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Glucose metabolism and pregnancy in South African women

Macaulay, Shelley

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ABSTRACT

Background

Gestational diabetes mellitus (GDM) refers to diabetes with first onset during pregnancy. A diagnosis of GDM has serious implications for the affected woman and her unborn child. Women with GDM are at risk of developing Type 2 diabetes mellitus (T2DM) and children are at risk of being born large for gestational age, becoming overweight or obese, and developing T2DM later in life. The prevalence of T2DM and GDM is increasing worldwide and particularly within low-to-middle income countries (LMICs). However, there is a lack of data on GDM prevalence and the effects of GDM-exposure amongst African populations. Like other LMICs, South Africa's public healthcare system is heavily burdened and under-resourced. In terms of antenatal care, South Africa utilises a selective screening approach for GDM whereby only women with certain risk factors are investigated further, and prenatal ultrasound services are not readily available to all. These two factors make the identification of women with GDM, the monitoring of fetal growth, and clinical decisions around gestational age at delivery, difficult. Evidence-based data is required in order to propose changes to current policies governing maternal health.

Aims

The overarching aim of this study was to investigate GDM amongst black South African women. The study set out to discern what GDM prevalence figures exist for the African continent, determine the prevalence of GDM amongst women living in urban Soweto, Johannesburg, assess the effects of GDM exposure on fetal growth and neonatal birth measures, and evaluate the reliability and validity of using last menstrual period (LMP) dates to estimate gestational age.

Methods

Firstly, a systematic review was performed to determine what GDM prevalence figures exist for Africa. Secondly, a cross-sectional screening study was performed to ascertain the GDM prevalence amongst black South African women living in Soweto. Pregnant women were recruited from the Chris Hani Baragwanath Academic Hospital in Johannesburg. Inclusion criteria were; black South African females, ≥18 years of age, residing in Soweto, ≤20 weeks pregnant with singleton pregnancies. A total of 3 656 women who fulfilled the inclusion criteria were briefed on the study and invited to access free GDM screening when they were 24-28 weeks pregnant. A total of 2 009 women underwent a two-hour 75 g oral glucose

tolerance test (OGTT) at 24-28 weeks gestation and a diagnosis of GDM was made using the World Health Organization's 2013 criteria. Of those 2 009 women, 1 909 had complete and conclusive OGTT readings and formed the study sample for the 'GDM screening' component of this study. Thirdly, a subgroup (n=1 017) of the 3 656 women formed the Soweto First 1000 Days study (S1000); a longitudinal pregnancy cohort study. These pregnant women were followed up from early in their pregnancies with repeated fetal ultrasounds and neonatal birth measures were taken at delivery. A total of 741 women from the S1000 study underwent an OGTT and had conclusive glucose results. These women formed the 'fetal growth and neonatal birth measures' component of this study whereby GDM-exposed fetuses were compared to unexposed fetuses. Furthermore, amongst these 741 women, gestational age was determined by last menstrual period (LMP) and ultrasonography. Comparisons between the two methods were made. Multiple statistical analyses were performed.

Results

Only six of the 54 African countries had reported data on GDM prevalence. At the time the systematic review was performed, South Africa had four reported studies of which only two involved black women. Based on the limited number of African studies, the GDM prevalence across Africa was estimated to be around 5%.

The GDM screening study revealed a 9.1% (95% confidence interval (CI) 7.9, 10.5) (174/1906) GDM prevalence. Compared to the women without GDM, those with GDM were significantly heavier with higher body mass indexes (BMIs), older, and of higher household socioeconomic status. A family history of diabetes and a diagnosis of anaemia were also more common amongst the women with GDM. Being ≥35 years, having a BMI ≥30 kg/m^2 (obese) and a family history of diabetes were found to be significant GDM risk factors. Furthermore, the fasting plasma glucose reading had a high sensitivity (83.3% (95% CI 77.0, 88.5)) in diagnosing GDM.

The longitudinal cohort study involving the 741 women who underwent repeated fetal ultrasounds showed that GDM exposure was associated with an increase in fetal growth measures, especially abdominal circumference which was already seen at 16-18 weeks gestation. When stratified by sex, male fetuses showed a significant association between GDM exposure and increased abdominal circumference (p=0.009) but this was not observed amongst female fetuses (p=0.286). There was no difference in birth measures between the GDM-exposed and unexposed neonates. Gestational age dating by LMP overestimated

gestational age by 0.2 days. Women with discrepancies between their LMP-based and ultrasound-based estimates were of significantly lower weight and household socioeconomic status that those without discrepancies. Whilst there was substantial agreement between the two methods, LMP had poor sensitivity in identifying late-term (41 weeks 0 days - 41 weeks 6 days gestation) and post-term (≥42 weeks gestation) pregnancies (29.0% (95% CI 14.2, 48.0) and 33.3% (95% CI: 4.33, 77.7) respectively).

Conclusion

Only 11% of the African continent reported GDM prevalence figures. The GDM screening component of this study represents the largest GDM prevalence study in South Africa to date. A GDM prevalence of 9.1% amongst black South African women living in urban Soweto is concerning and warrants further discussion around current GDM screening policies. Whilst universal screening for GDM may be unrealistic in South Africa's heavily burdened public healthcare system, the use of a fasting plasma glucose screen was shown to be highly sensitive in identifying women with GDM and should be considered as a possible screening tool.

Additionally, repeated ultrasound measures identified the effects of GDM as early as 16-18 weeks gestation, with GDM-exposed male fetuses having lager abdominal circumferences than unexposed fetuses. This highlights that sexual dimorphism in relation to *in utero* exposure to GDM exists with male fetuses being particularly susceptible to the hyperglycaemic environment and abdominal circumference being an indicator of increased fetal growth. A low rate of macrosomia and large-for-gestational age neonates was observed amongst the GMD-exposed group of neonates compared to historical GDM-exposed populations. In the absence of ultrasound, LMP is a reliable alternative for gestational age dating during early pregnancy. However, LMP estimates should not be relied upon to make clinical decisions regarding elective Caesarean sections or induction of labour for supposed prolonged pregnancies. In the case of GDM, fetal ultrasonography appears important for fetal sexing and the monitoring of fetal growth, as well as for informing clinical decisions around delivery. Health systems strengthening through increased availability of ultrasound services and detection of GDM should be considered in order to improve maternal and child health in South Africa.