

Research Article

Magnitude of Gestational Diabetes Mellitus and Association Factors among Pregnant Women in Public Hospitals of Addis Ababa, Ethiopia

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Abstract

Background: Gestational diabetes mellitus (GDM) is one of the most common metabolic disorders known to develop during pregnancy. A study in northern Ethiopia found a prevalence of 13% among urban women which was higher than that of women in rural areas (5%). Risk factors for GDM are mainly advanced maternal age, obesity and family history of diabetes.

Objective: This study aims to assess the magnitude of Gestational Diabetes Mellitus and association factors in public hospitals of Addis Ababa, Ethiopia.

Methods: Hospital-based cross sectional study was conducted in Addis Ababa from June 1/2021 to August 1/2021 among randomly selected hospitals. Data was collected through face to face interview using a semi structured questionnaire and stored in to EPI data version 7.1. Its completeness and cleanliness was checked before importing it to the SPSS version 25 software for the final analysis. The significant factors were computed by using multivariable logistic regression. The independent factors of GDM were those variables with a $p < 0.05$ in the multivariable logistic regression model and the measures of association was reported in adjusted odd ratio (AOR) with 95% CI.

Results: This study found that the magnitude of gestational diabetic mellitus among the study participant is 18.7 %. Factors like multi Parity [AOR=5.28, 95 % CI, 1.45-19.20], Regular ANC follow up [AOR= 0.37, 95% CI: 0.17-0.82], MUAC (24-26 cm) [AOR=5.07, 95% CI: 1.14-22.65] and Sweet drink consumption [AOR=1.9, 95% CI: 1.10-3.48] were positively associated with Gestational diabetic mellitus. While as fat consumption [AOR=0.52, 95% CI: 0.29-0.94], Nutritional advice [AOR=0.217, 95% CI: 0.12-0.40], fruit Consumption [AOR= 0.51; 95 % CI (0.28, 0.91] and meal frequency of ≥ 3 time per day [AOR= 0.4; 95 % CI (0.22, 0.93)] were negatively associated with Gestational diabetic mellitus.

Conclusions: The overall magnitude of Gestational diabetic mellitus was found to be 18.7% and a major public health concern among pregnant women in Addis Ababa. Parity, MUAC 24-26 cm, Nutritional advice, Sweet drink, and fat consumption were significantly associated with Gestational diabetic mellitus. Given the imminent burden of obesity, unhealthy eating, and physical inactivity, a substantial threat of Gestational diabetic mellitus is anticipated in Ethiopia. This may be an appropriate time to think about considering the need for routine screening of Gestational diabetic mellitus to reduce the impact of the diseases in the country.

Keywords: Genital tract tuberculosis, peritoneal tuberculosis and subfertility

1. Introduction

Gestational diabetes mellitus (GDM) is one of the most common metabolic disorders known to develop during pregnancy. Besides obesity and sedentary lifestyles being the main predisposing factors, dietary measures play an important role in its progression too [1]. International Diabetes Federation (IDF)-2015 report showed that about 16.2% of women had some form of hyperglycemia during pregnancy, of which GDM shares about 85.1% of the load [2]. The prevalence of GDM is reported to be 3.7% in Northern Ethiopia 3.7%. Additionally, a survey done in the same region (North Ethiopia) found a prevalence of 13% among urban women which was higher than that of women in rural areas (5%). However, the study used only fasting blood glucose test as diagnostic criteria for GDM [3]. Risk factors for GDM are mainly advanced maternal age, obesity and family history of diabetes. Women with a history of GDM are also at an increased risk of developing type 2 diabetes mellitus (T2DM) over 5–10 years after pregnancy, and their children have a higher risk of developing obesity and T2DM early in life [4].

Factors that may contribute to the prevention of GDM like Food and dietary factors have been reported to affect glucose homeostasis, and diet may be associated with GDM risk factors [5]. Several studies found a positive association between GDM risk and intake of total fat, saturated fat, and an inverse relation between the risk of GDM and polyunsaturated fat. Women with GDM are at an increased risk of GDM in future pregnancies and also at a higher risk of developing type 2 diabetes in the future. GDM also increases [6].

The screening and diagnosis of GDM differ widely between clinicians and among countries. GDM is usually diagnosed at 24–28 week of gestation by either “two-step approach” (that involves a 50-gram glucose challenge test with a diagnostic cut-off at 130mg/dl, 135mg/dl or 140mg/dl, followed by a 100g of 3 hour OGTT [7]. The detection of GDM during pregnancy provides an opportunity to identify women at risk of short term and long term complications. We now have evidence that early diagnosis and intervention can reduce the adverse prenatal outcomes [8]. Due to the growing trend of gestational diabetes and a shortage of research on the effect of dietary patterns on the prevention of GDM in Ethiopian women, this study aimed to assess the prevalence of Gestational Diabetes Mellitus and association Factors in selected Hospitals of Addis Ababa, Ethiopia.

2. Methods and Materials

Study Area: The study is conducted at selected public hospitals of Addis Ababa Ethiopia. Gandhi Memorial Hospital is a referral maternity hospital and Zewditu Memorial Hospital is also a comprehensive referral hospital. Two hospitals are catchment hospitals for 40 health centers and other health facilities. The Hospitals provide comprehensive emergency obstetric care (CEmOC) and attend over 17000 deliveries per year [9]. The referral system for an obstetric emergency in Addis Ababa is organized to include basic emergency obstetric care (BEmOC) and CEmOC facilities. The referral system is developed to work both ways. Referral between

health facilities is facilitated by the liaison office or the maternal health task force. An ambulance system is organized to transport women accompanied by midwives. The midwife provides care during transportation and hand over the mother to the receiving hospital care provider with a referral paper. In Addis Ababa, all maternity services including labor/delivery and the ambulance services are provided free of charge in all public health facilities [10].

Study Period

The study was conducted from July 1, 2021-Aug 1, 2021.

Study Design

Facility Based cross sectional study design was implemented

Source Population

All pregnant women aged 18–49 years at the selected hospitals in Addis Ababa Ethiopia.

Study Population

All pregnant women aged 18–49 years who has ANC follow up in the selected hospital of Addis Ababa during the study period were the study population.

Inclusion Criteria

All Pregnant women age from 18-49 years.

Exclusion Criteria

Women who had diabetes mellitus prior to the current pregnancy.

Sample Size Determination and Sampling Technique

A single population proportion formula with 95% confidence level was used to estimate the sample size required for the study by considering the following assumptions:

Level of significance, $\alpha = 0.05\%$,

Proportion, 'P' = 0.5 (due to absence of similar study in the study area)

Margin of error = 5%, and

The formula for calculating the sample size is,

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

On the basis of the above sample determination, $n = 384$. 10% non-response rate = 38. Thus, the total sample size will be 422.

Sampling Technique

A systematic random sampling method was used to recruit participants. First the two hospitals were selected using simple random sampling methods from all of the public hospitals found in Addis Ababa. Individuals in each hospital are recruited by using a systematic random sampling method. Sample size for each hospital was complemented using proportional to the total women's who had ANC follow up

during the study period. In Ghandi hospital there were 1018 pregnant women's who had ANC follow up during the study period and there were 900 pregnant women's in Zewditu hospital during the same period [11]. Thus, 224 participants from Ghandi hospital and 198 participants from Zewuditu Hospital were the calculated sample size for each hospital. From the first five eligible participants who came to the hospital for ANC follow up, one random participant was selected and interviewed, then it was continued every 5th ($900/198 \times 5 = 22.5$) of the participants until the desired sample size is achieved. Eligible women who provide oral and written signed informed voluntary consent were interviewed through face to face interview in a separate room at ANC clinics [12].

Data Collectors Supervisor

Four data collectors were assigned to collect the data. The data collectors were one MD and three BSc nurses. Each data collector can read, write and listen to the local language (Amharic). One Bsc nurse in conjunction with the principal investigator was assigned to supervise the data collectors on daily bases.

Data Collection Tool and Procedure

Data were collected through face to face interview by using pre tested semi-structured questionnaires with closed-ended questions in combination with patient's card review. The tool was developed based on previous studies and then adapted to the local situation with some modification. The questionnaire includes questions regarding socio-demographics characteristics, Health service utilization, Behavioral factors Physical, Gynecological and obstetric history, Dietary factors, and Anthropometry. Questions regarding GDM are also included. The tool was first prepared in English and translated to Amharic for data collection, and then back-translated to English for analyses to assure its consistency. The Amharic version was used for collecting the data [13, 14].

Study Variables

Dependent Variables

Magnitude Gestational diabetic Mellitus

Independent Variables

Behavioral factors Physical Activity: Alcohol consumptions, Smoking exposure.

Gynecological and obstetric history: Parity, GDM history, Familial History of GDM

Socio demographic factors: Age Marital status, Family size, Religion, Educational status

Dietary factors: Dietary Intake, Foods Groups, Dietary Patterns

Anthropometry: Maternal MUAC, Maternal weight at ANC

Health service utilization: ANC follow-up

Operational Definitions

- Gestational diabetes mellitus: A glucose intolerance resulting in hyperglycemia of variable severity with onset

during pregnancy

- Dietary pattern:** The quantity, proportions, variety or combination of different foods and beverages in diets and the frequency with which they are habitually consumed.
- Mid-Upper arm circumference:** The circumference of the left upper arm measured in the midpoint between the tip of the shoulder and the tip of the elbow.
- Normal MUAC =**Range from 21 cm to 23cm for pregnant women.

Data Quality Management

The data collection tool was prepared in English which is adapted from previous similar studies and translated to Amharic language by language experts. Before the actual data collection, a pretest was conducted in Tirunesh Beijing hospital by taking 5% of the total sample size on 21 pregnant women's before the actual data collection period [14-16]. The simplicity, flow and consistency of the questionnaire were checked. The data from pretest was not included in the analyses. Furthermore, one-day training was given for data collectors and supervisor by the principal investigator, on the general objective of the study, technique of interview on how to approach and keep confidentiality and privacy of the respondents. The supervisor monitored the activities of each data collection process concurrently with data collectors and checks the filled questionnaires for completeness and its accuracy. The principal investigator has checked the overall activity of the data collectors and supervisor.

Data Entry and Analysis

The data were coded, entered, and stored on Epi data 3.1 and exported to SPSS version 21 for further analysis. Descriptive statistics were done using frequency, percentage, tables and the magnitude of GDM was estimated. Multi co-linearity between covariates was tested by using standard error (>2) and no co linear variable is detected [17-19]. Bivariate analyses were done to see if there is an association between each of the independent variables and dependent variable. Variables with P-value < 0.25 in the bivariable analysis were entered to multivariable analysis to control the effects of confounding variables and to determine the independent predictors of the outcome variable. The odds ratio along with 95% CI was estimated to assess the association and P-value < 0.05 was considered to declare statistically significant association in multivariable analysis.

3. Results

Socio Demographic Characteristics: A total of 422 study participants were approached throughout the study period and all of them were met the eligibility criteria and consented to participate making a response rate of 100% Out of 422 women included in the study, 177 (42%) of them were 30-34 years old. Majority 277 (65.6 %) were single and most of the mothers 191 (45.3%) had primary education. Regarding their occupational status, 198 (46.9 %) were government worker and most 180 (42.7 %) of them have monthly income of 2501-3500 Ethiopian birr (Table 1).

Table 1: Socio Demographic Characteristics Of The Study Participants Attending Anc Follow Up At Public Hospitals Of Addis Ababa, Ethiopia From August 1 / 2021 To August 30/2021.

Variables	Category	Frequency (n)	Percentage (%)
Age	18-24	38	9
	25-29	131	31
	30-34	177	42
	>=35	76	18
Occupation	House wife	17	4
	Daily laborer	148	33.9
	Government worker	198	46.9
	Have Private business	64	15.2
Monthly income	<1500	19	4.4
	1500-2500	162	38.4
	2501-3500	180	42.7
	3501-4500	62	14.5

Gynecological Obstetric History of the Respondents

Almost half of the respondents 217 (51.4 %) were null Para and 89 (21.1%) had family history of gestational diabe-

tes mellitus (GDM). One hundred eighty eight (44.5 %) of the respondents had birth interval and majority 235 (55.7) had weight ranges from 66-75 kg (Table 2).

Table 2: Gynecological And Obstetric History Of The Study Participants Attending Anc Follow Up At Public Hospitals Of Addis Ababa, Ethiopia From August1 / 2021 To August 30/2021.

Variables	Category	Frequency(n)	Percentage (%)
Parity	Null Para	217	51.4%
	Primi Para	189	44.8%
	Multi Para	16	3.8%
Family history of GDM	Yes	89	21.1%
	No	333	78.9%
Birth interval	Yes	188	44.5%
	No	234	55.5%

Dietary Practice of the Respondents

More than majority 237 (56.2 %) of the study participants were take meal appropriately and 179 (42.4 %) of them eat three times per day. One hundred eighty five (43.8 %) of the respondents use sweet and soda drinks and majority

215(50.9%) of them take fat meat regularly. Regarding the fruit and vegetable consuming status, 245 (58.1 %) were consume fruits more than three times a day and 227 (53.8 %) consumes vegetables (Table 3).

Table 3: Dietary Practice of the Study Participants Attending Anc Follow up At Public Hospitals of Addis Ababa, Ethiopia from August / 2021 To August 30/2021.

Variables	Category	Frequency (n)	Percentage (%)
Take a meal	Yes	237	56.2%
	No	185	43.8%
How many times eat per day	one times	13	3.0%
	two times	55	12.8%
	three times	179	41.7%
	>-three time	174	40.6%
Drinks sweet and soda drinks	Yes	185	43.8%
	No	236	55.9%

Take Fat of Meat Regularly	Yes	215	50.9%
	No	207	49.1%
Consume fruits	Yes	245	58.1%
	No	177	41.9%
Eat vegetables	Yes	227	53.8%
	No	195	46.2%
Usually take fruits	whole fruit	252	59.7%
	Juiced	170	40.3%

Behavioral and Health Service Utilization of the Respondents

Around ninety percent (382) of the participants had ANC follow up, of them 245 (58.1 %) had first ANC visit in less than 8 weeks of their gestational age. Around 111 (26.3%) par-

ticipants received any nutritional advice and 364(86.3 %) of the participants had no history of regular exercise. Only 9(2.1 %) and 15 (3.6%) of the respondents reported cigarette smoking and drinking alcohol respectively (Table 4).

Table 4: Health Service Utilization And Behavioral Factors Of The Study Participants Attending Anc Follow Up At Public Hospitals Of Addis Ababa, Ethiopia From August / 2021 To August 30/2021.

Variables	Category	Frequency(n)	Percentage (%)
ANC service	Yes	382	90.5%
	No	40	9.5%
First ANC	< 8 weeks	245	58.1%
	8-12 weeks	174	41.2%
	23-16 weeks	3	7%
Receive nutritional advise	Yes	111	26.3%
	No	311	73.7%
Regular exercise	Yes	58	13.7%
	No	364	86.3%
Cigarette smoking	Yes	15	3.6%
Alcohol drinking	Yes	9	2.1%
	No	413	97.9%

Prevalence of GDM

In this study the prevalence of gestational diabetic mellitus (GDM) among the study participants were found to be 18.7 % (Figure 1).

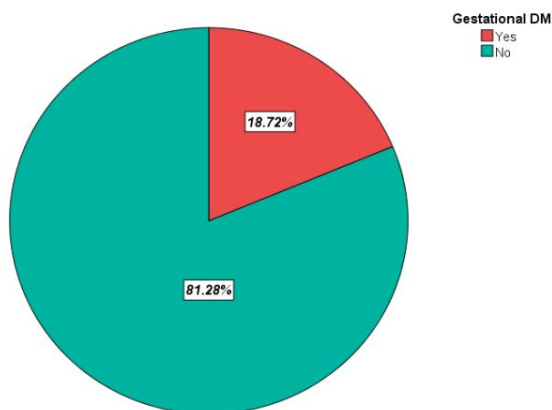


Figure 1: Prevalence of Gdm among Pregnant Mother Attending Anc Follow up In Selected Hospitals Addis Ababa, Ethiopia; 2021.

Factors Associated With GDM

In the biviriate analyses Age, parity, fat consumption, fruit consumption, sweet drinks, meal frequency/day, nutritional advice, regular ANC follow up and regular exercise were significantly associated with GDM (p value <0.05). Those variables having p-value <0.25 in the biviriate analyses were included in the final model of multivariate analyses to assess the predictors of GDM (Table 5).

Table 5: Factors Associated With Gestational Diabetes Mellitus (Gdm) In The Bivariate And Multivariate Analysis Among Pregnant Women In Selected Hospitals Of Addis Ababa, Ethiopia From To August 1/ 2021 To August 30/, 2021 (N=422).

Variables		Gestational DM		COR (95% CI)	AOR (95% CI)
		Yes	No		
Age	18-24	11	27	1	1
	25-29	24	107	1.82 (0.79, 44.16)	1.70 (0.64, 4.48)
	30-34	36	141	1.60 (0.72, 3.52)	0.83(0.32, 2.11)
	35+	8	68	3.46 (1.25, 9.55)	2.34 (0.68, 8.06)
Parity	Null Para	33	184	1	1
	Para	39	150	2.99 (1.05, 8.54)	3.01 (0.83, 10.85)
	multi-Para	7	9	4.34 (1.51, 12.45)	5.28 (1.45, 19.20) *
Regular Exercise	Yes	19	39	2.47 (1.34, 4.56)	1.28 (0.60, 2.74)
	No	60	304	1	1
Family History of DM	Yes	23	66	1.72 (0.99, 3.00)	0.89 (0.45, 1.80)
	No	56	277	1	1
Alcohol Consumption	Yes	4	5	3.61, 0.95, 13.75	1.28 (0.26, 6.39)
	No	75	338	1	1
MUAC (cm)	<23	43	182	1	
	24-26	32	154	2.42 (0.68, 8.64)	5.07 (1.14, 22.65) *
	>27	4	7	2.75 (0.76, 9.95)	6.65 (1.48, 29.97) *
ANC (Regular)	Yes	61	321	0.23 (0.12, 0.46)	0.37 (0.17, 0.82) *
	No	18	22	1	1
Nutrition Advice	Yes	45	66	0.18 (0.11, 0.30)	0.217 (0.12, 0.40) *
	No	34	277	1	1
Meal frequency/day	<3 times	28	41	1	1
	>3 times	51	302	0.25 (0.14, 0.44)	0.45 (0.22, 0.93) *
Sweet drinks	Yes	43	142	1.68 (1.03, 2.75)	1.9 (1.10, 3.48) *
	No	36	200	1	1
Fruit Consumption	Yes	37	207	0.58 (0.35, 0.94)	0.51 (0.28, 0.91) *
	No	42	135	1	1
Fat Consumption	Yes	51	162	1	1
	No	28	181	0.49 (0.29, 0.82)	0.52, (0.29, 0.94) *

*= Factors associated with GDM at p value <0.05; COR=Crude Odd Ratio, AOR= Adjusted Odd Ratio, CI=Confidence Interval.

In the multivariable analyses parity, fat consumption, fruit consumption, sweet drinks, meal frequency/day, nutritional advice, and regular ANC follow up were significantly associated with GDM (p value <0.05) [20].

Those multi Para women were 5.28 times more likely to have GDM as compared to null Para women [AOR=5.28,95 % CI, 1.45-19.20]. As compared to women who hadn't regular ANC follow up, woman's who had regular ANC follow up had 63% less likely to develop GDM [AOR= 0.37, 95% CI: 0.17-0.82]. MUAC (24-26 cm) of the women is found to be more likely to increase the odds of GDM by 5.07 as compare to women's whose MUAC is <23 cm [AOR=5.07,95% CI: 1.14-22.65]. Fat consumption [AOR=0.52, 95% CI: 0.29-0.94] and Nutritional

advise [AOR=0.217, 95% CI: 0.12-0.40], were found to decrease the odds of GDM by 48% and 78% respectively. Likewise, fruit Consumption [AOR= 0.51; 95 % CI (0.28, 0.91) and meal frequency of >=3 time per day [AOR= 0.4; 95 % CI (0.22, 0.93)] were also decrease the likelihood of having GDM by 49 % and 60 % respectively [21]. But, Sweet drink consumption were found to increase the likelihood of having GDM by almost 2 times as compare to their counter parts AOR=1.9,95% CI:1.10-3.48) (See Table 5).

4. Discussion

The current study found the Magnitude of GDM public hospitals at Addis Ababa, Ethiopia was 18.7%. A similar study done in Northern Ethiopia reported that GDM were reported

from 3.7% of the participants [22, 23]. Additionally, a survey done in the same region (Northern Ethiopia) found that prevalence of GDM is 13% [3]. This finding is higher with a study done in china (14.8%), India (10–19%), Africa (13.9%) and Japan is estimated at 8.2% [19]. The finding was higher than those of studies this may be due to the increasing of change of lifestyle.

According to this study factors associated with GDM parity, family history of GDM, MUAC 24-26 cm, Nutrition Advise, Sweet drink, fat consumption. The adjusted binary logistic regression factors significantly women with the mid-upper arm circumference of 24-26 cm were 5.07 times more likely to develop GDM than women with MUAC < 23 cm. This finding agreed with findings done in Northern Ethiopia which reports that MUAC < 28 cm were two times likely to have GDM [24, 25].

Those multi Para women were 5.28 times more likely to have GDM as compared to null Para women and women with family history of GDM had 11times more likely to have GDM. The commonest risk factors which increases the incidence of GDM were, increasing gravidity and parity respectively [1]. A similar case-control study in Saudi Arabia concluded that family history of diabetes, and multiple pregnancy as the major risk factor for GDM [26].

As compared to women who hadn't regular ANC follow up, woman's who had regular ANC follow up had 63% less likely to develop GDM. This study shows ANC follow up was protective factors. Other similar study prove this scenario as ANC follow-up factors of GDM [11].

Sweet drink consumption were found to increase the likelihood of having GDM by almost 2 times as compare to their counter parts in this study similar study Prospective observational study One clear dietary pattern was extracted with positive factor loadings for seafood; eggs; vegetables; fruits and berries; vegetable oils; nuts and seeds; pasta; breakfast cereals; and coffee, tea and cocoa powder, and negative factor loadings for soft drinks and French fries. This pattern was labeled a prudent dietary pattern. Explained variance was 8.2% and adhering to a prudent dietary pattern in pregnancy was clearly associated with lower risk of GDM, especially among women already at higher risk because of overweight/obesity before pregnancy [22, 24].

Fat consumption and Nutritional advice were found to decrease the odds of GDM by 48% and 78% respectively. Likewise in this study both are protective factors. Similar study Prospective observational study in European journal of clinical nutrition adhering to a prudent dietary pattern in pregnancy was clearly associated with lower risk of GDM, especially among women already at higher risk because of overweight/obesity before pregnancy [24]. But other study conducted Northern China 64 (8.5%) were diagnosed with GDM. Four dietary patterns, western pattern (white meat), traditional both the western pattern and the traditional pattern were associated with an increased risk of GDM [20].

Limitations

Because of the cross sectional nature of the study casual inference cannot be made. This study included only pregnant women attending ANC at governmental health center, private health institution in the were excluded.

5. Conclusion

This study shows that the magnitude of GDM in Adiss Abeba town governmental hospital, Adiss Abeba, Ethiopia, was found to be 18.7%.The overall magnnitude of GDM was found to be high and a major public health concern among pregnant women in Addis Ababa Ethiopia. Parity, MUAC 24-26 cm, nutritional advice, sweet drink, and fat consumption were significantly associated with GDM. Given the imminent burden of obesity, unhealthy eating, and physical inactivity, a substantial threat of GDM is anticipated in Ethiopia.

This may be an appropriate time to think about considering the

ABBREVIATION

ANC	Ante natal care
AOR	Adjusted Odds Ratio
BEMOC	Basic emergency obstetrics care
CEOC	Comprehensive emergency obstetrics care
CI	Confidence interval
DM	diabetes mellitus
ETB	Ethiopian birr
GDM	Gestational diabetes mellitus
GCT	Glucose challenge test
HIV.	Human Immunodeficiency Virus
IDF	International Diabetes Federation
USDA	United States Department of Agriculture Food Composition Databases
WHO	world health organization

Declarations

Ethical approval and consent to participate; the ethical clearance was obtained from Institutional Review Board of KEA-MED University college and official letters was submitted to each respective health facility. After explaining the objectives of the study, informed written consent was obtained from all mothers, and anonymity and confidentiality of the data were kept. Respondents have the right not to participate or withdraw from the study at any stage, and all study methods were performed in accordance with the Declaration of Helsinki.

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