

## Risk factors for gestational diabetes mellitus in Sudanese pregnant women

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### ABSTRACT

**Background:** The prevalence of gestational diabetes mellitus (GDM) in Sudan is less compared with international reports. Whether there is concomitant difference in the risk factors for GDM among Sudanese women is uncertain. **Aim:** This study investigated the common risk factors for GDM among Sudanese pregnant women. **Materials and Method:** The study involved a control group of 60 apparently healthy pregnant women matched with a test group of 60 pregnant women with GDM. Data were obtained through a questionnaire, proper examination, including anthropometric measurements, and laboratory evaluation for glycaemic control. **Results:** The age (mean (M)  $\pm$  standard deviation (SD) = 32.8 $\pm$ 7.4 years) and body mass index (BMI) (M $\pm$ SD = 27.9 $\pm$ 4.9 Kg/m<sup>2</sup>) were significantly higher in pregnant ladies with GDM compared with the control group (M $\pm$ SD = 29.7 $\pm$ 6.0 years, 25.1 $\pm$ 3.1 Kg/m<sup>2</sup> respectively) (P < 0.02 for both). There were significant associations between presence of GDM and age  $\geq$  30 years (relative risk (RR) = 1.28, P = 0.016), BMI  $\geq$  25 Kg/m<sup>2</sup> (RR = 1.48, P = 0.001), family history of diabetes mellitus (DM) (RR = 1.8, P = 0.002), glucosuria (RR = 2.39, P = 0.000), proteinuria (RR = 1.98, P = 0.008). In contrast, parity and urinary tract infections failed to demonstrate significant associations with GDM. **Conclusion:** The strongest predictor of GDM in Sudanese women is glucosuria, followed by proteinuria, family history of DM, BMI  $\geq$  25 Kg/m<sup>2</sup> and age  $\geq$  30 years in a descending pattern.

**Key words:** Diabetes mellitus, gestation, risk factors, Sudan

### INTRODUCTION

Gestational diabetes mellitus (GDM) is a universal risk factor for maternal and neonatal morbidity and mortality.<sup>[1]</sup> Low gestational age, neonatal macrosomia, hypoglycemia, respiratory distress syndrome are frequent complications of GDM and explain the increased rate of admission among neonates following delivery of their diabetic mothers.<sup>[2,3]</sup> Therefore, early detection, proper diagnosis and adequate management of GDM are crucial

clinical tools to diminish its potential complications.<sup>[4]</sup> An effective way for earlier detection for GDM is screening mothers at higher risk to develop this disease. Screening is usually based on the presence or absence of certain documented risk factors for GDM. The well-known screening guidelines for GDM are those recommended by the British National Institute for Health and Clinical Excellence (NICE)<sup>[5]</sup> and the American Diabetes Association (ADA).<sup>[1,6]</sup> According to these guidelines, the most common risk factors for GDM are advanced maternal age, higher body

mass index (BMI), family history of diabetes mellitus, past history of GDM or a baby with one of the known complication of GDM. It is worth to mention that some previous studies confirmed other risk factors for GDM, however, they were not considered in these guidelines e.g. spontaneous abortion,<sup>[7]</sup> glucosuria,<sup>[8]</sup> proteinuria,<sup>[9]</sup> high blood pressure<sup>[10]</sup> and vulvovaginal candidiasis.<sup>[7]</sup>

In Sudan, studies investigating GDM are scarce.<sup>[11-13]</sup> The only available report in the literature regarding risk factors for GDM in Sudanese pregnant ladies was conducted by Khattab and his colleagues in 2007.<sup>[11]</sup> The prevalence rate of GDM estimated by Khattab *et al.* was 2% and is relatively lower compared with international reports in which prevalence rate reached up to 7%.<sup>[14]</sup> This variation in the prevalence rate between Sudanese and international reports remains to be explored by further researches; but it also suggests concomitant variation in the risk factors for GDM among Sudanese pregnant women. According to Khattab *et al.* study, parity was an important risk factor for impaired glucose tolerance; however, no additional risk factors were reported. This study aimed to investigate the common risk factors for GDM among Sudanese pregnant women including those not considered in NICE and ADA guidelines.

## MATERIALS AND METHODS

The study received ethical clearance from the Gezira University. The authorities of the chosen hospitals were informed and their permissions were taken accordingly.

The study involved two groups: a control group of 60 apparently healthy pregnant women matched with a test group of 60 pregnant women with GDM. The sample size was determined by the following formula:

$$N = t^2 pq/d^2$$

Where; N = required sampling size, t= the confidence level, taken as 1.96, P = anticipated population, taken as 0.02 according to Khattab *et al.*,<sup>[11]</sup> q = 1-p = 0.98 and d = absolute precision required, taken as 0.05. Accordingly the required sample will be:  $1.96^2(0.02)(0.98)/(0.05)^2 = 30$  pregnant women. The sample size was further increased to 60 pregnant ladies to safeguard against possible contingencies like blood sample damage and recording errors.

Women were recruited mainly from obstetric outpatient clinics in the Khartoum state-Sudan. The age of both groups ranged between 18-50 years. Following history taking and clinical examination, blood samples were taken to assess patients' glycaemic control. Mean arterial blood pressure (MABP) for each subject was determined by the formula:  $MABP = \text{diastolic blood pressure} + [(\text{systolic blood pressure} - \text{diastolic blood pressure})/3]$ . Body mass index (BMI) was calculated using the formula:  $BMI \text{ (Kg/m}^2\text{)} = \text{Weight (Kg)} / (\text{Height (m)})^2$ .

## Statistical analysis

Statistical analysis was performed using the SPSS (SPSS for windows version 19) and Microsoft Office Excel (Microsoft Office Excel for windows; 2007). Normal distribution of studied variables was examined using Kolmogorov-Smirnova and Shapiro-Wilk tests. Unpaired T-test and Mann-Whitney U test were used to assess significant difference in the means of the studied variables in the different groups. Chi-square test and relative risk were used to assess the association between GDM and the possible risk factors.  $P < 0.05$  was considered significant.

## RESULTS

The age (mean (M)  $\pm$  standard deviation (SD) =  $32.8 \pm 7.4$  years) and body mass index (BMI) ( $M \pm SD = 27.9 \pm 4.9 \text{ Kg/m}^2$ ) were significantly higher in pregnant women with GDM compared with the control group ( $M \pm SD = 29.7 \pm 6.0$  years,  $25.1 \pm 3.1 \text{ Kg/m}^2$  respectively) ( $P < 0.02$  for both). Regarding the other studied variables, the means, standard deviations and the significance of the difference of the means between the test and the control groups ( $P$ ) are given in table 1, figure 2 and 3. Random blood glucose concentrations and blood pressures were significantly higher in pregnant women with proteinuria compared with those without proteinuria ( $P \leq 0.003$ ).

There were significant associations between presence of GDM and age  $\geq 30$  years (relative risk (RR) = 1.28,  $P = 0.016$ ), BMI  $\geq 25 \text{ Kg/m}^2$  (RR = 1.48,  $P = 0.001$ ), family history of diabetes mellitus (DM) (RR = 1.8,  $P = 0.002$ ), glucosuria (RR = 2.39,  $P = 0.000$ ), proteinuria (RR = 1.98,  $P = 0.008$ ). In contrast, parity and urinary tract infections failed to demonstrate significant associations with GDM (table 2).

## DISCUSSION

The main outcome of the current study is the strong association between GDM and increased ages, systolic hypertension, higher BMI, family history of diabetes mellitus, glucosuria and proteinuria. In contrast, parity and urinary tract infections failed to demonstrate significant associations with GDM. According to the relative risks, the strongest predictor of GDM was presence of glucosuria, followed by proteinuria, family history of diabetes mellitus, BMI  $\geq 25$  Kg/m<sup>2</sup> and Age  $\geq 30$  years in a descending pattern. These findings

were comparable with previous international reports.<sup>[1,2,6]</sup> For example, a recent large epidemiological survey conducted in China to determine the risk factors of GDM revealed significant association between GDM and advanced maternal age, pre-pregnancy obesity and family history of diabetes.<sup>[7]</sup> However, a history of recurrent vulvovaginal candidiasis and spontaneous abortion were new risk factors in that survey. A comparable study was conducted in Iranian women and gave analogous risk factors, namely like age  $>30$  years, family history of diabetes, obesity and glycosuria.<sup>[8]</sup>

**Table 1: characteristics of the test and control groups**

	Pregnant women with no GDM (N = 60) M $\pm$ SD	Pregnant women with GDM (N = 60) M $\pm$ SD	P Value
Age (years)	29.7 $\pm$ 6.0	32.8 $\pm$ 7.4	0.013*
Weight (Kg)	73.0 $\pm$ 9.8	79.5 $\pm$ 11.6	0.000*
Height (Cm)	170.6 $\pm$ 5.7	169.5 $\pm$ 7.7	0.616
BMI (Kg/m <sup>2</sup> )	25.1 $\pm$ 3.1	27.9 $\pm$ 4.9	0.000*
Fasting Blood Glucose(mg/dL)	86.9 $\pm$ 16.5	114.4 $\pm$ 40.3	0.000*
Random Blood Glucose (mg/dL)	102.2 $\pm$ 14.6	171.1 $\pm$ 55.0	0.000*
2Hours after meal Blood Glucose (mg/dL)	151.3 $\pm$ 27.3	189.6 $\pm$ 40.2	0.000*
Diastolic Blood Pressure (mmHg)	79.2 $\pm$ 7.4	83.1 $\pm$ 14.8	0.134
Systolic Blood Pressure (mmHg)	121.4 $\pm$ 8.1	125.2 $\pm$ 13.4	0.020*
Mean Blood Pressure (mmHg)	93.3 $\pm$ 6.9	97.1 $\pm$ 12.8	0.073

\* Significant difference of the means

**Table 2: Associations between GDM and anticipated risk factors**

Risk Factor	Relative Risk	Pearson $\chi^2$	P Value
Age ( $\geq 30$ years old Vs $<30$ years old)	1.28	5.76	0.016*
BMI ( $\geq 25$ Kg/m <sup>2</sup> Vs $<25$ Kg/m <sup>2</sup> )	1.48	10.28	0.001*
Parity (multipara Vs primagravidae)	1.31	1.82	0.178
History of Diabetes in the Family	1.80	9.64	0.002*
Glucosuria	2.36	-†	0.000*
Proteinuria	1.98	-†	0.008*
Urinary tract infection	1.24	1.32	0.251

\* Significant associations

† Cannot tolerate Chi-Square test, Fisher's exact test was used instead

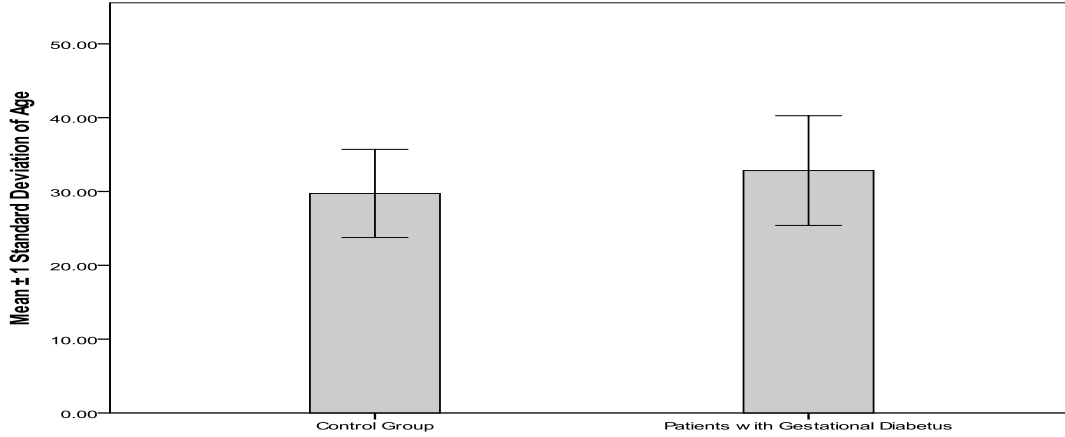


Figure 1: Means and standard deviations of studied groups' ages

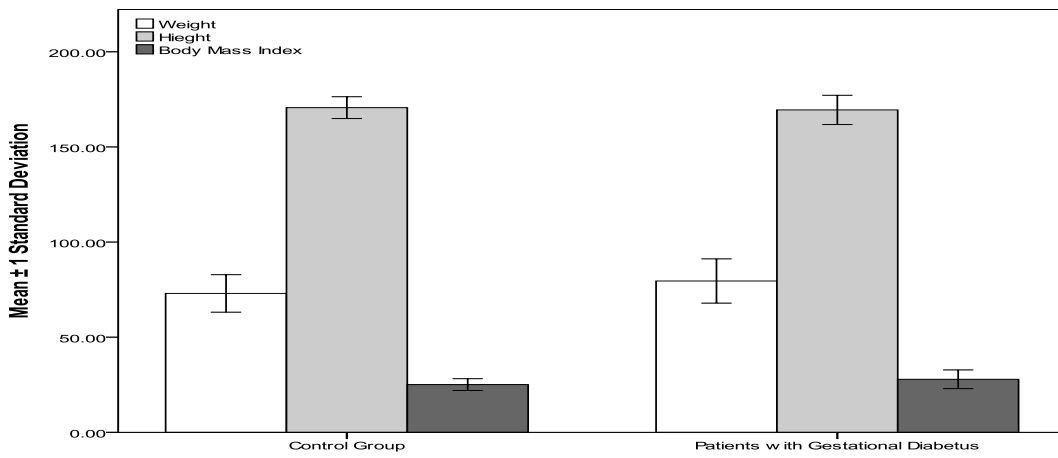


Figure-2: Means and standard deviations of studied groups' anthropometric measurements

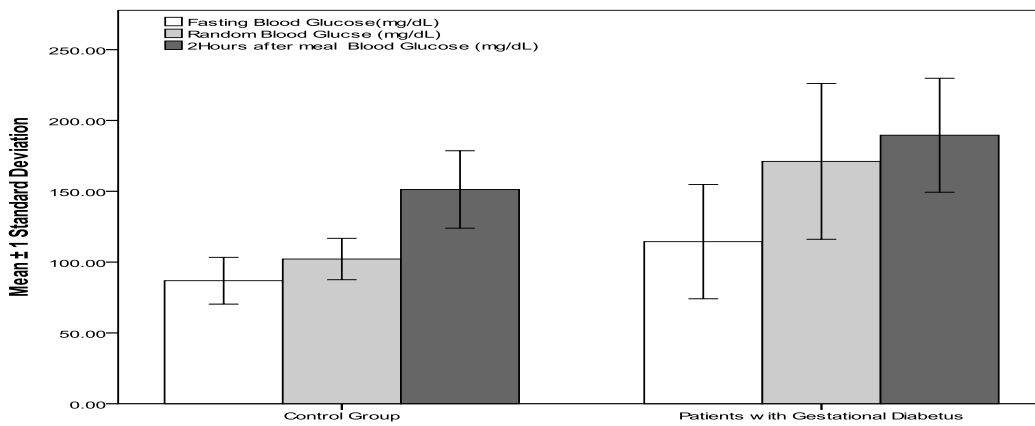


Figure 3: Means and standard deviations of studied groups' blood pressures

Literature regarding glucosuria and proteinuria as risk factors for GDM is inadequate. The relatively high glomerular filtration rate and low renal threshold for glucose explain glucosuria among pregnant ladies. Glycosuria is likely in about 50% of pregnant women<sup>[15]</sup> while GDM affects only about 7% of all pregnancies worldwide.<sup>[14]</sup> The sensitivity of glucosuria for diagnosing GDM is only 8.2% according to a recent study.<sup>[16]</sup> Notwithstanding, according to the findings of this study and others,<sup>[8, 17]</sup> glucosuria is proven to be a significant risk factor for GDM. A good explanation for the low prevalence and intermittent nature of glucosuria among patients with GDM was given by a novel study conducted by Coolen and Verhaeghe.<sup>[16]</sup> Their results showed that pure urine responders (any glycosuria but glucose <130 mg/dl) were younger and had a lower body weight and BMI when compared with plasma responders (no glycosuria but plasma glucose  $\geq$  140 mg/dl). This finding suggests that glucosuria is more likely in those with smaller plasma distribution volume. Accordingly, patients with increased BMI are at higher risk to develop GDM. However, they are less likely to have glucosuria.<sup>[16]</sup>

The proteinuria of late pregnancy is exaggerated in women with diabetes, which also increases the risk of preeclampsia. This fact is further supported by the results of the current study which demonstrated that pregnant women with proteinuria had poor glycaemic control and higher systolic blood pressure compared with those with no proteinuria. Most of the data published on GDM covers the risks of preeclampsia<sup>[10]</sup> which in turn explain the strong association between proteinuria and GDM in this study.<sup>[9]</sup> It has been postulated that GDM may be the first manifestation in those who will later develop diabetes mellitus (DM) and therefore they share common abnormalities like high blood pressure.<sup>[18]</sup> This is supported by Clark *et al.* results which confirmed that numerous of the recognized metabolic components of the syndrome of insulin resistance (syndrome X) are predictive of GDM.<sup>[19]</sup> Alternatively, against the postulation that GDM is the first stage of DM is failure of previous researches to show direct association between measures of insulin resistance and high blood pressure.<sup>[20]</sup> Montoro *et al.* compare the degree of insulin resistance in women with GDM who do and do not develop preeclampsia.<sup>[20]</sup> Results revealed no significant

differences between the two groups regarding measures of the oral glucose tolerance tests, insulin sensitivity index, free fatty acid in either the third trimester or 15 months postpartum. These findings suggest that women who developed preeclampsia were not more insulin resistant when compared with those who remained non-preeclamptic.

In conclusion, it is clear that risk factors for GDM in Sudanese women are comparable with international reports. The strongest predictor of GDM was found to be glucosuria, followed by proteinuria, family history of diabetes mellitus, BMI  $\geq$  25 Kg/m<sup>2</sup> and Age  $\geq$  30 years in a descending pattern. On the contrary, parity and UTI failed to demonstrate significant associations with GDM.

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