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An Investigation into the Relationship between Maternal Age and Some Indices of Foetal Nutrition in Warri, Delta State, Nigeria

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Abstract: It has been observed that the amount of maternal serum and cord blood glucose influence foetal weight and well-being. This study reports the effect of maternal age on maternal serum/cord blood glucose and birth weight at term. One hundred and sixty eight (168) consenting pregnant subjects between 15 and 45 years, and who were in the late trimester period were randomly recruited from the Ante-Natal Clinic, Central Hospital, Warri, Delta State, Nigeria. Cases of ill-health, pregnancy complications and disease conditions associated with pregnancy were excluded. One hundred and eighty four (184) weight and age-matched, non-pregnant women in apparent good health were randomly recruited from the hospital community as control subjects. The results show that younger (15-19 years) and older (40-45 years) pregnant women had lower mean blood glucose (4.42±1.31 mmol/L vs 3.52+1.49mmol/L; $p>0.05$), and this was associated with lower neonatal cord blood glucose (3.28±0.98 vs 2.81±0.79 mmol/L, $p<0.05$) and birth weight (3.28±0.77kg vs 3.10±0.63kg, $p>0.05$) at term. Mean maternal serum glucose of the pregnant women between 20-39 years was 4.65±1.39 mmol/L. The mean cord blood glucose and mean birth weight of their neonates at term were 3.51±1.16 mmol/L and 3.48±0.70 kg, respectively. Maternal age affects blood glucose and foetal weight. Special prenatal care should be given to pregnant women between 15-19 and 40-45 years in Nigeria, in order to minimize or if possible, eliminate the medical complications associated with low birth weight at term.

Key words: Birth weight, cord blood, glucose, maternal age, nutrition

INTRODUCTION

Pregnancy is a complex nutritional state that involves the maternal synthesis and transport of nutrients for foetal metabolism and wellbeing and also the provision of internal environmental conditions favourable for foetal growth. One of the basic nutrients required for foetal nourishment is glucose, and glucose intake by pregnant women has been reported to influence birth weight (Adams *et al*., 1998).

Transplacental glucose transport is a facilitated process and in humans it is mediated by the glucose transporter isoform, GLUT 1. The GLUT 1 transporter is highly abundant in the syncytiotrophoblast plasma membrane and this ensures an efficient maternofoetal transport of glucose. Therefore, net transport is highly dependent on maternal blood levels (Babson *et al*., 1970). GLUT 1 glucose-transporting capacity is as much as 20 fold higher than basal membrane transport capacity. Basal membrane transport thus is the rate limiting step in the maternofoetal transport chain. Hence any alteration in basal membrane transport of glucose would affect net transport across the placenta. The number of GLUT 1 transporter per membrane area in basal membrane vesicles increases during the first half of the gestational period and remains constant thereafter, suggesting that early pregnancy is a critical period in establishing an efficient glucose-transporting capacity of the human placenta (Babson *et al*., 1970; Barham and Trinder, 1972). High glucose concentrations down-regulate GLUT 1 expression in a variety of cell culture systems but in placenta cells, pronounced hyperglycemia appears to be required to alter GLUT 1 expression and activity (Campbell and Mottola, 2001; Campbell *et al*., 1993). Placental glucose transporters are sensitive to regulation by nutrient availability mainly during early pregnancy (Coustan and Imarah, 1984).

Perinatal and neonatal morbidity and mortality rates are functions of birth weight. They decrease with increasing birth weight upto 4.0 kg beyond which they start to increase (Hahn and Desoye, 1996). Low birth weight neonates have been shown to be at a higher risk of perinatal death and growth difficulties (Hahn and Desoye, 1996), and the identified risk factors include: ethnicity, genetic, lower socioeconomic status, lower pregnant weight, smaller pregnancy weight gain, alcohol consumption, maternal smoking during pregnancy, maternal hypertension, infection during pregnancy,

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Table 1: Relationship between maternal age and maternal serum glucose, cord blood glucose and birth weight at term

Maternal age (year)	15-19	20-24	25-29	30-34	35-39	40-45
Pregnant women						
Number of subject, n	26	31	42	28	23	18
Indices of Foetal nutrition						
Maternal serum glucose (mmol/L)	4.42±1.3	14.83±1.22	5.01±1.43	5.04±1.30	3.71±1.61	3.52±1.49
Cord blood glucose (mmol/L)	3.28±0.98	3.61±0.86	3.66±0.91	3.54±0.88	3.22±0.79	2.81±0.79
Birth weight at term (kg)	3.28±0.77	3.55±0.81	3.68±0.69	3.50±0.66	3.19±0.63	3.10±0.63
Non-pregnant women						
Number of subject, n	28	36	44	26	27	23
Maternal serum glucose (mmol/L)	4.22±1.73	4.16±1.90	4.31±1.52	4.50±1.61	4.11±1.42	4.20±1.31
Cord blood glucose (mmol/L)	-	-	-	-	-	-
Birth weight at term (kg)	-	-	-	-	-	-

Indices of foetal nutrition are expressed as mean ± SEM for 'n' subjects; *: $p<0.05$ when compared with those within 25-34 age ranges

perceived psycho logic stress, prior adverse pregnancy outcomes and multiple births (Illsley, 1995). Therefore, prevention of low birth weight should be an important health goal of maternal and child health.

Gestational diabetes results in increased birth weight which could be an indication for cesarean delivery. It can also cause birth trauma (Jansson *et al.*, 1993). Other complications include intellectual and developmental retardation (Jansson *et al*., 1993). The impact of gestational diabetes on the foetus is as a result of the maternal derangements in glucose metabolism and alterations in placental transport characteristics (Adams *et al*., 1998).

This present study attempts to report the influence of maternal age on neonatal birth weight, and maternal and cord blood glucose-the main source of energy during pregnancy, and the primary determinant foetal nutritional status.

MATERIALS AND METHODS

Subjects: This cross sectional study was carried out in the Labour Unit of the Central Hospital, Warri, a government owned District Hospital in Warri in the Niger Delta region of Nigeria. The study was from December 2009 to November 2010. Three hundred and fifty two women were recruited for this study. The subjects comprised one hundred and sixty eight pregnant women aged between 15 and 45 years who were in their late trimester. All cases of complications and disease conditions associated with pregnancy were excluded in the study. One hundred eight four weight and age-matched, non-pregnant women in good health were recruited as controls for the study. They were counseled and their written consent was obtained prior to the commencement of the study. Ethical approval was obtained from the Ethics Committee of the Hospital.

Specimen collection and analysis: The usual aseptic process of vein puncture to collect blood samples from the participants was observed. Cord blood specimens were also collected from the neonates by introducing the needle into the umbilical vein at any point on the umbilical cord. The blood sample collected into fluoride oxalate bottle was centrifuged within 30 min of collection at 1200×g for 5 min at room temperature to get about 1.0 mL of plasma. The plasma samples were stored frozen in bijou bottles, and analysed for glucose within 48hours.

The glucose levels of the plasma specimens were determined by the glucose oxidase method (Jansson *et al*., 1999) using commercially prepared reagent kit (Randox laboratories, Ardmore, UK).

The birth weights of the neonates were taken and recorded to the nearest 0.1 kg.

Statistics: All statistical calculations were performed by the SPSS-PC programme package (version 7.5).

RESULTS

The results obtained show that there was no significant difference ($p>0.05$) in glucose levels between the pregnant and non-pregnant women in all the age ranges studied. However, the mean blood glucose levels for the pregnant women at term were observed to be higher (except for 35-39 and 40-45 age ranges) peaking at 25-29 age range (Table 1).

Older pregnant women above 35 years, and young ladies below 20 years had lower mean blood glucose levels when compared with those between 20-24, 25-29 and 30-34 years. The difference between those within 20-34 years, "the child bearing age" and those above 35 years was statistically significant ($p<0.05$).

The influence of maternal age on the cord blood glucose seems similar, though maternal serum glucose level was calculated to be 34.8, 33.8, 36.9, 42.4, 15.2 and -9.4% different from the cord blood level at the various age categories, respectively. These differences were not significant ($p>0.05$).

The amount of glucose in the umbilical cord blood could determine foetal weight, and in apparent good health, this appears to be dependent on the maternal level and age.

DISCUSSION

Pregnant women between the ages of 15 and 34 years have higher mean levels of glucose at term when compared with the non-pregnant women at the different maternal ages, though not statistically significant ($p>0.05$). This agrees with the observation of Meuckley (1994) who reported an increase in maternal blood glucose during the child bearing ages (18-35 years).

Pregnancy-induced increase in blood glucose is due to hormonal influence which causes increased glucogenesis and protein metabolism to meet the energy demand caused by the physiochemical changes associated with pregnancy. This in turn assures the availability of nutrient materials for foetal metabolism, growth and development. However, it was observed that pregnant women above 35 years demonstrated decrease in the level of plasma glucose. It therefore, appears that maternal age affects blood glucose. This could imply that synthesis and mobilization of basic nutrients, to be transported for foetal growth and development may be inadequate since the foetus does not synthesize its own nutrients but entirely dependent on maternal source.

The effect of maternal age on cord blood glucose was observed to be same, and so the changes in maternal blood glucose, correlates positively with cord blood glucose ($r = 0.452$; $p<0.05$). Udo *et al*. (1996) have reported similar relationship between maternal and cord blood glucose. It follows that maternal nutritional state could modulate foetal nutrient status.

From this study, it was observe that both maternal and cord blood glucose strongly influence neonatal birth weight. Previously, Coustan and Imarah (1984), Adams *et al*. (1998) and Yen (1993) have observed increased neonatal birth weight in women with higher maternal blood glucose.

Evidence from this present study suggests that maternal age could affect the synthesis and transport of glucose for foetal growth and development. Older women above the age of 35 years, and who have had multiple births especially, demonstrated reduced blood glucose and consequently, gave birth to neonates with lower birth weight. This could be worrisome since low birth weight infants have been reported to be at much a risk of perinatal death and growth difficulties (Hahn and Desoye, 1996).

CONCLUSION

This study has been able to demonstrate a clear relationship between maternal age, maternal blood glucose levels, cord blood glucose level and foetal birth weight. Extremes of maternal age are associated with low maternal blood glucose and low cord blood glucose and foetal birth weight. It is therefore, recommended that among the Nigerian pregnant population, women above 35 years, who have had multiple births especially, and younger women below 20 years should be specially monitored to reduce giving birth to babies with small body size and low weight at term.

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