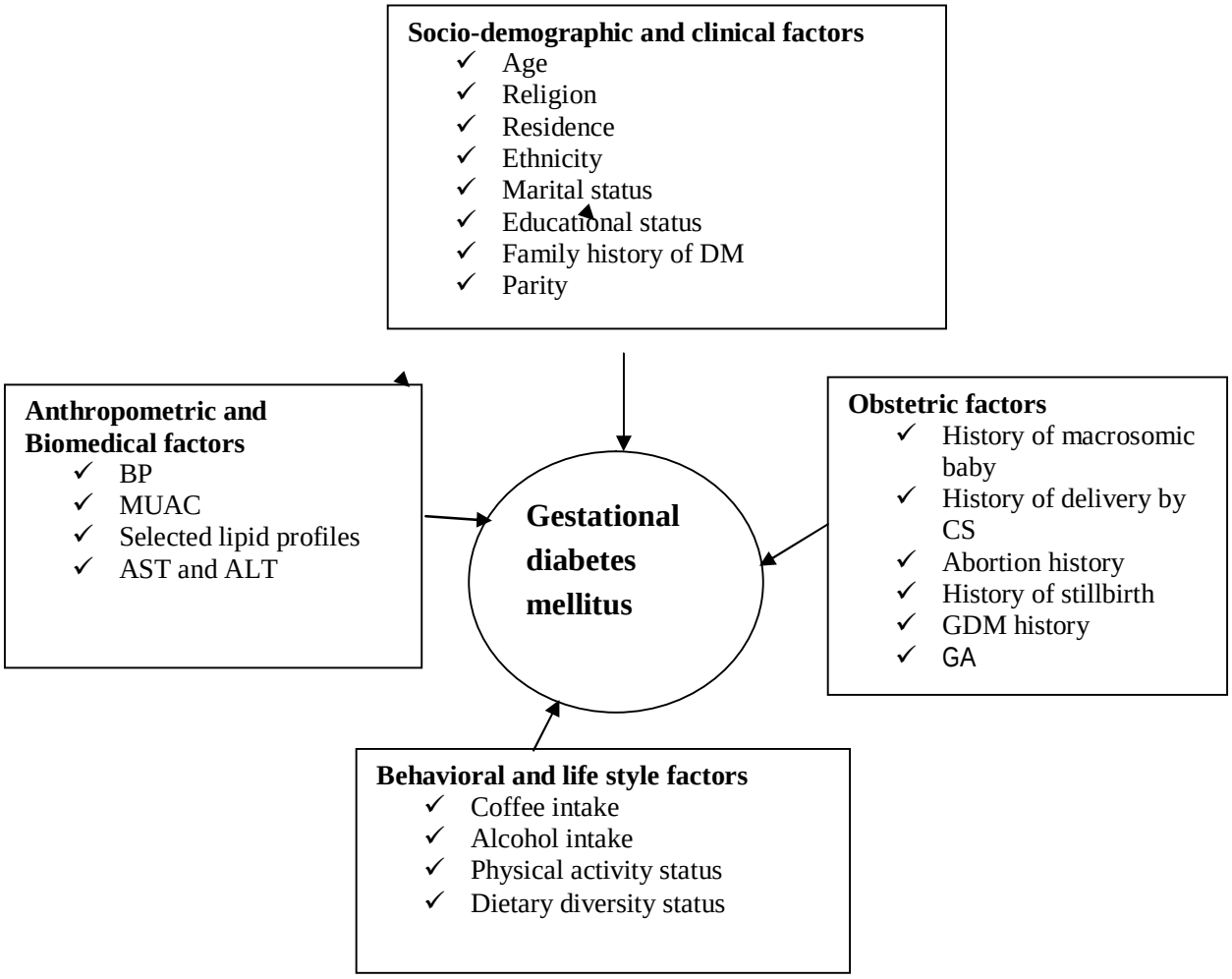

Figure 1: Conceptual framework of factors associated with gestational diabetes mellitus adapted from T chirikov (2018)

3. Objectives of the study

3.1. General objective

To assess the prevalence of gestational diabetes mellitus and associated factors among pregnant women following antenatal care at public health facilities in Bule Hora town, Oromia, Southern Ethiopia, 2021

3.2. Specific objectives

To determine the prevalence of gestational diabetes mellitus among pregnant women following antenatal care at public health facilities in Bule Hora town, Oromia, Southern Ethiopia.

To identify associated factors of gestational diabetes mellitus among pregnant women following antenatal care at public health facilities in Bule Hora town, Oromia, Southern Ethiopia.

4. Materials and methods

4.1. Study area

The study was conducted at public health facilities in Bule Hora town. The public health facilities included one general hospital called Bule Hora general hospital (having 155 beds and 9 wards) and a health center named Bule Hora town health center. The antenatal care department in Bule Hora general hospital gives antenatal care services for more than 9,000 pregnant women per year, whereas the antenatal care department in Bule Hora town health center gives antenatal care services for more than 2,000 pregnant women per year. Bule Hora town is located in the West Guji zone, Oromia regional state, Southern Ethiopia, 467 km far from Addis Ababa the capital city of Ethiopia. Bule Hora town has eight urban kebeles. According to the population record office of the Bule Hora town municipality administrative, the current total population of Bule Hora town is 209,256 of whom 108,979 is male and 100,277 is female. The town has also more than 5 private clinics. The health facilities in Bule Hora town provide health services for above 1.3 million population i.e., for both urban and rural residents.

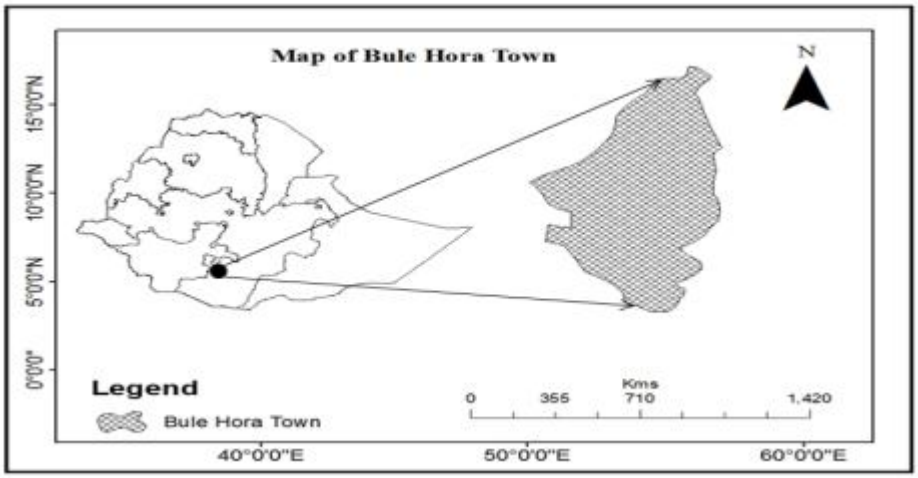

Figure 2: Map of Bule Hora Town[47]

4.2. Study design and period

4.2.1. Study design

The health facilities based cross-sectional study design was conducted to determine the prevalence of gestational diabetes mellitus and associated factors among pregnant women following antenatal care at public health facilities in Bule Hora town, Oromia, Southern Ethiopia.

4.2.2. Study period

The study was conducted from February to April 2021 at Bule Hora town public health facilities.

4.3. Population

4.3.1. Source population

All pregnant women attending their follow up at ANC department from February to April 2021.

4.3.2. Study population

All eligible pregnant women (between 24-32 weeks of gestation) attending their follow up at ANC department from February to April 2021.

4.4 Eligibility criteria

4.4.1. Inclusion criteria

- ✓ Pregnant women (at 24–32 weeks of gestational age) attending their follow up at ANC department from February to April 2021 were enrolled in this study.

4.4.2. Exclusion criteria

- ✓ pregnant women who have overt DM were excluded
- ✓ Mothers on medications like β-adrenergic agonists, anti-psychotic and steroids drugs were not included
- ✓ Mothers unwilling to be included in the study were excluded
- ✓ Women with Thyroid and adrenal related diseases were excluded

4.5. Study variables

4.5.1. Dependent variable

- Gestational diabetes mellitus (By Fasting blood glucose)

4.5.2. Independent variables

- ✓ Age
- ✓ Marital status
- ✓ Educational status
- ✓ Residence
- ✓ Family history of DM
- ✓ Parity
- ✓ MUAC
- ✓ Blood pressure
- ✓ Selected lipid profiles
- ✓ Selected liver function tests
- ✓ Behavioral and life style characteristics
- ✓ Obstetric history

4.6. Measurement and data collection

4.6.1 Sample size determination

In this study, the sample size was computed by employing single-population proportion formula, with the prevalence value 12.8% from study done on the associated factors and prevalence of GDM in Gondar town, Northwest Ethiopia[38].

- ✓ P =is the estimated proportion in the population, p =0.128
- ✓ Z reflects the confidence interval (CI); we used 95 % confidence interval so the value of zα/2 is 1.96
- ✓ d = is the margin of error (0.05) &-α =is the level of error one is willing to tolerate

$$n = \frac{(z\ \alpha/2)^2 * P(1-P)}{d^2} = \frac{(1.96)^2 * 0.128(1-0.128)}{(0.05)^2} = 172$$

By adding assumed 10% for non-response rate, the final sample size for this study was 190 respondents.

4.6.2. Sampling method

Convenient sampling method was used for this study. The data was collected until the required sample size was achieved. All pregnant women who fulfill eligibility criteria were included in this study.

4.6.3. Data collection procedure and instruments

The structured questionnaire was developed in English and translated to the local language which is Afan Oromo and then translated back to English to look over its constancy[38]. T h e questionnaire was pre-tested in 5% at Kercha primary hospital. 4 Midwives, 2 Laboratory technologists, 1 Laboratory technician were recruited as the data collectors and trained by Principal investigator.

During data collection a face-to-face interview was used to collect information on marital status, religion, age, ethnicity, residence, educational status, LNMP, DM family history, prior case of GDM and weight at delivery of the previous child; features of life-style and behavior, like recent

alcohol consumption, coffee intake, level of physical activity, and dietary diversity. Blood pressure and MUAC were also measured. Gestational age estimation was determined by reliable LNMP together with first-trimester ultrasonography (if present). Moreover, obstetric history and medical history were retrieved from antenatal care cards.

4.6.3.1. Measurement of blood pressure and mid-upper arm circumference (MUAC)

In the measurement of blood pressure (BP), BP was determined on the right arm employing normal cuffs fitted for adults with a standard sphygmomanometer putting the stethoscope bell gently on the arm artery. When SBP≥ 140 mmHg and DBP≥ 90 mmHg, hypertension was diagnosed to be present[38].

A non-stretchable measuring tape was used to measure the mid-upper arm circumference (MUAC) on the left arm. Since majority of the mothers could not remember their body weight before gestation, determining body mass index (BMI) was difficult. MUAC was a reliable measure because of quite steady during pregnancy and well equated to the body mass index before pregnancy[48,49]. Pregnant mothers with MUAC of greater than or equal 28 cm was considered as having overweight and/or obesity[50].

4.6.3.2. Measurement of level of physical activity and dietary diversity

The physical activities that pregnant women do as part of their everyday lives was assessed as to the short form International Physical Activity Questionnaire (IPAQ). Information collected on physical activities was described as metabolic equivalents (MET-minutes per week) employing the International Physical Activity Questionnaire scoring standard to classify mothers into low, moderate, high status of physical activity classes[51].

The assessment of dietary diversity was done according to a twenty four-hour food recall technique by the Food and Nutrition Technical Assistance (FANTA) 2016 version woman's minimum dietary diversity measurement technique. The adequate dietary diversity was considered to be present with MDDS of five and more[52].

4.6.4. Blood specimen collection and analysis

Venous blood samples were obtained after overnight fasting (for 8–12 hr.) from each participant for measurement of Fasting blood glucose, selected Lipid profiles and LFT tests. Secondly, the blood specimen was allowed to stand for 10– 20 min for clot formation. Then, the specimen was centrifuged at 3500 revolution per minute (rpm) for 10min and the serum was separated from the whole blood and stored at −20 °C until analysis. Finally, the serum was analyzed for FBS, Lipid profile and LFT tests by using Mindray semi-automated analyzer (BA 88A SEMI-AUTO Chemistry analyzer, China).

4.7. Data quality assurance

All collected data was checked for consistency and completeness daily by principal investigator. The pre-analytical, analytical and post-analytical factors that can interfere the results of biochemical measurements was controlled and maintained by medical laboratory technologist who perform the specimen analysis. The proper functioning of instruments, laboratory reagents and technical performance was checked daily by using quality control samples (human sera) before running patient samples and the process was repeated for the result fallen outside the established values.

4.8. Data statistical analysis and interpretation

All data was entered into EpiData 3.1 software, then was exported to SPSS version 25.0 (IBM, SPSS) to be analyzed. Proportion, mean, standard deviation and frequency were employed to present the study variables. Additionally, for the presentation of data, tables and figures were employed. Chi-square analysis was done to compare percentages and categorical variables were described as percentages. Binary logistic regression model was employed to recognize factors linked with gestational diabetes mellitus. Variables with P-value of less than or equal to 0.25 in the bivariate analysis was transferred to the analysis of multivariate to manage the confounders' possible effect. Model goodness of fit test was examined by the Hosmer and Lemeshow test (P-value = 0.853). Adjusted Odds Ratio (AOR) with a 95% confidence level was approximated to indicate association strength and a P-Value of < 0.05 was accepted as statistically significant, in the analysis of multivariate.

4.9. Ethical considerations

Ethical clearance was obtained from Department of Research and Ethical Review Committee of Department of Medical laboratory Science, College of Health Science, Addis Ababa University. The committee wrote an official letter to West Guji zone health department and the zone health department wrote an official letter to health facilities. The purpose of the study was clearly explained for each study participant and signed written informed consent was obtained from the study participants. Participant's confidentiality was strictly handled during the interview process, data processing and report writing.

4.10. Dissemination of the result

The study findings were submitted to Addis Ababa University, College of health science and school of medical laboratory sciences. The results will be submitted to the study site (public health facilities in Bule Hora town). The findings of the study will be submitted to national or international peer reviewed journal for publication. The findings will be presented at national and international scientific conferences.

4.11. Operational definitions

Gestational diabetes mellitus: is usually identified during the late second or third trimester of gestation and it is considered to be present when a Fasting blood glucose concentration is ≥92-126 mg/dl[1].

Gestational age (GA) is the fetus age, starting from the fertilization period to birth.

Parity is the defined number of live-born children that a mother has given birth.

Nullipara: Pregnant mothers who have never given birth.

Primipara: Pregnant mothers who gave birth only once.

Multipara: Pregnant mothers who gave birth above one.

5. Results

5.1. Socio demographic and clinical characteristics of respondents

A total of 190 pregnant mothers were enrolled in this study. Among the study participants, 165(86.8%) were urban residents. The mean age of the pregnant women was 30.06 (SD ± 5.53) years. Most of the pregnant mothers were greater than 35 years old 34.2%.

Almost all were married 170(89.5). Majority of the women were from Oromo ethnic group 113(59.5%), and 103(54.2%) were protestant followers and the majority of pregnant mothers had post-secondary education 64(33.7%). Besides among the study participants, almost three fourth 140(73.7%) mothers had no family history of DM. Most of the mothers were multipara 110(57.9%) (Table 1).

Table 1: Selected clinical and socio-demographic features of the pregnant mothers following ANC at public health facilities in Bule Hora town, Oromia, Southern Ethiopia: From February–April 2021 (n = 190).

Variables	**Categories**	**Frequencies (%)**
Age	<25	34(17.9)
	25-29	43(22.6)
	30-34	48(25.3)
	>35	65(34.2)
Marital status	Single	4(2.1)
	Married	170(89.5)
	Divorced and others	16(8.4)
Educational status	Not formal education	18(9.5)
	Primary education	59(31.1)
	Secondary education	49(25.7)
	Post-secondary	64(33.7)

Religion	Protestant	103(54.2)
	Orthodox	26(13.7)
	Muslim	40(21.1)
	Others	21(11.0)
Ethnicity	Oromo	113(59.5)
	Amhara	15(7.9)
	Gurage	19(10.0)
	Others	43(22.6)
Residence	Urban	165(86.8)
	Rural	25(13.2)
Family history of DM	No	140(73.7)
	Yes	50(26.3)
Parity	Nullipara	43(22.6)
	Primipara	37(19.5)
	Multipara	110(57.9)

5.2. Anthropometric and Biochemical tests measurements of respondents

Among the study participants 60(31.6%) were with overweight/obesity and 18(9.5%) mothers had abnormal blood pressure. The mean of the MUAC was 25.23 (SD ±3.34) cm, Fasting plasma glucose was 83.46 (SD ±8.84) mg/dl, Total cholesterol level was 191.65 (SD ± 37.39) mg/dl, Triglycerides Level was 187.52 (SD ± 34.52) mg/dl, HDL level was 63.38 (SD ± 9.84) mg/dl, AST level was 40.17(SD ± 9.09) U/L, ALT level was 41.15 (SD ± 9.74) U/L (Table 2).

Table 2: Anthropometric and biomedical tests measurements of the pregnant mothers following ANC at public health facilities in Bule Hora town, Oromia, Southern Ethiopia: From February–April 2021 (n = 190).

Variables	**Categories**	**Frequencies (%)**
MUAC	MUAC < 28 cm	130(68.4)
	MUAC ≥28 cm	60(31.6)
Blood pressure	Normal (120/80 mmHg)	172(90.5)
	Abnormal(≥140/90mmHg)	18(9.5)
Fasting plasma glucose (mg/dl)	GDM (≥92-126mg/dl)	14(7.4)
	Normal (<92mg/dl)	176(92.6)
Total cholesterol level (mg/dl)	Normal(≤200mg/dl)	132(69.5)
	Abnormal (>200mg/dl)	58(30.5)
Triglycerides Level (mg/dl)	Normal(≤200mg/dl)	137(72.1)
	Abnormal (>200mg/dl)	53(27.9)
High density lipoprotein level(mg/dl)	Normal(>47mg/dl)	174(91.6)
	Abnormal (≤47mg/dl)	16(8.4)

AST(U/L)		
	Normal(11-39U/L)	132(69.5)
	Abnormal (>39U/L)	58(30.5)
ALT(U/L)		
	Normal(9-39U/L)	108(56.8)
	Abnormal (>39U/L)	82(43.2)

5.3. Behavioral and lifestyle characteristics of respondents

In the present study, a moderate status of physical activity was reported by 149 (78.4%) Participants. Nearly all, 173 (91.1%), pregnant mothers had no history of alcohol consumption, meanwhile majority had history of coffee consumption 135(71.1%). Most of the pregnant mothers were classified under inadequate dietary diversity status, 143(75.3%). In this study, history of alcohol consumption, history of coffee consumption and status of physical activity were not associated with GDM (Table 3).

Table 3: Life style and behavioral features of the pregnant mothers following ANC at public health facilities in Bule Hora town, Oromia, Southern Ethiopia: From February–April 2021 (n = 190)

Variables	**Categories**	**Frequencies (%)**
Status of physical activity	High	12(6.3)
	Moderate	149(78.4)
	Low	29(15.3)
Status of dietary diversity	Adequate (≥5)	47(24.7)
	Inadequate (<5)	143(75.3)
Consumption of alcohol	NO	173 (91.1)
	YES	17(8.9)
Consumption of coffee	NO	55(28.9)
	YES	135(71.1)

5.4. Obstetric history of pregnant women

Among 190 pregnant women, 25(13.2%) were with history of having macrocosmic babies, 141(74.2%) had history of gestational age between 24 and 28 weeks. Besides, had no prior history of GDM 174 (91.6%), no prior history of stillbirth 176(92.6%), history of abortion 47(24.7%) and cesarean section rate was reported by 20(10.5%), as shown in (Table 4).

Table 4: Obstetric history of the pregnant mothers following ANC at public health facilities in Bule Hora town, Oromia southern Ethiopia: From February-April 2021 (n = 190)

Variables	**Categories**	**Frequencies (%)**
Previous history of macrocosmic baby	No	165(86.8)
	Yes	25(13.2)
History of delivery by caesarean section	No	170(89.5)
	Yes	20(10.5)
History of abortion	No	143(75.3)
	Yes	47(24.7)
History of still birth	No	176(92.6)
	Yes	14(7.4)
Previous history of GDM	No	174(91.6)
	Yes	16(8.4)
Gestational age in weeks	2^{nd} trimester (24-28 wks.)	141(74.2)
	3^{rd} trimester (29-32 wks.)	49(25.8)

5.5. Prevalence of Gestational Diabetes Mellitus

The prevalence of gestational diabetes mellitus in this study was **7.4%** with mean fasting plasma glucose level of 108.5(SD ± 9.06) mg/dl. GDM was more common among multiparous mothers, and it was identified in 2 (4.7%) of nulliparous, 3 (8.1%) of primiparous and 9 (8.2%) of multiparous pregnant mothers.

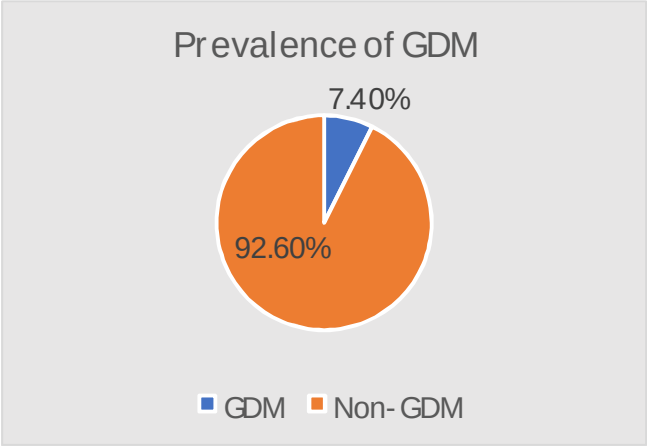

Figure 3: The prevalence of gestational diabetes mellitus among mothers following ANC at Public health facilities in Bule Hora town, Oromia, Southern Ethiopia: From February-April 2021(n = 190).

5.6. Risk factors associated with Gestational Diabetes mellitus

Findings of the unadjusted binary logistic regression showed that overweight and/or obesity (MUAC ≥28 cm), inadequate dietary diversity, maternal late gestational age from 29 to 32 weeks, Total cholesterol level (>200mg/dl), Triglycerides Level (>200mg/dl), history of abortion, history of having macrocosmic baby, family history of DM, History of delivery by caesarean section and Previous history of GDM were associated with Gestational Diabetes mellitus. Analysis of multivariate was done to manage potential confounders, consequently, Family history of diabetes (AOR = 5.7; 95% CI: 1.28-25.27), Triglycerides (AOR =5.6; 95% CI: 1.258-25.46), History of having macrocosmic baby (AOR =6.8; 95% CI: 1.56-29.59) and History of abortion (AOR = 4.4; 95% CI: 1.09-18.39) were independently associated with GDM (Table 5).

Table 5: Presenting associated factors independently linked with gestational diabetes mellitus among pregnant mothers following ANC at public health facilities in Bule Hora town, Oromia, Southern Ethiopia: From February-April 2021. (n=190).

Variables	**Gestational diabetes mellitus**		**COR (95%CI)**	**AOR (95%CI)**	**P Value**
	Non-GDM	**GDM**			
	N (%)	**N (%)**			
Family history of DM					
No	137**(97.9)**	3(2.1)	1	1	
Yes	39(78)	11(22)	12.8(3.42, 48.47)	5.7(1.28, 25.27)	0.02
Triglycerides					
Normal	134(97.8)	3(2.2)	1	1	
Abnormal	42(79.2)	11(20.8)	11.6(3.12, 43.91)	5.6(1.258, 25.46)	0.024
History of having macrocosmic baby					
No	159(96.4)	6(3.6)	1	1	
Yes	17(68.0)	8(32.0)	12.4(3.86, 40.2)	6.8(1.56, 29.59)	0.01
History of abortion					
No	138(96.5)	5(3.5)	1	1	
Yes	38(80.9)	9(19.1)	6.5(2.06, 20.6)	4.4(1.09, 18.39)	0.038

5. Discussion

In the course of healthy gestation, body of the pregnant women experiences a number of physiological changes to assist the demands of the fetus. Adaptations to the metabolic cardiovascular, respiratory, hematologic, and renal systems are the major physiological changes. In the process of pregnancy, sensitivity of insulin shifts on the basis of the requirements of pregnancy. In early pregnancy, insulin sensitivity elevates, promoting the glucose uptake into adipose stores during preparation for the energy demands of later pregnancy[53]. But, as gestation develops, an increase in placental and local hormones, such as progesterone, estrogen, cortisol, leptin, placental growth hormone and placental lactogen together stimulate a condition of resistance of insulin. Consequently, blood sugar is somewhat raised, and the raised sugar is easily transported across the placenta to support the fetal development. This light condition of resistance of insulin also stimulate endogenous glucose production and the breakdown of fat stores, leading to further elevation in blood sugar and free fatty acid levels. Advanced maternal age, obesity and family history diabetes etc. are associated factors of GDM. GDM results in macrosomia and birth complications of the newborn; and raised risk of maternal cardiovascular disease and type 2 diabetes[6].

A total of 190 pregnant women within the gestational age of 24-32 weeks were screened for gestational diabetes mellitus by using the World Health Organization's (WHO) 2013 recommendation. In this study, the overall prevalence of gestational diabetes among pregnant women was 7.4%. The finding was consistent with those of studies conducted in Egypt (8%) [54], Tanzania (5.9%)[33], Bangladesh (5%)[43], Tehran (6.8%)[55].

The prevalence of GDM in this study was found to be almost 2-folds higher than the study conducted on the associated factors and prevalence of gestational diabetes mellitus in wolaita, southern Ethiopia which was 4.2%[46]. The major reason for the high prevalence of gestational diabetes mellitus in this study might be due to differences in screening techniques and characteristics of the population. On the contrary, the result in this study is lower than those of studies done in Gondar, Northwest of Ethiopia (12.8%) [38], Tanzania (19.5%)[36], Limbe Cameroon (20.5%)[45]. These variations in the GDM prevalence can be ascribed to differences in diagnostic criteria and features of the population[56,57]. Change in lifestyle, Elevated testing for GDM, and the increasing incidence of obesity might also have contributed[24].

In this study, Gestational diabetes mellitus was associated with family history of diabetes mellitus; the odds of developing gestational diabetes mellitus was 5.7 times higher among mothers with family history of diabetes mellitus as compared to those who had no family history of diabetes mellitus. The result was in line with an investigation done in the United States of America[58] and research conducted in

Iran[55]. This might be due to the fact that the abnormal blood glucose was associated with familial predisposition to insulin secretory defects and a genetically dysfunctional of pancreas beta cell[59]. Additionally, lifestyles and families living standards are more likely similar leading to sharing the associated factors[60].

In this study, pregnant mother with previous history of abortion had 4.4 times higher gestational diabetes mellitus than their counterparts. This finding is similar with other investigations done in Wolaita, southern Ethiopia[46] and China and the investigations stated that previous history of spontaneous abortion was associated with increased possibility of acquiring gestational diabetes[61]. The risk of abortion during the index pregnancy might be indicative of women with poor blood glucose control and various endocrine system problems which affect the normal metabolism of insulin, which might then predispose women to recurrent or risk for GDM.

The current study also found that pregnant mothers who were ever had macrocosmic baby (>4kg) was almost seven folds more likely to develop GDM as compared to pregnant mother who had no macrocosmic baby previously. This finding agrees with a cohort study in Nova Scotia Atlee Perinatal Database (NSAPD) in Canada by Stephanie et al.[62]. This could be due because large infant birth weight during index pregnancy may be indicative of poor control and/or poor maternal diet or may reflect GDM severity, which might predispose the women to recurrent gestational diabetes mellitus[62].

In present study, pregnant women who had elevated serum concentration of TG were nearly six times more likely to develop gestational diabetes mellitus than women with normal serum concentration of TG. This result is supported by studies conducted in China by Jin et al.[63]. this might be due to the fact that Insulin resistance could elevate serum concentration of triglycerides.

7. Strength and limitation of the study

7.1. Strength of the study

- Updated and universal screening method was employed to detect gestational diabetes mellitus.
- Measurement of fasting blood glucose was done on serum samples by rejecting the use of point-of-care tests that may influence the result as to WHO recommendation.
- The investigation was done at 24-32 weeks of gestation for all pregnant mothers.
- The assessment of Liver function test and lipid profiles was done along with diagnosis of GDM to check association.

7.2. Limitation of the study

- Laboratory diagnosis of gestational diabetes mellitus was done solely by Fasting blood glucose.
- Pregnant mothers who had risk factors for gestational diabetes mellitus and whose Fasting blood glucose results were negative at the regular test could not be checked again at late gestational age because of resource and time limitations.
- The nature of study design (cross sectional) and sampling technique(convenient)

8. Conclusion and recommendation

8.1. Conclusion

The overall prevalence of gestational diabetes mellitus was found to be 7.4% in present studies. The present study showed that gestational diabetes mellitus is a common pregnancy complication among pregnant mothers attending antenatal care at Bule Hora town public health facilities, Oromia, southern Ethiopia.

History of having macrocosmic baby, Family history of diabetes, History of abortion and elevated concentration of Triglycerides were significantly associated with GDM. The finding of this study agreed with different studies result regarding significant association of risk factors with gestational diabetes mellitus.

8.2. Recommendation

This study indicated that History of abortion, History of having macrocosmic baby and Family history of diabetes are significantly associated with GDM, thus health workers should give attention to all women having family history of diabetes and poor obstetric history and screen for gestational diabetes mellitus to mitigate the burden.

Elevated concentration of Triglycerides was also found to be significantly associated with gestational diabetes, with regard to this maternal lipid profiles should be screened along with gestational diabetes to prevent pregnancy complications and adverse birth outcomes.

The present study strongly recommends that universal screening and early diagnosis of gestational diabetes mellitus are necessary for better management and to halt the burden.

All stakeholders should provide creation of awareness through health promotion and health education to large community regarding risk factors of gestational diabetes mellitus.

All pregnant mothers should attend all schedules of antenatal care visits to reduce the risk of adverse outcomes related with gestational diabetes mellitus. Conduction of further large scale study is highly recommended.

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ANNEXES

Participants' information sheet in English Version

Title of the Research: the prevalence of gestational diabetes mellitus and associated factors among women attending ANC at Bule Hora town public health facilities, Oromia, Southern Ethiopia.

Principal Investigator: Wako Dedecha (BSc, MSc candidate)
Name of the Organization: Department of Medical Laboratory Sciences, College of Health Sciences, Addis Ababa University

Introduction

You are invited to participate as a study subject in a research conducted by MSc candidate, from Addis Ababa University. Your participation is voluntarily. The research teams will include one principal investigator, two advisors; both from Addis Ababa University Clinical chemistry department. Please take as much time as you need to read or listen in the information sheet.

Purpose of the Research

We are asking you to take part in this study because we will try to assess the prevalence of gestational diabetes mellitus and associated risk factors among pregnant women.

Purpose of the research:

The health laboratory plays an indispensable role in the health care system. It supports diagnosis (to rule in or rule out a diagnosis), monitoring of response to treatment, epidemiological surveillance, prevention as well as Research (to understand the pathophysiology of a particular disease process). Especially there is lack of assessment of the prevalence of gestational diabetes mellitus and associated risk factors in Ethiopia. Therefore, the purpose of this proposed study is to assess the prevalence of gestational diabetes mellitus and associated factors among women attending health facilities at Bule Hora town, Southern Ethiopia. You have been chosen for this study. Therefore, we invite you to take part in this study and contribute to the assessment of the prevalence of gestational diabetes mellitus and associated risk factors. The findings of this study

are needed for monitoring the adverse outcome of gestational and diabetes mellitus. Thus, result from this study is anticipated to improve the health status of the pregnant women in Ethiopia.

Procedures and the expected participation

If you are willing to participate, you need to understand the purpose of the study and give your consent. Not only this but also specimen collected from you will be used for the research purpose, and the results of your sample will be exposed to some concerned professional staffs as it is needed. The required clinical sample will be collected by residents of Medical laboratory department. Then, you are requested to give your consent to the sample collector. After consent, a sample will be taken from venipuncture. Moreover, there will be a face-to-face interview for additional questions.

Procedures: After agreeing that you can take part, one or more of our research staff will ask you some questions which will take up to 15 minutes. We will collect 5ml venous blood from you into serum separator tube. We will conduct laboratory examination to determine level of blood sugar, lipid profile and LFT.

Potential risks and Discomforts

There will be some minimal risk and discomfort when we take venous blood. Nevertheless, we will try to minimize the discomfort as much as possible, as the blood samples will be taken by experienced laboratory professionals.

Confidentiality

We respect your privacy and confidentiality. Any information that identifies you will not be shared with anyone else outside the study team. The information we will collect from you as part of the study will be kept in a locked file cabinet, or be protected by a password on the computer only accessible to personnel involved in the study. There is no sensitive issue that you will be asked related with your social desirability but any information that is obtained in connection with this study and that can be identified with you will remain confidential.

Potential benefits to subjects and/or to the society

You will not receive any payment for your participation in this research study as compensation. However, based on the diagnosis result you will be treated in view of that. In addition, the result of the study will be beneficial for the detection and managing of gestational diabetes mellitus. Hence, you are indirectly benefiting other patients and the society in this respect.

Participation and Withdrawal from the Study

The participation is voluntary and you have the right not to participate in this study. You may withdraw at any time and place without consequences of any kind. You may also reject to give any sample. You can ask any questions regarding to this study and you have a right to get a laboratory diagnosis result free.

Contact information

If you have any questions about this study, you can contact the following principal investigator and advisors for further information.

Name	phone cell	email
Wako Dedecha (MSc candidate)	0931002698	wakdboko99@gmail.com
Mistire Wolde (Associate prof, PhD)	0911699710	mistire08@gmail.com
Tatek G/Egziabher (MSc, PhD candidate)	0911644338	tatekgeher@yahoo.com

Participants' information sheet in Afaan Oromoo Version

Mat-duree qorannichaa: "The prevalence of gestational diabetes mellitus and associated factors among women attending ANC at Bule Hora town public health facilities, Oromia, Southern Ethiopia.**" "Qorannoo facaatii dhukkuba sukkaaraa ulfaan walqabatee dhufuu fi wantoota dhukkubichaaf sababa ta'anii Dhaabbilee fayyaa magaalaa Bulee Horaa keessatti"**

Qorataa qorannichaa: Waaqoo Dhaddachaa (Barataa digrii lammeessoo)

Dhaabbaticha qorataan itti baratu: Yuunivarsiitii Addis Ababaatti Kolleejjii fayyaa, Muummee Meedikaali laboraatoorii

SEENSA

Qorannoo kadhimamaa digrii lammeessoo barataa yuunivarsiitii Addis Ababaatiin geggeeffamu kanarratti akka hirmaattanuuf kabajaan affeeramtaniittu!

Kaayyoo qorannichaa: Qorannoo facaatii dhukkuba sukkaaraa ulfaan walqabatee dhufuu fi wantoota dhukkubichaaf sababa ta'an irratti godhuu.

Akkuma beekamu laboratooriin fayyaa namaa sirna fayyaa keessatti gahee olaanaa taphata. Kanumaan walqabatee laboratooriin fayyaa namaa qorannoo dhukkubaa, wal'aansa dhukkubaa, ittisa dhukkubaa fi qorannoo fi qo'annoo facaatii dhukkubaa keessatti gahee bakka bu'aa hin qabne taphata. Itiyoophiyaa keessatti qorannoon facaatii dhukkuba sukkaaraa ulfaan walqabatee dhufurratti geggeeffame baayyee muraasa waan ta'eef kaayyoon guddaan qorannichaa qaawa kana duuchuudha. Isinis kanuma hubannaa keessa galchuudhaan waan isinirraa eeggamu qorannichaaf akka gumaachitaniif kabaja guddaadhaan filatamtaniittu. Bu'aan qorannoo kanalle miidhaa dhukkuba sukkaaraa ulfaan walqabatee dhufuu too'achuuf ni gargaara, akkasumalle fayyummaa haadholii ulfaa eeguu keessatti gahee guddaa ni taphata.

ADEEMSAA FI HIRMAANNAA EEGGAMU

Yoo kaayyoo qorannichaa hubattee, qorannicha keessatti hirmaachuu murteessite haayyamamaa ta'uu kee nutti himta. Eega haayyamamaa ta'uu kee beeksifteen booda Saamudni dhiigaa 5ml

hidda dhiigaa harkaarraa ni fudhatama, itti aansuudhaan af-gaafiin gabaabaan daqiiqaa 15 hin caallee isin woliin ni godhama. Dhumarratti qorannoon laboraatoorii saamudicharratti eega godhameen booda firiin qorannoo laboraatoorii oggeessota fayyaa si tajaajilani qofaaf ni beeksifama.

Miira dhukkubbii jiraatuu malu

Yeroo saamudni dhiigaa hidda dhiigaarraa fudhatamu miirri dhukkubbii ni jiraata haata'uu maalee ogeessi laboraatoorii muuxannoo qabu waan isinirraa fudhatuuf dhukkubbichi ni diqqaata.

Icciitii eeggamu

Yaada dhunfaa keetii ni kabajna, icciitii gola keetii ni egna. Odeeffannoon ati nuuf kennitu garee qorannichaatiin ala qama garabiraatiif hin saaxilamu. Odeeffannoon nuuti qorannichaaf sirraa fudhannu sirritti eeggama, garee qorannootiin ala eennuufille banaa hin ta'u.

Bu'aa hirmaattuun qorannichaa/hawaasi bal'aan qorannoo kanarraa argatu

Kafaltiin sababa qorannoo kanarratti hirmaattaniif isiniif kaffalamu jiraachuu baatulle, firii qorannoo kanarratti hundaa'ee adeemsi ittisaa fi too'annaa dhukkubichaa isin bira darbee uummata badhaa ni fayyada.

Hirmaannaa fi mirga qorannoo addaan kutuu

Hirmaannaan qorannicha keessatti qabaattan fedhii keessan qofaan waan ta'eef mirga qorannicha keessatti hirmaachuu dhabuu ni qabdu. Akkasumalle, yeroo fi bakka barbaaddanitti qorannicha addaan kutuuf mirga guutuu qabdu.Yoo isinitti hin tolin saamudas kennuu dhiisuu dandeettu. Gaafii qorannicha Kanaan wolqabate kamiiyyuu gaafachuu mirga qabda. Dhumarratti,qorannoo laboraatoorii bilisaan argattu.

Karaa odeeffannoo dabalataa argachuu dandeessaniin

Gaafii qorannicha Kanaan wolqabate kamiiyyuu yoo qabaattan karaa sarara qunnamtii armaan gadiitiin qorattoota qorannichaa qunnamuu dandeessu!

Maqaa	Lakk. bilbilaa	Iimelii
Obboo Waaqoo Dhaddachaa (MSc candidate)	0931002698	wakdboko99@gmail.com
Doktoor Misxiree Woldee (Associate prof, PhD)	0911699710	mistire08@gmail.com
ObbooTaaxeq G/Igzihaaber (MSc, PhD candidate)	0911644338	tatekgeher@yahoo.com

Consent Form

I have read the information above, or it has been read to me. I have been given the opportunity to ask questions and my questions have been answered to my satisfaction. I voluntarily consent that I would participate in this study.

By allowing to collect my blood and be a participant in this study and understand that I have the right to withdraw from the study at any time.

Print name of participant, date and signature or thumb impression of participant

_____ ____ /____ /____ (dd/mm/yy) _____

If illiterate;

Print name of independent literate witness, date and signature of witness (if possible, this person should be selected by the participant and should have no connection to the research team)

_____ ____/____/_____ (dd/mm/yy) _____

Phone number_____

Print name of researcher, date and signature of researcher

_____ _____/____/_____ (dd/mm/yy) _____

Consent Form in Afaan Oromoo version

UUNKAA HAYYAMAMAA TA'UU IBSU

Odeeffannoo armaan olii dubbiseera yokaan naaf dubbifameera. Carraan gaafii barbaade gaafachuus naaf kennameera akkasumas gaafii gaaffadheef deebiin gahaan naaf kennameera.

Fedhii kiyyaan qorannaa kanarratti hirmaaachuuf hayyamamaa ta'eera. Hirmaataa qoranichaa ta'ee saamuda dhiiga kiyyaa hanga qorannichaaf barbaachisu akkan kennuuf hayyamamaa ta'een jira. Yeroo barbaade kamittuu qorannicha addaan kutuuf mirga guutuu qabaachuu kiyyas dhageeffadheera/dubbiseera.

Maqaa hirmaataa Guyyaa Mallattoo

_____ ___/___/____ _____

Hirmaataan dubbisuu fi mallatteessuu yoo hin dandeenye ta'e.

Maqaa nama ragaa Guyyaa Mallattoo

_____ ____/___/____ _____

Lakk. Bilbilaa:_____

Maqaa qorataa/raga funaanaa Guyyaa Mallattoo

_____ ____/____/_____ _____

Principles of each laboratory analysis, procedures and interpretation

- **Test principle for glucose measurement**

glucose oxidase or peroxidase method (god pod method) was performed and its principle is, Glucose oxidase (GOD) catalyzes the oxidation of glucose to gluconate or Gluconic acid, the formed hydrogen peroxide (H2O2) is detected by a chromogenic oxygen acceptor, phenol, 4-Amino phenazone (4-AP) in the presence of peroxidase (POD), the intensity of the color formed is proportional to the glucose concentration in the serum. Intensity is determined at wavelength of 505 nm.

-D-Glucose + O2 + H2O in the presence of GOD Gluconate + H 2O2, H2O2 + Phenol + (4-AP) POD Red Quinone dye + H 2O.

Advantages:

- ✓ It is specific for glucose estimation.
- ✓ This method is sensitive, simple.
- ✓ It is cheap method.

Reaction type: end point increasing assay.

Interpretation; FBS= 92-126mg/dl is GDM

FBS<92mg/dl Normal blood sugar level

FBS>126 mg/dl Pre-existing (Overt) diabetes mellitus **(2013 WHO diagnostic criteria for GDM)**[1**]**.

- **Test principle for ALT measurement**

This technique follows the IFCC recommendations. ALT catalyzes the reaction between L-alanine and 2-oxoglutarate. The pyruvate formed is reduced by NADH in a reaction catalyzed by lactate dehydrogenase (LDH) to form L-lactate and NAD+.

L-Alanine + 2-oxoglutarate $\xrightarrow{ALT}$ pyruvate + L-glutamate

Pyruvate + NADH + H+ $\xrightarrow{LDH}$ L-lactate + NAD+

The rate of the NADH oxidation is directly proportional to the catalytic ALT activity. It is determined by measuring the decrease in absorbance. ALT activity is determined at wavelength of 340nm

Reaction type: Kinetic – Decreasing assay

Reference values: 9-39U/L

Reference:

- ✓ Internal. Federation of clinical Chemistry, Scientific committee, Clin. Chem., 23, 887 (1977).

❖ **Test principle for AST measurement**

Kinetic determination of Aspartate aminotransferase recommended by IFCC. AST in the sample catalyzes the transfer of an amino group between L-aspartate and 2-oxoglutarate to form oxaloacetate and L-glutamate. The oxaloacetate then reacts with NADH, in the presence of malate dehydrogenase (MDH), to form NAD+. The rate of the NADH oxidation is directly proportional to the catalytic AST activity. It is determined by measuring the decrease in absorbance. AST activity is determined at wavelength of 340nm

Reaction type: Kinetic – Decreasing assay

Reference values: 11-39U/L

Reference:

- ✓ Internal. Federation of clinical Chemistry, Scientific committee, Clin. Chem., 23, 887 (1977).

❖ **Test principle for HDL-cholesterol measurement**

Low-density lipoproteins, very low-density lipoproteins and chylomicrons are specifically precipitated by Phosphotungestic acid and Magnesium ions and can be removed by

centrifugation. High- density lipoproteins (HDL) remain in the supernatant. Finally, only HDL-particles can react with CHER and CHOD. The concentration of HDL-cholesterol is determined enzymatically by CHER and CHOD. Cholesterol esters are broken down quantitatively into free cholesterol and fatty acids by CHER.

In the presence of oxygen, cholesterol is oxidized by cholesterol oxidase to Δ 4 -cholestenone and hydrogen peroxide.

In the presence of peroxidase, the hydrogen peroxide generated reacts with 4-amino-antipyrine and EMSE to form a dye. The color intensity of this dye is directly proportional to the cholesterol concentration and is measured photometrically.

Reference values: >47 mg/dl

References:

- ✓ Castelli et al. Circulation 1975, 55, 767
- ✓ Burstein M et al. Lipid Res. 1970, 11, 583.

❖ **Test principle for total cholesterol measurement**

Enzymatic colorimetric method. Cholesterol esters are cleaved by the action of cholesterol esterase to yield free cholesterol and fatty acids. Cholesterol oxidase then catalyzes the oxidation of cholesterol to cholest-4-en-3-one and hydrogen peroxide. In the presence of peroxidase, the hydrogen peroxide formed effects the oxidative coupling of phenol and 4-aminophenazone to form a red quinone-imine dye.

The color intensity of the dye formed is directly proportional to the cholesterol concentration. It is determined by measuring the increase in absorbance. Intensity of the dye is determined at wavelength of 500 nm.

Reaction type: Endpoint increasing assay

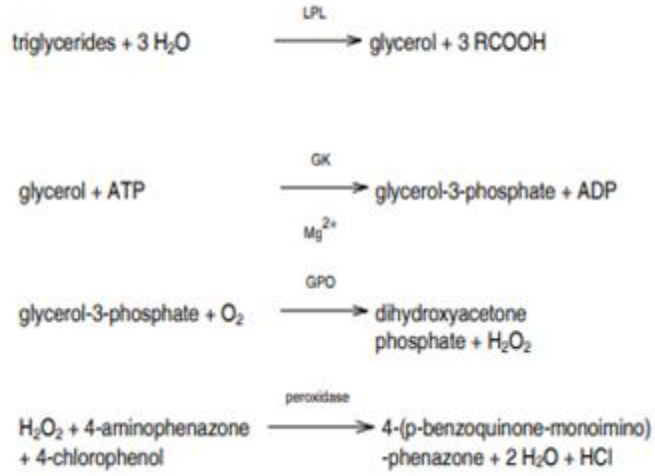
Reference values: 130-200mg/dl

References:

- ✓ Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). NIH Publication No 01-3670; May 2001.
- ✓ Study Group, European Atherosclerosis Society. Strategies for the prevention of coronary heart disease: A policy statement of the European Atherosclerosis Society. European Heart Journal 1987; 8:77.

❖ **Test principle for triglycerides measurement**

Enzymatic colorimetric method



Intensity of the dye is determined at wavelength of 520 nm.

Reaction type: Endpoint increasing assay

Reference values: <200mg/dl

Reference:

- ✓ Study Group, European Atherosclerosis Society. Strategies for the prevention of coronary heart disease: A policy statement of the European Atherosclerosis Society. European Heart Journal 1987; 8:77.

Measurement of blood pressure

In the measurement of blood pressure (BP), the pregnant mothers were told to take a rest for a minimum of five minutes in sitting positions. After taking a rest, BP was determined on the right arm employing normal cuffs fitted for adults with a standard sphygmomanometer putting the stethoscope bell gently on the brachial artery. After two readings were taken within an interval of 5–10 min, systolic blood pressure mean and diastolic blood pressure mean were reported in millimeters of mercury. When SBP≥ 140 mmHg and DBP≥ 90 mmHg, hypertension was diagnosed to be present [38].

Measurement of level of physical activity and dietary diversity

The physical activities that pregnant women do as part of their everyday lives was assessed as to the short form International Physical Activity Questionnaire (IPAQ). For the adults at 15-69 years of age International Physical Activity Questionnaire was appropriate and used in various countries. IPAQ was developed to evaluate particular sorts of activities such as moderate and strong intensity activities done at work places, walking, as part of house and yard work, to go from place to place, and in leisure time for recreation, body exercise. Pregnant Mothers were requested to remember the activities they had done in the past seven days prior to interview. Information collected on physical activities was described as metabolic equivalents (MET-minutes per week) employing the International Physical Activity Questionnaire scoring standard to classify mothers into high, moderate and low level of physical activity categories[51].

The assessment of dietary diversity was done according to a twenty four-hour food recall technique by the Food and Nutrition Technical Assistance (FANTA) 2016 version woman's minimum dietary diversity measurement technique. This technique comprised a list of ten categories of food (starchy staples, nuts and seeds, pulses, dairy, meat, eggs, poultry and fish, dark green leafy vegetables, other vitamin-A rich fruits and vegetables, other vegetables, and other fruits). After the minimum dietary diversity score (MDDS) was divided into two depending on whether or not pregnant mothers had eaten the list of specified food categories in the 24-hour prior to interview. The adequate dietary diversity was considered to be present with MDDS of five and more[52].

Additionally, A pregnant mothers were requested, “How frequently have you consumed coffee since your pregnancy?” If their response was “daily” or “sometimes per a week” the women were classified as coffee exposed. They were also requested, “How frequently have you consumed alcohol since your pregnancy?” If their response was “daily” or “sometimes per a week” the mothers were classified as alcohol exposed.

Questionnaire in English Version

ADDIS ABABA UNIVERSITY, COLLEGE OF HEALTH SCIENCE, DEPARTEMENT OF MEDICAL LABORATORY SCIENCES

Instruction: Please try to complete all information

PARTICIPANT'S CODE NUMBER _____

PART-I

Table 6: Socio demographic and clinical characteristics of the study participants attending antenatal care at Bule Hora town public health facilities, Oromia, Southern Ethiopia: From February–April 2021 (n= 190).

Variables	**Categories**	**Responses**
Age	Age	
Marital status	Single	
	Married	
	Divorced and others	
Educational status	Not formal education	
	Primary education	
	Secondary education	
	Post-Secondary	
Religion	Protestant	
	Orthodox	
	Muslim	
	Others	
Ethnicity	Oromo	
	Amhara	
	Gurage	
	Others	
Residence	Urban	
	Rural	

Family history of DM	NO		
	YES		
Parity	Nullipara		
	Primipara		
	Multipara		
MUAC	MUAC		
Blood pressure	Systolic blood pressure (mmHg)		
	Diastolic blood pressure(mmHg)		
Laboratory investigation results	Fasting blood sugar (mg/dl)		
	Lipid profile (mg/dl)	Tot. cholest	
		HDL	
		TG	
	LFT (U/L)	GOT/AST	
		GPT/ALT	

PART-II: Behavioral and life style characteristics of the study participants attending antenatal care at Bule Hora town public health facilities, Oromia, Southern Ethiopia: From February–APRIL 2021 (n= 190)

1. Level of physical activity
    A. High_____
    B. Moderate_____
    C. Low_____
2. Dietary diversity status
    A. Adequate (≥5) _____
    B. Inadequate (<5) _____
3. Alcohol intake
    A. NO_____
    B. YES_____
4. Coffee intake
    A. NO_____
    B. YES_____

PART-III: Obstetric history of the study participants attending antenatal care at Bule Hora town public health facilities, Oromia southern Ethiopia: From February-April 2021 (n= 190)

1. History of having macrocosmic baby
    A. NO_____
    B. YES_____
2. History of delivery by caesarean delivery
    A. NO_____
    B. YES_____
3. History of abortion
    A. NO_____
    B. YES_____
4. History of still birth
    A. NO_____
    B. YES_____
5. Previous history of GDM
    A. NO_____
    B. YES_____
6. Gestational age in weeks
    A. 2^{nd} trimester (24-28 wks.)
    B. 3^{rd} trimester (29-32 wks.)

We thank you for your cooperation!!

Contact us through: phone cell= 0931002698

EMAIL ADRESS= wakdboko99@gmail.com

Questionnaire in Afaan Oromoo Version

YUUNIVARSIITII ADDIS ABABAATTI, KOLLEEJJII SAAYINSII FAYYAATTI, MUUMMEE SAAYINSII MEEDIKAALI LABORAATOORII

Hubachiisa: abboo! Odeeffannoo barbaachisoo mara guutaa!

Laakkofsa footuu hirmaattotaa: _____

Kutaa-I: Socio demographic and clinical characteristics of the study participants attending antenatal care at Bule Hora town public health facilities, Oromia, Southern Ethiopia: From February–April 2021 (N = 190).

Varaabiloota	**Qoqqoodamiinsa**	**Deebii hirmaataa**
umurii	--------	
Odeeffannoo waa'ee gaa'ilaa	Hin heerumne	
	Heerumteetti	
	Irsaan adda baateetti fi garabiroo	
Odeeffannoo sadarkaa barnootaa	Barnoota idilee hin baranne	
	1-8	
	9-12	
	>12	
Amantii	Prootestaantii/pheenxee	
	Ortodoksii	
	Islaama	
	Kan biraa	
Saba	Oromoo	
	Amaaara	
	Guraagee	
	Kan biraa	
Bakka jireennaa	Magaalaa	

	Baaddiyaa		
Maatii keeti keessaa nami dhukkuba sukkaaraa qabu jiraa?	Jira		
	Hin jiru		
Baayyina ijoollee kan hirmaattuu	Ijoollee hin qabdu		
	daa'ima tokko qabdi		
	Daa'ima tokkoo oli qabdi		
MUAC	----------		
Blood pressure	Systolic blood pressure (mmHg)		
	Diastolic blood pressure(mmHg)		
Laboratory investigation results	Fasting blood sugar (mg/dl)		
	Lipid profile (mg/dl)	Tot. cholest	
		HDL	
		TG	
	LFT (U/L)	GOT/AST	
		GPT/ALT	

PART-II: Behavioral and life style characteristics of the study participants attending antenatal care at Bule Hora town public health facilities, Oromia, Southern Ethiopia: From February–APRIL 2021 (n = 190)

1. Sadarkaa sochii qaamaa
    1. Ol-aanaa_____
    2. Gidduu galeessa_____
    3. Gad-aanaa_____
2. Haala facaatii soorataa kan hirmaattuun sa'aatii 24 keessatti soorattu
    1. Geyaa (5 oli) _____
    2. Geyaa moti (5 gadi) _____
3. Alkoolii hin untaa?
    1. Eetii_____
    2. Waawwoo_____
4. Buna hin untaa?
    1. Eetii_____
    2. Waawwoo_____

PART-III: Obstetric history of the study participants attending antenatal care at Bule Hora town public health facilities, Oromia southern Ethiopia: From FEBRUARY-APRIL 2021 (N = 181)

1. Ulfaatinni daa'ima/daa'immaan duraanii kiiloogiram 4 ol ta'aa?
    1. Eetii_____
    2. Waawwoo_____
2. Kanaan dura opraasiyooniin deetteettaa?
    1. Eetii_____
    2. Lakkii_____
3. Ulfi sirraa bayee beekaa?
    1. Eetii_____
    2. Waawwoo_____
4. Daa'ima lubbuun hin jirre deessee beettaa?
    1. Eetii_____
    2. Waawwoo_____
5. Kanaan dura dhukkubni sukkaaraa ulfaan wolqabatu sitti himamee beekaa?
    1. Eetii_____
    2. Waawwoo_____
6. Umurii ulfaa/garaachaa torbeedhaan_____

Marroo odeeffannoo nuuf kennitaniif guddoo ulfaadhaa!!

Laakkofsa Kanaan nuu bilbiluu dandeettu= 0931002698

EMAILn keenna= wakdboko99@gmail.com

Declaration

Declaration I, the undersigned agrees to accept responsibility for the scientific ethical and technical conduct of the research project and for provision of required progress reports as per terms and conditions of the research publication office in effect at the time of grant is forwarded as the result of this application.

Name of the principal investigator: **Wako Dedecha (BSc, MSc candidate)**

Signature: _____

Date of submission: _____

Approval of Advisors

Name of Advisor

Mistere Wolde (PhD, Associate Professor)

Signature: _____

Date: _____

Place: Addis Ababa, Ethiopia.

Name of Advisor

Tatek G/Egziabeher (MSc, PhD Fellow)

Signature: _____

Date: _____

Place: Addis Ababa, Ethiopia**.**