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REVIEW PAPER

CAN FETAL MACROSOMIA BE PREVENTED?

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ABSTRACT

Fetal macrosomia is an obstetric complication that makes child birth hazardous to women in labor, and sometimes an enigma to medical practitioners. It tasks the skills of obstetricians and places a burden on human and material medical resources. There is therefore a need for the prevention of fetal macrosomia in order to reduce the accompanying feto-maternal morbidity and mortality. Though nutritional restriction has been suggested, it seems that better preventive strategies need to be developed, since clinical trials have established that low glycemic index food do not necessarily reduce incidence of fetal macrosomia in susceptible women. However, quantification of food intake and the magnitude of disparity between high and low glycemic index foods administered to control and intervention groups, need to be known in order to fully validate the outcome of randomized controlled trial.

Keywords: Fetal Macrosomia, feto-maternal health, Maternal morbidity and mortality, Child health

INTRODUCTION

Fetal macrosomia is a condition in which the fetal birth weight is 4000g or more regardless of age. It has been more appropriately defined as fetal weight above the 90th percentile for a given gestational age in weeks (Resnik, 2003). The criterion for this definition is related to the maximum birth weight of fetus that the human pelvis can effectively transport from the uterus to the exterior. This criterion depends on the pelvic size, which varies according to geopolitical regions and level of nutrition.

In a study of 23 countries by Koyanagi et al. (2013), the 90th percentile of birth weight was 3250 g in India and 4050g in Algeria, while the 90th percentile in United States of America ranged between 4060g and 4500g (Resnik, 2003). Therefore, when the fetal weight is above the benchmark for a given geopolitical region, feto-pelvic disproportion 'in breech presenting fetuses (fetus presenting with buttocks) or cephalo-pelvic disproportion 'in cephalic presenting fetuses (fetus presenting with head) occur. Thaddeus and Maine (1994) further emphasized that in areas where there is delay in management due to prolonged obstructed labor, fetal and maternal complications may occur. Complications include shoulder dystocia and its associated complications of birth asphyxia and brachial nerve injury, and maternal trauma such as obstetric fistulae, sepsis, hemorrhage, and obstetric shock secondary to ruptured uterus (Resnik, 2003).

It has been suggested that limitation of intake of dietary calories to 2000 Calories (Kilocalories), adequate exercise and avoidance of sedentary lifestyle, are capable of preventing obesity, excessive gestational weight gain and therefore fetal macrosomia (Inegbenebor and Ebomoyi, 2012). In a randomized controlled trial involving 800 women at risk of fetal macrosomia in their second pregnancies, a low glycemic index diet in pregnancy did not reduce the incidence of 'large' for gestational age infants. There was however, a significant positive effect on

gestational weight gain and maternal glucose intolerance (Walsh et al, 2012). But, quantification of food intake and the magnitude of disparity between high and low glycemic index foods administered to control and intervention groups need to be known in order to fully validate the outcome of this randomized control trial.

Considering the fetal and maternal health implications of fetal macrosomia, there is therefore a need to develop preventive strategies to reduce the incidence of fetal macrosomia and the associated feto-maternal morbidity and mortality. This article discusses the possible preventive measures of fetal macrosomia while giving an insight of the condition.

DISTRIBUTION OF FETAL MACROSOMIA

Although fetal macrosomia is found in all parts of the world (Dennedy and Dunne, 2013), it is expected that the incidence will be higher in affluent countries, where the nutritional status is higher. However, it is also becoming increasingly prevalent in developing countries.

Specifically, the prevalence of fetal macrosomia in developed countries has increased by some 15 - 25% in recent decades; an increase largely attributed to increasing maternal obesity and diabetes (Koyanagi et al, 2013). The prevalence of a birth-weight of 4000g or greater ranging from 0.5% in India (90^{th} percentile, 3250 g) to 14.9% in Algeria (90^{th} percentile, 4050g) has been documented (Koyanagi et al, 2013). In the case of Nigeria in particular, an analysis of 6376 singleton births in Lagos, presented a 4.9% prevalence of macrosomia and the attending perinatal mortality was 58 per 1000 compared to 18 per 1000 in controls (Abudu and Awonuga, 1989).

DETERMINANTS OF FETAL MACROSOMIA

According to Savona-Ventura and Chircop (2004), fetal macrosomia appears to be commoner in the older obese and previously diabetic women, who have had at least one previous pregnancy or miscarriage. By implication, factors that have been linked to fetal macrosomia include uncontrolled diabetes mellitus, pre-gravid maternal obesity, excessive gestational weight gain, as well as maternal over-nutrition. Foods with high glycemic index such as sugary beverages, high energy dense carbohydrate diets and fatty diets commonly served in fast food restaurants have been suggested as capable of causing fetal macrosomia (Inegbenebor and Ebomoyi, 2012). These causes have a common factor of persistent hyperglycemia which is believed to be converted by fetal insulin into adipose tissue and believed to induce excessive bone growth especially of the shoulders (Sacks, 2007). Other risk factors for macrosomia according to Koyanagi et al. (2013) include; male fetal sex, high parity, maternal age, maternal height and post-term pregnancy.

DETERRENTS OF FETAL MACROSOMIA

Fetal macrosomia poses perinatal risks to mother and child. These include prolonged obstructed labor due to feto-pelvic disproportion or cephalopelvic disproportion (Inegbenebor and Ebomoyi, 2012). There may also be maternal trauma such as obstetric fistulae, which are socially devastating to affected women (Koyanagi et al., 2013) and postpartum hemorrhage, a frequent cause of maternal mortality. In fact, it is the cause of increased risk of caesarean section, prolonged labor, maternal haemorrhage, and perineal trauma (Koyanagi et al., 2013).

Neonatal complications such as shoulder dystocia, neonatal asphyxia, and neonatal injuries such as Erbs palsy and klumpke's palsy (Resnik, 2003) may lead to childhood and adult disability as well as death.

INTERVENTION STRATEGIES FOR PREVENTING FETAL MACROSOMIA

Prevention strategies for fetal macrosomia can be discussed at five levels of intervention as stated by Lucas and Gilles (2006) and Park (2007).

1. **Health promotion and education**: This involves behavioral modification of susceptible women through interpersonal communication, mass media, and folk media. A perusal of the determinants of fetal macrosomia presupposes that avoidance of high energy dense, high glycemic index foods (Ihediohanma, 2011) and beverages can prevent fetal macrosomia in glucose tolerant susceptible women. In view of this fact, the suggestion by Inegbenebor and Ebomoyi (2012) becomes relevant. However, a controlled trial carried out on 800 women in Ireland disagrees with this suggestion (Walsh et al, 2012). Of interest in the study by Walsh et al. (2012) is the reported reduction in gestational weight gain and improved glucose

tolerance even though nothing was reported on the quantification and the disparity of the administered diet between the control and intervention groups.

2. **Specific protection:** intra-peritoneal injection of aqueous extract of Alligator pepper (*Zingiberaceae aframomum melegueta*) was found to reduce gestational weight gain and litter size in female Sprague Dawley rats without adverse effects on the off springs or mother rats (Inegbenebor et al., 2009). It was therefore suggested that further research be done to determine the possibility of use of this extract as a food supplement or vaccine in women at risk of fetal macrosomia (Inegbenebor et al., 2009; Inegbenebor and Ebomoyi, 2012).

   Interestingly, some researchers have found that the extract of Alligator pepper causes improved glucose tolerance in normo-glycermic and alloxan induced diabetic rats (Mojekwu et al., 2011). In addition, a recent study showed that oral ingestion of alligator pepper extract increased whole body energy expenditure through the activation of brown adipose tissue in human subjects (Sugita et al., 2013). Considering the fact that brown adipose tissue is preponderant in newborns, this effect might explain the litter size reduction in pregnancies treated with intra-peritoneal injection of aqueous extract of Alligator pepper as previously reported by Inegbenebor et al. (2009).

   There is however a probability that the active ingredient in Alligator pepper might be implicated. Abscicic acid, a sesquiterpene isoprenoid phytohormone, that has been shown to be an endogenous stimulator of insulin release from human pancreatic β cells with cyclic ADP-ribose as second messenger (Bruzzone et al., 2008) might be responsible for the improved glucose tolerance, while, 6-Paradol (6-gingerol) is responsible for the energy expenditure secondary to activation of brown adipose tissue as reported by Sugita et al. (2013). By implication, abscicic acid and or 6-Paradol may be the principal active constituents of Alligator pepper that can prevent fetal macrosomia.

3. **Early diagnosis and treatment:** Early diagnosis can be done with the aid of obstetric ultrasound scan, which can estimate fetal weight though with decreasing precision as gestational age increases (Resnik, 2003). However diagnosis is often retrospective as birth weight can only be measured after delivery of the fetus. Active management of labor is the rule in women with fetal macrosomia. Warning signs for obstetric intervention include fetal distress, cervical dystocia, and delayed descent. Intervention may be in form of induction of labor, cesarean section, or skilled management of shoulder dystocia. Expertise in management of post partum hemorrhage that may complicate prolonged labor or induction is also required. Neonatologist should be available to manage neonatal asphyxia that may occur.

4. **Limitation of disability:** Maternal complications such as obstetric fistulae should be referred to the gynecologist while foot drop should be referred to the physiotherapist. Fetal complications such as fractured clavicle, Erb's palsy and klumpke's palsy should be managed by the orthopedic surgeon and physiotherapist respectively.

5. **Rehabilitation:** Where maternal complications are of such magnitude that they result in chronic disability, the mothers should be rehabilitated functionally, socially, psychologically and vocationally (Park, 2007), so that they live an economically productive life devoid of social ostracism. Children with cerebral palsy can be give special education in order to make them socially acceptable and economically productive.

CONCLUSION

Fetal macrosomia is an undesirable condition that can lead to devastating obstetric complications and childhood obesity. It tasks the capability and endurance of the obstetrician, consumes the hospital facilities and may cause untold suffering to mother and child. It is therefore better prevented. If prevention is ineffective or impossible, adequate human and material resources must be available for early diagnosis and treatment, limitation of disability and rehabilitation.

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AUTHOR(S) CONTRIBUTION

Dr Ute Inegbenebor conducted the literature search and wrote all aspects of this article.