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Original Research Article

Assessing Glycemic Control and Pregnancy Outcomes in Diabetic Patients in Morocco: A Cross-Sectional Study

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Abstract

This study aimed to characterize the association of diabetes with pregnancy in the Souss Massa Agadir population, focusing on epidemiological and clinical profiles, therapeutic aspects, and prognosis, while also identifying factors linked to glycemic control and maternal-fetal complications. We conducted a descriptive and analytical single-center cross-sectional study on 67 diabetic parturients at Hassan II University Hospital. Our findings reveal that half of the patients were aged 30-39, with 90% having low socioeconomic status, 55% from rural areas, and 34% illiterate. Common antecedents included family history of Type 2 diabetes (68.7%), spontaneous miscarriages (31.3%), and macrosomia (23.9%). Gestational diabetes was prevalent (60%), often incidentally diagnosed by fasting blood glucose (87.5%). While 52% of gestational diabetes cases managed with diet and lifestyle modifications alone, only 63% achieved balanced FBG and 49% balanced PPG. PPG (P=0.018) and BMI (P=0.020) were associated with FBG balance, while FBG (P=0.036), pre-gestational diabetes (P=0.029), and adherence to DLM (P=0.040) influenced PPG balance. Maternal-fetal complications occurred in 60% of cases, primarily urogenital infections, hydramnios, anemia, and macrosomia, with rural origin being a significant risk factor (OR: 3.56, P=0.01). These results underscore the critical need for multidisciplinary preconception care, early gestational diabetes diagnosis, and long-term metabolic follow-up to ensure better pregnancy outcomes and reduce future diabetes risk.

Keywords: Gestational diabetes, Pregnancy, Glycemic Control, Complications, Maternal Health, Risk Factors, Prognosis.

INTRODUCTION

Diabetes in pregnancy can manifest as pre-gestational diabetes (type 1 or type 2 diabetes diagnosed before pregnancy), overt diabetes diagnosed early in pregnancy, or gestational diabetes (GDM or glucose intolerance first detected during pregnancy, regardless of its etiology, duration, and post-pregnancy outcome) [1]. The aim of our study was to identify the epidemiological, clinical, diagnostic, and therapeutic characteristics of diabetic pregnant patients in our context and compare them with existing literature, to identify factors associated with poor glycemic control, and to determine risk factors for maternal-fetal complications.

MATERIALS AND METHODS

This was a descriptive and analytical monocentric cross-sectional study conducted at the Endocrinology, Diabetology, and Metabolic Diseases department of Hassan II University Hospital Center Souss Massa Agadir. The study spanned 18 months, from June 2023 to December 2024.

We included all diabetic pregnant women seen in consultation, either previously diagnosed with diabetes (regardless of type and duration) or with newly discovered diabetes during pregnancy (regardless of gestational age at diagnosis, screening method, and diagnostic test used).

Epidemiological, demographic, clinical, and paraclinical data were collected using a form developed on the Google Forms platform. All data were transferred to an Excel 2013 file, cleaned, and then analyzed using JAMOVI software 2.3.21.

Normally distributed continuous variables were presented as mean and standard deviation, while asymmetrically distributed continuous variables were presented as median and quartile percentile. Qualitative variables were expressed as number and percentage n (%). Factors related to glycemic control and maternal-fetal complications were investigated using univariate and multivariate logistic regression. A p-value (α risk) of 0.05 was considered statistically significant. Statistical

analyses were performed using JAMOVI software (version 2.3.21).

RESULTS

The median age of our patients was 36 years [30.5-40]. The predominant age group was 30 to 39 years, with 79% being ≥ 30 years old. Ninety percent of the women were from low socioeconomic backgrounds, 55% from rural areas, and 34% were illiterate. A family history of type 2 diabetes (68.7%), spontaneous abortions (31.3%), macrosomia (23.9%), and gestational diabetes (14.9%) were the most frequently noted in our patients (Table 1). Half of the parturients were multiparous, and overweight and obesity were observed in 42% and 43% of patients, respectively. Gestational diabetes was the most frequent (60%) (Figure 1), with its discovery being incidental in 85% of cases during routine check-ups, in 7.5% due to genitourinary infections, in one patient due to fetal macrosomia, and in another during diabetic ketosis. GDM was primarily discovered in the first (46%) and second trimesters (40%) of pregnancy. Diagnosis was made by fasting plasma glucose (FPG) in the majority of patients (87.5%), and the 75g oral glucose tolerance test (OGTT) was performed in only 5 parturients. Fifty-two percent of pregnant women with GDM were treated with lifestyle interventions (LSI) alone, and 46% were initiated on insulin therapy. In half of these patients, insulin was introduced during the 2nd trimester of pregnancy. The gestational age at insulin introduction ranged from 4 to 37 weeks of amenorrhea (WA), with a median of 14 WA [10-24]. The median daily insulin dose was 12 IU/day [10-20]. Pre-gestational diabetes was observed in 40% of pregnant women (36% T2DM and 4% T1DM). Before pregnancy, 41% of these patients were on oral antidiabetic drugs alone, and 18.5% were on LSI alone. The majority of parturients with pre-gestational diabetes were started on insulin therapy within the first 10 weeks of amenorrhea; 3 patients received insulin only in the 3rd trimester of pregnancy, while one patient was maintained on LSI alone. The basal/bolus regimen was used in half of the patients, and basal insulin alone in 19%. The median daily insulin dose was 30 IU/day [20.5-49]. Sixty-three percent of patients had controlled FPG with a median of 0.91 g/l [0.82-0.98], and half had correct postprandial glucose (PPG), with a median of 1.21 g/l [1.11-1.46]. HbA1c was performed in 35 patients, and its median was 7.70% [6.40-8.70]. Maternal-fetal complications were noted in 63% of cases. Urogenital infections, hydramnios, and anemia were observed in one-third of patients, while macrosomia was objectified in 24% of our population (Figure 2). In a univariate logistic regression analysis, factors associated with FPG imbalance were: age ≥ 40 years compared to age between 20 and 30 years, BMI, PPG, adherence to LSI, and treatment with diet alone compared to basal/bolus insulin therapy. In multivariate analysis, factors associated with FPG imbalance in our population were: PPG (P=0.018) and BMI (P=0.020) (Table 2). For PPG, factors associated with its imbalance in univariate logistic regression analysis were: age ≥ 40 years compared to age between 20 and 30 years, BMI, FPG, adherence to LSI, and treatment with diet alone compared to basal/bolus insulin therapy. In multivariate analysis, factors associated with PPG imbalance were: FPG (P=0.036) and pre-existing diabetes (P=0.029) as risk factors, and adherence to LSI (P=0.040) as a protective factor (Table 3). Regarding maternal-fetal complications, only rural origin was found as a risk factor in multivariate analysis, with OR: 3.56 (1.26 -10.04) P= 0.01.

Table 1: Distribution of Study Patients According to Maternal History

Variable	**Frequency** (n = 67)	**Percentages** (%)
Gestational diabetes	10	14.9
Macrosomia	16	23.9
Hydramnios	6	9.0
IUFD	4	6.0
IUGR	1	1.5
Prematurity	1	1.5
Miscarriage	21	31.3
Pre-eclampsia	2	3.0
Multiparity	39	58.2
Family history of diabetes	46	68.7

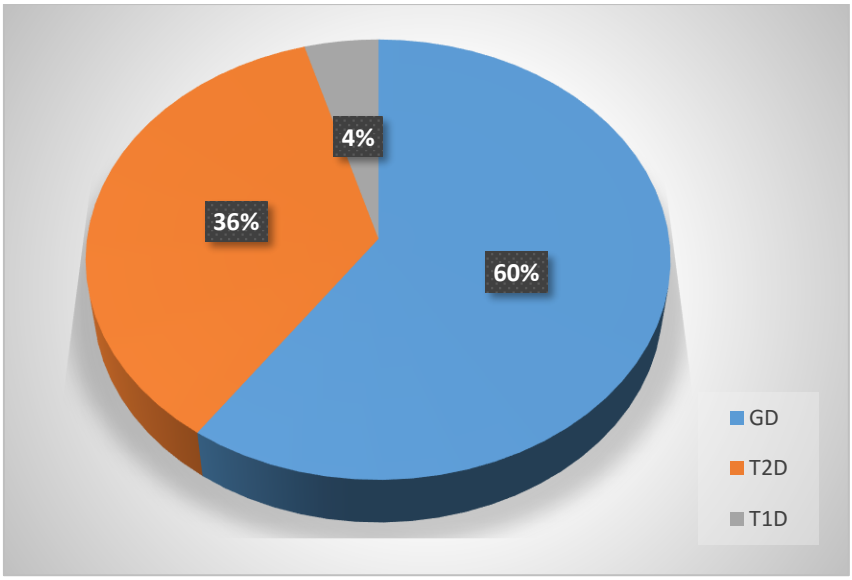

Figure 1: Distribution of patients according to type of diabetes

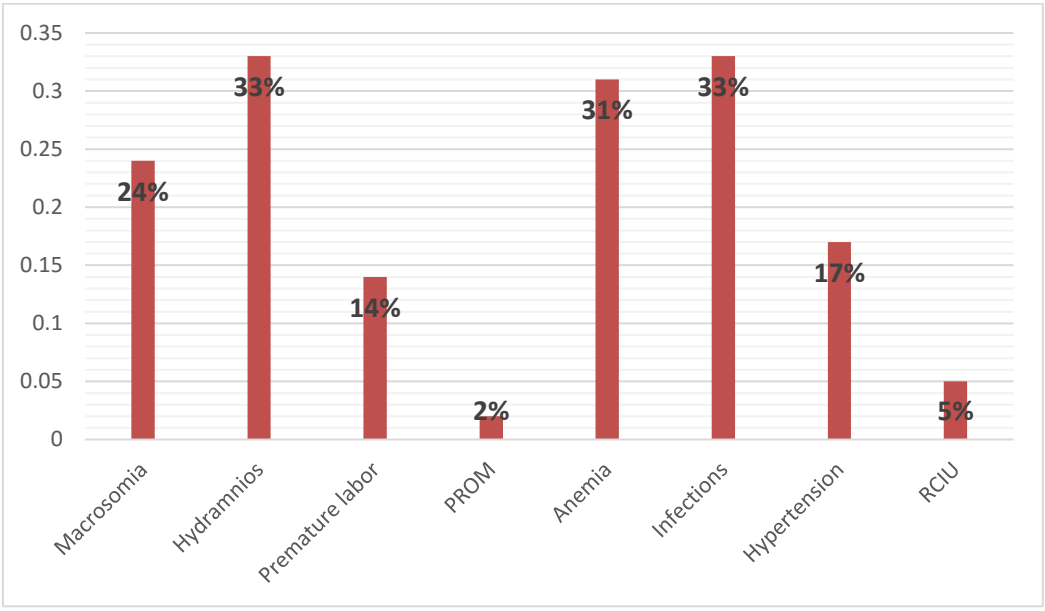

Figure 2: Distribution of patients according to the type of maternal-foetal complications

Table 2: Risk Factors for Fasting Blood Glucose (FBG) Imbalance in Logistic Regression

	OR	CI 95%		P Value
		Lower Bound	Upper Bound	
Age:				
≥40 Years – 20-30 Years	7.5	1.29	34.96	0.025
BMI (kg/m^2)	1.18	1.05	1.33	0.005
PPG (g/l)	27.14	3.33	221.45	0.002
Adherence to DLM	0.35	0.12	0.98	0.046
Treatement:				
Basal/bolus – Diet alone	4.01	1.11	14.45	0.033

Table 3: Risk Factors for Postprandial Plasma Glucose (PPG) Imbalance in Logistic Regression

	OR	CI 95%		P Value
		Lower Bound	Upper Bound	
Antécédents:				
Macrosomia	3.95	1.12	13.94	0.032
Family history of diabetes	3.89	1.27	11.88	0.017

	OR	CI 95%		P Value
		Lower Bound	Upper Bound	
Type of Diabetes:				
PGD – GD	7.27	2.36	22.34	<0.001
FBG (g/l)	265	4.69	15000	0.007
Adherence to DLM	0.19	0.06	0.55	0.002
Treatment:				
Basal/bolus – Diet alone	12.92	3.81	52.48	<0.001
Insulin Regimen:				
Basale/bolus – Basale alone	4.43	1.02	19.27	0.047
Total Insulin Dose	1.05	1.00	1.10	0.043
Pregnancy Follow-up	0.26	0.08	0.79	0.018

DISCUSSION

Diabetes mellitus is a global pandemic currently affecting 1 in 10 individuals aged 20 to 79 and ranks among the leading causes of premature mortality. Its global incidence and prevalence continue to rise, with the latter projected to reach 784 million people by 2045 [2].

According to the International Association of Diabetes in Pregnancy Study Group's (IADPSG) criteria, a meta-analysis conducted in 2021 estimated the global prevalence of gestational diabetes at 14.0% [3], with significant fluctuations across regions: 7.1% in North America and the Caribbean, 7.8% in Europe, 10.4% in South and Central America, 14.2% in Africa, 14.7% in the Western Pacific, 20.8% in Southeast Asia, and 27.6% in the Middle East and North Africa (MENA). In Morocco, according to a cross-sectional study conducted in 2018, the prevalence of gestational diabetes was estimated at 23.7% in Marrakech and 18.3% in Al Haouz [4].

Epidemiological Characteristics:

The majority of patients in our study were over 30 years old, with a median age of 36 years, which is a recognized risk factor for gestational diabetes. This finding aligns with the results of Sqalli [5] and Moumhil [6]. A lower average age was found in the series by Adrien [7] and Lahlou [8].

Furthermore, 90% came from disadvantaged socioeconomic backgrounds, with a high rate of illiteracy (34%) and rural origin (55%), reflecting social vulnerability and unequal access to healthcare [9]. These data are consistent with the results of other Moroccan and African studies [10].

Regarding the weight status of our patients, a normal body mass index (BMI) before pregnancy was observed in only 13% of patients, while overweight and obesity represented 42% and 43% of cases, respectively. Similar observations were made by Adrien [7] and Lahlou [8]. Multiparity was noted in 58% of patients in our study. Similar results were reported by Adrien (55.4%) [7], Sqalli (54%) [5], and Traoré (46%) [13]. Lahlou reported a higher multiparity rate of 86.4% [8].

Maternal History:

Regarding maternal history, our results are comparable to other studies. A family history of type 2 diabetes was present in 68.7% of women, confirming the role of the hereditary component [11]. A history of miscarriages, macrosomia, or GDM was also frequent, indicating a predisposition to glucose metabolism disorders during pregnancy [12]. Lahlou found a history of spontaneous abortions in 22% of cases, macrosomia in 34%, and family diabetes in 48% of cases [8]. In the study by Adrien in Bamako, a history of gestational diabetes was found in 18% of patients, while a family history of diabetes was found in only 10% [7]. Furthermore, the study by Traore showed that 41% of patients had a history of miscarriages, and 26% had a history of macrosomia [13]. A similar result was found by Moumhil in her study conducted in Marrakech, who observed a family history of diabetes in 67% of cases, macrosomia in previous pregnancies in 33% of parturients, and a history of gestational diabetes in 13% [6].

Type of Diabetes:

Gestational diabetes accounted for 60% of cases, which is higher than the global average estimated at 14% according to IADPSG criteria [3], but consistent with some local studies like that of Marrakech (23%) [7]. The frequency of pre-gestational diabetes was 40%, with a predominance of T2DM (36%). Our result aligns with Adrien's [8] in Bamako, with 64.9% gestational diabetes, and Boumezbeur's [14] in Algeria (64.9%). In contrast, in Moumhil's series [6], pre-gestational diabetes was noted in 70% of patients, while gestational diabetes represented only 30% of cases. Similarly, in Traoré's result [13], diabetes was gestational in 13% and pre-gestational in 87%, including 30 cases of T1DM and 57 cases of T2DM. Sqalli [5] and Lahlou [8] had also observed a predominance of pre-gestational diabetes (68.2% and 56% respectively) in their studies conducted in Fes.

In our study population, screening and diagnosis of gestational diabetes were made by fasting plasma glucose (FPG) in the majority of patients, 87.5%. Nevertheless, the 75g oral glucose tolerance test (OGTT) was performed in only 5 patients, or 12.5%. This

observation can be explained by the high cost of OGTT compared to FPG and the fact that almost all patients in our study were from low socioeconomic backgrounds (90%). Our results are similar to other studies that have shown a predominance of FPG use compared to OGTT.

Regarding pre-gestational diabetes in our study, we noted a predominance of type 2 diabetes (89% of cases). This aligns with the results of Sqalli (57.14%) and Lahlou (77%) [5,8]. For the duration of diabetes, it was 3 years, close to that found by Sqalli, which was 4.5 years [5]. No degenerative complications were known in our patients before pregnancy, which is consistent with the results of other studies [5,8].

Glycemic Control:

Fasting plasma glucose was controlled in 63% of parturients in our series with a median of 0.91g/l, and postprandial glucose was within target in 49% of patients with a median of 1.21g/l. Our result is close to Adrien's [7], who noted good glycemic control in 50% of his study population. A similar result was reported by Moumhil [6], who found that 42% of patients were controlled. In contrast, in Lahlou's series, only 12.9% of women had controlled diabetes with an average FPG of 1.93g/l and PPG of 2.35 g/L [8]. These high rates of glycemic control in our series could be justified by the fact that almost all patients in our study had already benefited from a consultation with a healthcare professional.

Performing a logistic regression, the multivariate analysis showed that PPG and BMI were significantly linked to FPG imbalance (P=0.018 and P=0.020 respectively). Furthermore, pre-gestational diabetes and FPG were found as risk factors for PPG imbalance (P=0.029 and P=0.036 respectively), while adherence to lifestyle interventions was a protective factor (P=0.040).

Maternal-Fetal Complications :

Maternal-fetal complications were observed in 63% of parturients in our study. Urogenital infections, hydramnios, and anemia were observed in one-third of patients, while macrosomia was objectified in 24% of our population. In Adrien's series [7], maternal complications were noted in 51% of women, dominated by urinary tract infections in 27% of cases. For the study conducted in Fes by Lahlou [85], a predominance of genitourinary infections, gestational hypertension, macrosomia, and hydramnios was noted. The same observation was made by Sqalli [5], who objectified macrosomia in 54.5% of patients, hydramnios in 43.2%, and gestational hypertension in 25% of cases. Traoré [13] and Moumhil [6] also reported high rates of macrosomia in their series (67.5% and 53%). Performing a univariate and multivariate logistic regression analysis, the only risk factor linked to maternal-fetal complications in our study was rural origin with OR: 3.56 (95% CI: 1.26 -10.04 P= 0.01).

Limitations of Our Study:

Our study allowed for a detailed description of the clinical profiles and management strategy in our institution. Nevertheless, certain limitations should be highlighted, notably the limited use of standardized tests such as OGTT, and the absence of long-term follow-up of maternal and neonatal outcomes.

CONCLUSION

Diabetic pregnancy remains a high-risk situation for both mother and fetus. For better management, it is essential to involve the patient herself, who must be sufficiently informed, aware, and educated to adhere to pregnancy follow-up, self-monitoring, and lifestyle interventions, as non-adherence is the main cause of therapeutic failures. Furthermore, standardization of follow-up by a multidisciplinary team (endocrinologist-diabetologist, gynecologist, general practitioner, nutritionist, and midwife) is crucial. It is also important to raise awareness among women with gestational diabetes about the importance of postpartum and long-term metabolic follow-up given the risk of developing type 2 diabetes later.

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