International Journal of Gynecology and Obstetrics xxx (2015) xxx–xxx

Contents lists available at ScienceDirect

International Journal of Gynecology and Obstetrics

journal homepage: www.elsevier.com/locate/ijgo

CLINICAL ARTICLE

Gestational diabetes mellitus among women attending prenatal care at Korle-Bu Teaching Hospital, Accra, Ghana

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ARTICLE INFO

Article history:
Received 17 December 2014
Received in revised form 1 May 2015
Accepted 6 August 2015

Keywords:
Body mass index
Gestational diabetes mellitus
Ghana
Obesity
Oral glucose tolerance test

ABSTRACT

Objective: To determine the burden of gestational diabetes mellitus (GDM) among pregnant women in Accra, Ghana. *Methods:* The present cross-sectional study enrolled women at 20–24 weeks of pregnancy attending their first prenatal clinic at Korle-Bu Teaching Hospital, Accra, between March and November 2013. Participants underwent a 2-hour, 75-g oral glucose tolerance test between 24 and 28 weeks. The odds of GDM among different body mass index (BMI, calculated as weight in kilograms divided by the square of height in meters) groupings were calculated in a multiple logistic regression model. *Results:* Among 399 women screened, 37 (9.3%) had GDM. Compared with women with a BMI in the normal range (18.50–24.99), obese women (BMI >30.0) had an increased risk of GDM (odds ratio [OR] 2.98, 95% confidence interval [CI] 1.08–8.20; $P = 0.034$]; overweight women (BMI 25.00–29.99) had a slightly elevated risk (OR 1.20, 95% CI 0.41–3.55; $P = 0.742$). Maternal age, parity, education, employment status, place of residence, and previous pregnancy complications did not affect the risk of GDM. *Conclusion:* GDM was found in 10% of pregnant women in Accra. Women who were obese by 20–24 weeks of pregnancy had a significantly increased risk of GDM.

1. Introduction

Gestational diabetes mellitus (GDM) is characterized by an impairment of glucose metabolism that first occurs during pregnancy [1,2]. Pregnancy itself is known to induce a diabetogenic state through changes in maternal glucose metabolism and insulin sensitivity [3]. As pregnancy advances, there is an increased demand for insulin action. In a normal pregnancy, this demand is met by increased production from the pancreas. In some pregnancies, however, this demand is not met, resulting in poor glycemic control and the development of GDM.

The reported prevalence of GDM ranges from 1% to 14% of all pregnancies, depending on the population studied and the diagnostic tests employed [3]. In Africa, the prevalence has been found to vary widely from nearly 0% in Tanzania to 13.9% in Nigeria [4]. A systematic review of GDM in Sub-Saharan Africa [4] showed that there is a lack of data on the burden of GDM in several countries, thereby emphasizing the need for active research into GDM on the continent.

Many studies have identified risk factors that predispose expectant mothers to GDM, including advanced maternal age, excessive gestational weight gain, and previous cesarean delivery [5–8], as well as maternal obesity, ethnic origin (African Americans, Hispanics, and Indians show a higher incidence of GDM), family history of type 2 diabetes mellitus, and previous delivery with fetal macrosomia (>4.0 kg) [9–11]. Other risk factors include a previous history of GDM and increased pre-pregnancy body mass index (BMI, calculated as weight in kilograms divided by the square of height in meters) [12]. Lower socioeconomic status has gained recognition as a risk factor for chronic disease in both low- and high-income countries. A higher level of education, urban dwelling, formal employment, and high socioeconomic status have also been shown to correlate positively with the development of GDM [13].

Ghana—similar to many low-income countries—has a population that is going through a demographic transition. Consequently, there is increasing prevalence of lifestyle-associated diseases such as obesity, hypertension, coronary heart disease, and type 2 diabetes [14]. A systematic review in 2008 [15] found that the prevalence of obesity among women more than doubled in the 15-year period from 1990 to 2004 in West Africa, which includes Ghana. With increasing obesity and type 2 diabetes among young people, the incidence of GDM is also expected to rise.

A previous population-based study in the Greater Accra region in Ghana [16] estimated the crude prevalence of diabetes mellitus to be

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http://dx.doi.org/10.1016/j.ijgo.2015.05.029
0020-7292/

6.3% in the general population, with a prevalence of 7.7% among men and 5.5% among women. However, the prevalence of GDM among pregnant women in Ghana is not known. Despite the fact that GDM is known to adversely affect pregnancy outcome for mother and fetus [4,12], the burden of this disease has not been studied in Ghana to our knowledge.

Management of women diagnosed with GDM primarily begins with non-pharmacological lifestyle modifications such as diet and exercise. Drug treatment is only added when these measures fail to achieve glycemic control or fetal complications develop (e.g. fetal macrosomia or polyhydramnios). In Ghana, drug therapy usually comprises a combination of short- and intermediate-acting insulin that is administered in multiple daily doses and modified until glycemic targets are achieved. Oral hypoglycemic agents such as metformin that are used elsewhere are not currently administered in Ghana.

The gold standard diagnostic test for GDM is the oral glucose tolerance test (OGTT), which is usually performed between 24 and 28 weeks of pregnancy [4]. In Ghana, however, there is no national policy or guideline for GDM screening. Most clinicians rely on historical risk factors to indicate screening, such as GDM in previous pregnancy, family history of type 2 diabetes, maternal age older than 35 years, maternal weight more than 90 kg, or previous fetal macrosomia. With this approach, many women are likely to be overlooked until they develop symptoms of overt GDM with its attendant maternal and fetal complications.

The Korle-Bu Teaching Hospital in Accra has the largest tertiary referral obstetric unit in Ghana and cares mainly for women with high-risk pregnancies. More than 80% of women are referred with various obstetric complications. The hospital conducts approximately 11 000 deliveries annually with a cesarean rate of approximately 35%, according to the 2012 annual report [17]. The hospital has no clearly defined policy for screening and diagnosis of diabetes during pregnancy. As in the rest of Ghana, most women with diabetes in pregnancy are diagnosed on the basis of a previous history of diabetes or are screened after the identification of historical risk factors or pregnancy-related complications such as polyhydramnios, large for date, or new-onset symptoms of diabetes.

The aim of the present study was therefore to determine the prevalence of GDM via the OGTT, and to identify associated risk factors among a cohort of pregnant women receiving prenatal care at the Korle-Bu Teaching Hospital to provide data to support a national screening program to minimize the complications arising from undiagnosed GDM.

2. Materials and methods

The present cross-sectional study was conducted at the Korle-Bu Teaching Hospital between March 1 and November 30, 2013. During the study period, all new prenatal registrants were approached and screened for eligibility. Women were included in the study if they were aged 18 years or older and had a singleton pregnancy of 20–24 weeks, as dated by a reliable last menstrual period combined with first-trimester ultrasonography. Women who could not have their weight or height measurements taken, had a multiple pregnancy, were known to have diabetes mellitus or hypertension, or had abnormal random blood sugar level at screening were excluded. The participants were recruited prospectively as part of the Maternal Obesity and Pregnancy Outcome Study and provided written informed consent. The study protocol was approved by the Institutional Review Board of the Noguchi Memorial Institute for Medical Research (Protocol Number NMIMR-IRB 042/12-13).

A structured questionnaire was used to obtain demographic and obstetric characteristics, and the medical history of participants. Blood pressure, weight, and height measurements were taken, and BMI was determined. On the basis of their BMI at the first prenatal visit, the study women were divided into categories in accordance with the WHO standard BMI criteria for adults [18]: underweight (<18.50), in the normal range (18.50–24.99), overweight (25.00–29.99), or obese (≥30).

Participants were scheduled for an OGTT between 24 and 28 weeks of pregnancy. Before the test, they were called and reminded to complete an overnight fast for 8–14 hours. On arrival at the Diabetic Research Laboratory, where the tests were performed, the women sat and rested for 30 minutes before a first venous sample was taken. They were then given 75 g of glucose dissolved in 300 mL of water, which they drank within 3 minutes under supervision. Venous blood samples were taken again at 1 hour and 2 hours.

Venous blood was used for laboratory blood glucose profile analysis. Analysis of fasting blood glucose, 1-hour blood glucose, and 2-hour blood glucose was done by enzymatic photometric testing using a Mindray BS-400 chemistry analyzer (Mindray Medical International, Shenzhen, China). Blood sugar levels in the samples were measured and the results were interpreted via the 2012 diagnostic criteria of the WHO/American Diabetes Association (fasting >5.1 mmol/L; 1 hour >10.0 mmol/L; 2 hours >8.5 mmol/L) [19]. A diagnosis of GDM was made when one or more of the values was exceeded.

All participants attended the prenatal clinic at 28 and 36 weeks of pregnancy to review any pregnancy-related complications and to assess weight. Women who developed complications (e.g. large-for-gestational-age fetus or polyhydramnios) or symptoms suggestive of GDM were advised to repeat screening by their attending obstetrician, even if their OGTT results at 28 weeks were negative. All women were managed at the Korle-Bu Teaching Hospital in accordance with the clinic's standard prenatal protocol.

The primary outcome of the study was the 2-hour plasma glucose level. Other important outcome measures were fasting plasma glucose and 1-hour plasma glucose.

All data were entered into a spreadsheet and cleaned. Statistical analysis of the data was performed with SPSS version 16 (SPSS Inc, Chicago, IL, USA). The independent variables investigated were maternal age, education, place of residence, parity, obesity status, and complications of previous pregnancies; the dependent outcome was incidence of GDM in the current pregnancy. Continuous variables (maternal age, weight and BMI) were reported as mean ± SD. Categorical variables were reported as number (percentage). The χ^2 test was used to determine differences between BMI category and the development of GDM.

Multiple logistic regression was used to assess relationships between maternal age, education, residence, parity, BMI, complications of previous pregnancies, and incidence of GDM in the current pregnancy. The odds of GDM were estimated for each BMI category, and the overall odds ratio (OR) and 95% confidence intervals (CIs) were estimated after controlling for the above covariates in a logistic regression model. $P < 0.05$ was considered statistically significant.

3. Results

In total, 399 pregnant women underwent a 2-hour, 75-g OGTT for GDM during the study period. The mean BMI of the participants was 29 ± 6. Only 104 (26.1%) participants had a BMI within the normal range; 287 (71.9%) were overweight or obese. More than half the participants were aged 30–39 years (Table 1). Most participants lived in urban areas, were married, and were employed (Table 1). More than one-third had completed tertiary education (Table 1). Among the participants who had delivered previously, most had had uneventful pregnancies and deliveries (Table 1). The most commonly reported previous obstetric complications were hypertension, GDM, and postpartum hemorrhage (Table 1).

Among the 399 women who had undergone OGTT by 28 weeks, 37 (9.3%, 95% CI 6.6%–12.5%) had a positive test. Two women who tested negative had a repeat OGTT at 33 and 35 weeks, respectively, owing to polyhydramnios, but the results were normal. The mean age of women with GDM was 32 ± 5 years. The mean weight of these participants was 79 ± 15 kg and their mean BMI was 31 ± 5. The proportion of women who were obese was higher among those with GDM than among those who tested negative ($P = 0.019$) (Table 2). No significant differences

Please cite this article as: Oppong SA, et al, Gestational diabetes mellitus among women attending prenatal care at Korle-Bu Teaching Hospital, Accra, Ghana, Int J Gynecol Obstet (2015), http://dx.doi.org/10.1016/j.ijgo.2015.05.029