ORIGINAL ARTICLE

Exploring The Burden and Prevention of Gestational Diabetes Mellitus In Mali: A Focus On Maternal Health, Macrosomia, And Type 2 Diabetes Progression.

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Abstract

Background: Gestational diabetes mellitus (GDM) is a critical global health issue, particularly in Sub-Saharan Africa (SSA), where healthcare challenges are severe. Despite normalization of blood glucose levels post-pregnancy, women with a history of GDM have a high risk of developing type 2 diabetes mellitus (T2DM). In the SSA context, early detection and intervention for GDM, along with postpartum blood glucose follow-up, are crucial for safeguarding women's health and reducing the burden of T2DM. This study aims to provide a perspective on GDM screening and follow-up interventions.

Methods: This study employed observational, descriptive cross-sectional design at "Centre de Lutte Contre le Diabète (Center for fight against diabetes)" in Bamako, Mali from 20th April to 3rd Aug 2024. Forty-seven female diabetic patients with at least one childbirth experience were recruited. Data on age, gravidity, parity, number of miscarriages, history of GDM during pregnancy and macrosomia were collected through structured interviews. The prevalence of macrosomia among diabetic women was measured.

Results: The average age of participants was 55 ± 9.4years. Nearly 47% of participants experienced miscarriage and 72% had a history of macrosomia. **No significant correlation was observed between gravidity and miscarriage/stillbirth (χ^2: 0.776, p=0.678, df: 2), but gravidity was significantly associated with macrosomia (χ^2:**

9.177, p=0.010, df: 2). Conclusion: GDM screening and postpartum blood glucose follow-up for women with a history of GDM and macrosomia could improve pregnancy outcomes, and mitigate the burden of T2DM.

Key Words: Gestational diabetes mellitus, type 2 diabetes mellitus, Sub-Saharan Africa, macrosomia

Introduction

Gestational diabetes mellitus (GDM) is defined as diabetes mellitus (DM) first detected during pregnancy and is a major global health concern that has detrimental effects on the health of both the mother and the fetus [1]. In addition, it has also been proven that GDM has a high probability of developing type 2 diabetes mellitus (T2DM) a few years later, although blood glucose normalizes after the end of pregnancy.

In Sub-Saharan Africa (SSA), the increasing population [2] is accompanied by persistently high maternal mortality rates. Despite efforts to improve healthcare access, SSA faces challenges in maternal health, including high maternal mortality and limited healthcare resources. These factors make early GDM detection and intervention crucial. In 2020, sub-Saharan Africa had the highest maternal mortality rate (MMR) globally, with **545 maternal deaths per 100,000 live births** (uncertainty intervals: UI 477–654), significantly higher than in Australia and New Zealand (UI 3–4) where MMR was lowest [3]. Studies indicate that **poor healthcare infrastructure and workforce shortages are linked to increased maternal deaths and a higher burden of diabetes-related complications** [4]. Given the strong link between **gestational diabetes mellitus (GDM) and adverse pregnancy outcomes**, improving access to maternal care and diabetes management could be a key strategy to reduce maternal mortality in SSA.

Kyei-Nimakoh et al. highlight that **financial constraints remain a major barrier to accessing maternal healthcare in SSA** [4]. Even in countries offering free maternity services, **indirect costs such as transportation expenses often prevent women from seeking timely care**. For example, in rural SSA, transport to a maternal health facility can cost **$5–$20 per visit**, which is prohibitive for households surviving on less than **$2 per day** [5]. Additionally, despite free maternal health policies, women in some SSA countries still face **out-of-pocket expenses ranging from $18 to $60** for antenatal and delivery services [6]. The financial burden is even higher for women diagnosed with **GDM**, as a **single GDM screening test cost $5–$15**, and insulin therapy—when needed—may cost **$10–$50 per month** [7]. These economic challenges contribute to **delayed or missed prenatal visits, lack of postpartum glucose monitoring, and increased maternal and neonatal complications**. Given the **high prevalence of macrosomia and GDM-related complications in SSA**, addressing these financial barriers is crucial for improving maternal health outcomes. Even if pregnant women who present hyperglycemia during pregnancy have no complications at delivery, T2DM develops years later, and patients bear the financial burden of T2DM care. For women in SSA, who have limited access to adequate health care geographically and financially, early intervention for GDM and prevention of T2DM are urgent issues for protecting women's health.

In SSA context, however, several cultural and socioeconomic factors hinder diabetes management among women. In many SSA communities, **larger-than-average babies are often perceived as healthier and**

more likely to survive infancy, despite the risks associated with macrosomia. High infant mortality rates reinforce this belief, leading some families to celebrate larger birth weights while **overlooking potential complications**, such as **birth injuries and the increased risk of GDM**. Traditional birth attendants and limited prenatal education further contribute to this perception. Similarly, **obesity is culturally associated with beauty, fertility, and social status** in SSA, leading to a **lack of awareness about its link to GDM and T2DM [8]**. Public health efforts remain inadequate in addressing the **long-term risks of obesity and macrosomia**, highlighting the need for **better maternal education and improved access to healthcare**. Given the scarce healthcare resources and limited access to affordable healthcare facilities in SSA, early detection and intervention in pregnancy complication such as GDM are vital. In addition, it is well documented that women with a history of GDM are predisposed to developing T2DM. The burgeoning diabetic patient population in SSA presents economic and healthcare challenges. Halting the progression from GDM to T2DM is an effective measure to mitigate the increase in the number of diabetic patients. This observational, descriptive cross-sectional study aims to assess the association between GDM history, macrosomia, and diabetes progression among the female diabetes patients in Bamako.

Methods

The main investigator is a Japanese diabetologist who provides preventive foot care consultation for diabetic patients at the Centre de Lutte Contre le Diabète (hereinafter referred to as "Bamako Diabetes Center") in Bamako, Mali. Through consultations with diabetic patients at this center, it was determined that a certain number of female patients experience macrosomia without knowing the risk of pregnancy complications and the development of T2DM. To address this knowledge gap, I obtained authorization from the Bamako Diabetes Center's administration to conduct in-depth interviews with patients regarding their perinatal status.

Study site, population and data collection: Data collection was conducted at **Bamako Diabetes Center, a specialized diabetes treatment facility in Mali that provides outpatient care, preventive services, and diabetes education**. The study took place **from April 20 to August 3, 2024**. The study population consisted of **diabetic patients attending preventive foot care consultations**. A total of **60 patients receiving diabetes treatment** at the center were initially screened. **Inclusion criteria:** Women with diabetes **who had experienced at least one childbirth**. **Exclusion criteria:** Male patients (n = 10), **women without previous pregnancies** (n = 3), and **patients with missing or unreliable medical histories**. After applying these criteria, **47 female diabetic patients were included in the study**. Patient recruitment flowchart is shown in Figure 1.

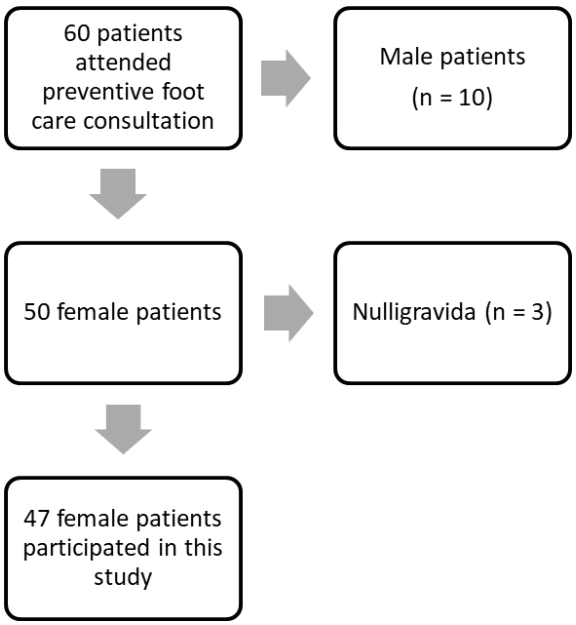


Figure 1:Patient recruitment flowchart

Age, length of time since diabetes treatment started, gravidity, parity, number of miscarriages, diagnoses of GDM during pregnancy and macrosomia were asked. Interviews were conducted in Bambara (Malian domestic language) or French and translated into English by the Malian interpreter. All answers were based solely on the participants' recollection due to lack of objective medical data, e.g. electronic medical record, mother-child health record. The exact age was unknown and relies on participants' self-report, as it is not common practice to record dates of birth in Mali. Since it is not a common practice to measure birth weight, participants who did not know their birth weight were asked if the baby was very heavy or if the baby was heavier than a 5 kg bag of flour, which is popular in this region.

Statistical analysis: The mean and median of participants' age at interview (years), duration of diabetes therapy (years), gravidity (number of times), and number of miscarriages/stillbirths (number of times) were determined. Whether GDM was diagnosed during pregnancy (yes / no) and experience of macrosomia (yes / no) were tabulated, and the proportion of participants with diagnosed GDM and those with macrosomia was calculated. Correlations between gravidity and the presence or absence of miscarriage/stillbirth, and between gravidity and the presence or absence of macrosomia were also calculated. The data were collected and analyzed using Microsoft Excel.

Ethical considerations: This study was approved by the appropriate institutional management board. The following conditions were explained to the participants and their signed consent was obtained: 1) Participantś information is anonymized and used for data analysis and study papers. 2) Bamako Diabetes Center staff may follow up on health conditions by phone or SMS. Despite problems with the accuracy of data on patient age and birth weight, participants clearly remembered the birth of each child. By restricting the target group to diabetics and interviewing each person individually, we were able to obtain realistic data.

Results

Forty-seven (47) participants were enrolled in this study. The average age was 54.93 years old and median age was 55 ± 9.4 years old. The numbers in each age group were 2 (2%) in their 30s, 9 (19%) in their 40s, 21 (45%) in their 50s, 14 (30%) in their 60s and 1 (2%) in their 70s and over.

Average and median duration of diabetes therapy were 5.7 years and 4 ± 5.14 years respectively. Average and median gravidity were 7.29 times and 8 times respectively.

Forty-seven (47) percent of participants experienced miscarriage and 72% of participants experienced macrosomia. Only two (2) out of 47 had been diagnosed with GDM during pregnancy. One was diagnosed with GDM by a screening test at the clinic she attended during her pregnancy. The other was diagnosed with GDM after she told her doctor that her last delivery was macrosomia, and the doctor then tested her.

Participants' characteristics are shown in Table 1.

SD : Standard Deviation

Table 1. Participants' Characteristics	n = 47	
Age (y)		
average	54.94	
mean ± SD	55±9.4	
Age group (y), n (%)		
30-39	2 (4)	
40-49	9 (19)	
50-59	21 (45)	
60-69	14 (30)	
70-	1 (2)	
Duration of DM therapy (y)		
average	5.69	
mean ± SD	4±5.14	
Gravidity (times)		
average	7.29	
mean	8	
Outcomes	Yes	No
miscarriage / stillbirth, n (%)	22 (47)	25 (53)
macrosomia, n (%)	34 (72)	13 (28)

The distribution of age groups, age of DM treatment initiation, duration of diabetes therapy and gravidity are shown in Figure 2, 3, 4 and 5 respectively.

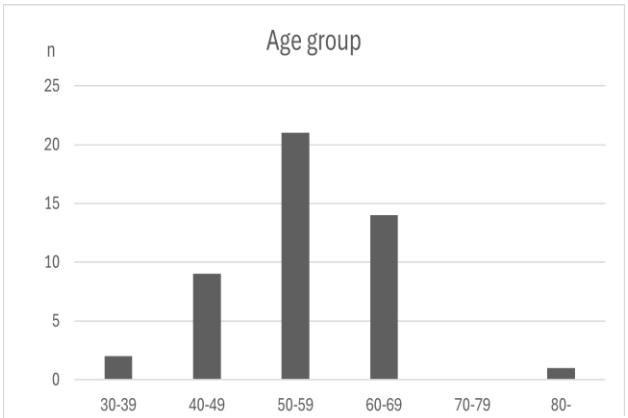


Figure 2:Age group

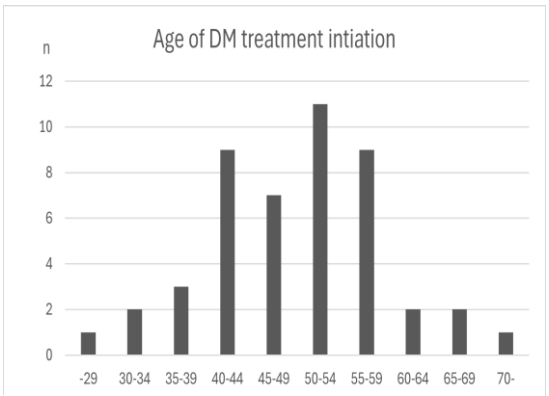


Figure 3:Age of DM treatment initiation

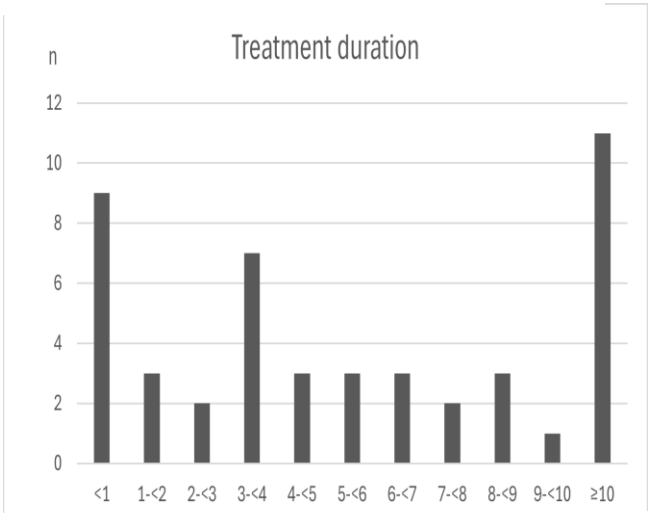


Figure 4:Treatment duration

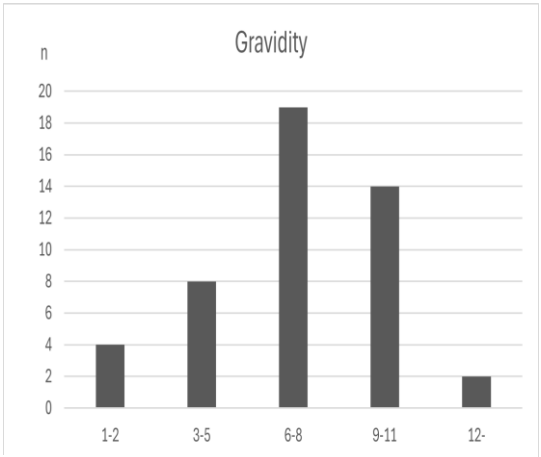


Figure 5:Gravidity

There was no statistically significant association between the number of gravidity and the occurrence of miscarriage / stillbirth (Chi-square statistic (χ^2): 0.776, p-value: 0.678, Degrees of freedom (df): 2). There was statistically significant association between the number of gravidity and the occurrence of macrosomia (Chi-square statistic (χ^2): 9.177, p-value: 0.010, Degrees of freedom (df): 2) (Table 2). No correlation was identified between the gravidity and the presence or absence of miscarriage / stillbirth experience. However, a correlation was observed between gravidity and macrosomia. The frequency of pregnancies was found to be positively associated with the likelihood of experiencing macrosomia.

Table 2. Cross-tabulation of Chi-square test

	Miscarriage / Stillbirth (n)				Macrosomia (n)	
Gravidity (times)	Yes	No		Gravidity (times)	Yes	No
1-2	2	2		1-2	0	4
3-5	3	5		3-5	6	2
6-	17	18		6-	28	7

The number of gravidity and the occurrence of miscarriage / stillbirth (Chi-square statistic (χ^2): 0.776, p-value: 0.678, Degrees of freedom (df): 2).The number of gravidity and the occurrence of macrosomia (Chi-square statistic (χ^2): 9.177, p-value: 0.010, Degrees of freedom (df): 2)

Discussion

This study found a high prevalence of macrosomia (72%) among diabetic women in Mali, suggesting a strong association between macrosomia and later-life diabetes. The higher-than-expected prevalence of macrosomia compared to previous studies may indicate undiagnosed GDM, which could contribute to adverse pregnancy outcomes. According to UN-DESA, the average number of pregnancies in SSA is 4.6 births per woman [2], and Tela et al. reported that the prevalence of macrosomia in SSA, regardless of GDM status, is 19.1% [9]. While direct comparisons between these studies are limited, the lack of structured GDM screening in Mali suggests that many cases go undiagnosed, increasing the risk of perinatal complications.

The findings emphasize that early detection and management of GDM can significantly reduce perinatal complications [10-12]. Routine GDM screening during pregnancy would enable early intervention, better glycemic control, and improved pregnancy outcomes. To mitigate these risks of perinatal complications, pregnant women should undergo at least eight antenatal check-ups, as recommended by WHO [3, 13]. Screening should be prioritized for high-risk groups, including women with obesity, a family history of T2DM, a history of GDM, or previous macrosomic deliveries. Additionally, weighing newborns at birth can help identify mothers at risk for GDM recurrence in future pregnancies. Studies indicate that women who previously delivered a macrosomic baby without a GDM diagnosis have an increased risk of developing GDM in subsequent pregnancies [14].

Postpartum blood glucose monitoring is equally critical in preventing the progression from GDM to T2DM. Research suggests that women with a history of GDM have a 7–10 times higher risk of developing T2DM compared to those without GDM [15]. However, without structured postpartum glucose testing, many cases of T2DM remain undiagnosed until complications develop. Ensuring that women with a history of GDM undergo regular postpartum blood glucose follow-up could significantly improve early detection and intervention. Studies have shown that lifestyle interventions and

glucose monitoring can delay or prevent the progression to T2DM, especially in high-risk populations [16, 17].

Interventions targeted at high-risk populations can be effective in preventing GDM patients from progressing to T2DM. Berté et al. reported that the risk factors for gestational diabetes found in the endocrinology unit and in the gyneco-obstetrics department of the Reference Health Center of Commune VI of the Bamako district were 1) family history of first degree diabetes in 37.04%, 2) advanced maternal age in 25.93%, 3) obesity or overweight pre-existing during pregnancy in 22.22%. At least 2 risk factors were found in 51.85% of the study participants [18]. Various diabetes prevention programs in both high-income and low-to-medium-income countries have shown that lifestyle interventions can reduce the risk of T2DM in high-risk populations, such as people with impaired glucose tolerance (IGT) [19-21], although screening for IGT in a population can be expensive and difficult. Chivese et al. highlighted the notion that women with a history of GDM were an obvious and easily accessible target for prevention because they were diagnosed as part of routine care in the health system [22]. Postpartum blood glucose follow-up for women with a history of GDM and macrosomia offers an opportunity for early intervention, thereby reducing the burden of T2DM and its complications.

To summarize, it is posited that the implementation of regular screening during pregnancy, in conjunction with systematic postnatal follow-up for patients diagnosed with GDM, holds potential for enhancing the health outcomes of pregnant women and mitigating the progression of T2DM.

Limitations

There are several limitations to this study. First, this is an observational study of diabetic patients only, so it does not compare with those who had GDM but did not subsequently develop diabetes, or with non-diabetic patients who had experienced macrosomia. Second, this study population consists exclusively of women who are "healthy" survivors of multiple macrosomic deliveries. These participants can be considered stronger than the average woman. The data from the participants in this study don't allow us to speculate how many pregnancy complications are caused by macrosomia and GDM. In Mali, it is difficult to assess the association between GDM and maternal mortality because the causes of maternal mortality are often unexamined, the actual number of women who died from pregnancy complications related to GDM remains unclear. Finally, all data were based solely on the patient's recollection due to lack of concrete medical data, e.g. electronic medical record, mother-child health record. The exact participants' age and babies' birth weight were unclear as it is not common practice to record those data. Long-term glycemic control could also not be assessed because few patients had their glycated hemoglobin measured. Interviews were conducted in Bambara (Malian domestic language) or French and translated into English by the Malian interpreter. The author cannot rule out the possibility of miscommunication between the Malian interpreter and myself in the interview process.

Although there are some limitations listed above, the association of macrosomia and GDM with pregnancy complications and progression from GDM to T2DM is already well established. Therefore, extrapolating these data on GDM to the Malian female population may be considered appropriate.

Conclusion

GDM screening and postpartum blood glucose follow-up of women with a history of GDM and macrosomia can improve maternal health outcomes in SSA by reducing maternal mortality, preventing pregnancy complications, and mitigating the burden of T2DM.

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Declaration of Interest

This study has received no external financial support.

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