UNIVERSITI PUTRA MALAYSIA

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RISK FACTORS OF FETAL MACROSOMIA

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ABSTRACT

Aim: Maternal characteristics such as maternal age, maternal weight at term and gestational diabetes mellitus are associated with macrosomia. We aimed to determine the association between maternal characteristics and fetal macrosomia, and its contribution to the clinician in managing the problem of fetal macrosomia. **Methods**: This study was a case control study. We look back of patient's medical history to determine the risk factor, maternal and neonatal outcome, and method of delivery among patients having macrosomic baby and the control group. **Results**: There were a total of 204 cases of fetal macrosomia out of 10461 deliveries in Hospital Serdang during last year. The incidence of fetal macrosomia was 1.95%. Statistically analysis showed that the mothers of macrosomic babies were older (OR 2.909, 95% CI 1.056; 8.011). The study group had more mothers with gestational diabetes mellitus (32.9% vs. 17.1%) and history of macrosomic babies (21.4% vs. 2.9%) compared with the control group. **Conclusion**: Estimating a fetal birth weight is difficult. A definitive diagnosis of fetal macrosomia is only through weighing the neonate once they are delivered. Although there are no intervention has been proven to significantly reduce the risk of macrosomia, several potentially useful strategies may be helpful to reduce the risk of macrosomia. For example, in diabetic patient, tight glucose control and insulin therapy can be practice to reduce the risk of macrosomia.

Keywords: *Macrosomic baby, Gestational Diabetes Mellitus, Perinatal complication*

FAKTOR-FAKTOR BAYI MAKROSOMIK

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ABSTRAK

Tujuan: Ciri-ciri ibu seperti umur ibu, berat ibu yang mempunyai kencing manis semasa mengandung sentiasa dikaitkan dengan makrosomia.Kami sasar untuk menentukan hubungan antara ciri-ciri ibu dan bayi makrosomik, dan sumbangan kepada doktor dalam menguruskan masalah bayi makrosomik itu. **Metodologi**: Kajian ini merupakan satu kajian kes kawalan. Kita melihat kembali sejarah perubatan pesakit untuk menentukan faktor risiko, kesan terhadap ibu dan bayi, dan kaedah bersalin di kalangan pesakit yang mempunyai bayi makrosomik dan kumpulan kawalan. **Keputusan**: Terdapat sejumlah 204 kes bayi makrosomia daripada 10461 kes bersalin di Hospital Serdang pada tahun lepas. Insiden bayi makrosomia adalah 1.95%. Analisis statistik menunjukkan bahawa ibu-ibu yang melahirkan bayi makrosomik adalah lebih tua (2,909 ATAU, 95% CI 1,056; 8,011). Kumpulan kajian mempunyai lebih banyak ibu-ibu dengan kencing manis gestasi (32.9% vs 17.1%) dan sejarah bayi makrosomik (21.4% vs 2.9%) berbanding dengan kumpulan kawalan. **Kesimpulan**: Anggaran berat badan bayi adalah sukar. Satu diagnosis muktamad bayi makrosomia hanya melalui menimbang bayi tersebut setelah selamat dilahirkan. Walaupun tiada penemuan yang membuktikan boleh mengurangkan risiko makrosomia, beberapa strategi yang berguna boleh membantu untuk mengurangkan risiko makrosomia. Sebagai contoh, bagi pesakit kencing manis, kawalan glukosa yang ketat dan terapi insulin boleh menjadi amalan untuk mengurangkan risiko makrosomia.

Kata kunci: *Bayi makrosomik, diabitis gestasi, komplikasi bayi*

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CHAPTER 1 : INTRODUCTION

Risk Factors for Fetal Macrosomia in Hospital Serdang.

1.0 Introduction

Macrosomia is used to describe a new born with an excessive birth weight, that is 4000g and above. The term 'large for gestational age' is defined as an estimated fetal weight above the 90th percentile for a specific week of pregnancy. So, fetal macrosomia is defined as the fetal birth weight above 90th percentile for gestation or 97.75th percentile of reference population regardless of gestational age and fetal gender.

Macrosomia affect 10% of all deliveries in worldwide (Martin JA et al., 2006). In a study, the results showed that the prevalence of macrosomia in Universiti Malaya Medical Center (UMMC) was 1.1% during period 1st September 1999 to 31st August 2000 (Yadav H, 2008). Factors such as genetics, presence of gestational diabetes mellitus (GDM), ethnicity, fetal gender, and history of macrosomic baby influence the risk of macrosomia (Berard J. et al., 1998). Apart from that, other maternal characteristics such as maternal age, parity of mother, and maternal weight at term are also associated with fetal macrosomia (Peipert Jeffrey F. Et al., 1993).

Fetal macrosomia is associated with risks of maternal and neonatal morbidity thus is a cause of concern for both pregnant women and clinicians.

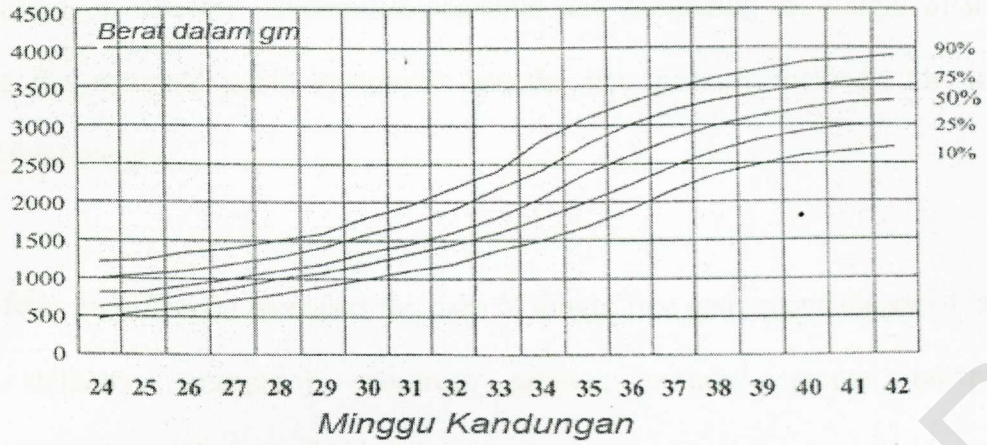


Figure 1: Percentile chart of estimated fetal weight in Malaysia

Generally, macrosomia is associated with poorly controlled diabetes, maternal obesity, and excessive maternal weight gain. Regarding Pederson hypothesis, macrosomia is associated with gestational diabetes mellitus (Nesbitt TS et al., 1998) . Pederson hypothesis also suggested that fetal overgrowth is related to increased transplacental transfer of glucose, which stimulating release of insulin in the fetal beta cell and causes macrosomia (Catalano PM et al., 2011). Stimulation of insulin and insulin-like growth factors which resulted from intermittent period of hyperglycemia in fetus will in turn stimulate fetal growth and deposition of glycogen and fat. Advanced gestational age results in a larger birth weight at delivery by allowing the growth process to continue in uterus.

Estimating a fetal birth weight is difficult. A definitive diagnosis of fetal macrosomia is only through weighing the neonate after delivery. However, there is still some ways to estimate the fetal birth weight. Towards the end of the third trimester, doctor will do an ultrasound to take the measurement of the fetal body parts such as head, abdomen and femur. Then the measurements will be calculated using a formula to find the fetal birth weigth. Maternal obesity is associated with fetal macrosomia. So, maternal body mass index (BMI) is a good way of diagnosing obesity prior to pregnancy. A BMI greater than 30 kg/m^2 are associated

with larger infants at delivery. Abdominal palpation and measuring the height of uterine fundus above the maternal pubis symphysis are the two primary methods for clinical estimation of fetal weight.

Macrosomic fetus significantly increases the risks of longer first and second stages of labour, instrumental delivery, emergency caesarean section, perineal trauma, postpartum haemorrhage (Ezegwui HU et al., 2011). Besides that, macrosomia can result in neonatal complications fetal asphyxia, shoulder dystocia and brachial plexus injury, and newborn metabolic problem such as hypoglycaemia. The incidence of shoulder dyatocia is 0.6% in macrosomia with non diabetic mother and increased with macrosomia associated with maternal diabetes. This risk is directly related to neonatal birth weight and begins to increase substantially when birth weight exceeds 4500 g. Mulik et al reported the risk of shoulder dystocia was 10 times higher in the larger babies (4.1% vs 0.4%). However, brachial plexus injury is complicated 4-16% in deliveries with shoulder dystocia, but less than 10% will results in permanent damage.

The role of cesarean delivery in suspected fetal macrosomia remains controversial. While the risk of birth trauma with vaginal delivery is higher with increased birth weight, caesarean delivery reduces (J Berard et al., 1998). With the exception of extreme emergencies, a cesarean delivery should be performed for midpelvic arrest of the fetus with suspected macrosomia. If a decision is made to perform a cesarean delivery in the presence of suspected macrosomia, the incision should be large enough to avoid a difficult abdominal delivery (Joanne Chatfield et al., 2001). Given that the fetus continues to gain about 230 g per week after the 37th week (Ott WJ et al., 1988), elective induction of labor before term has been suggested to prevent macrosomia and its complications (Boyd ME et al., 1983).

Although no intervention has been proven to significantly reduce the risk of macrosomia, several potentially useful strategies may be helpful to reduce the risk of macrosomia. For example, in diabetic patient, tight glucose control and insulin therapy can be practice to reduce the risk of macrosomia.

Since there is no accurate method of assessing suspected fetal macrosomia and uncertainties in the management of fetal macrosomia, thus this study is to examine the clinical management as well as maternal and fetal outcomes of macrosomic study in Hospital Serdang in accordance to local practice.

1.1 Problem statement

Fetal macrosomia can cause complications to either mother or neonate such as genital tract laceration, postpartum hemorrhage and shoulder dystocia. Literature search showed several maternal characteristics such as maternal age, maternal weight at term and GDM are associated with macrosomia (Peipert Jeffrey F. Et al., 1993). Local data on the maternal characteristics and obstetric morbidity in relation to the fetal macrosomia is limited.

Therefore, the aim of this study is to determine the association between maternal risk factors, diagnosis of fetal macrosomia, modes of delivery, obstetric and perinatal outcome of fetal macrosomia in our local setting. Information obtained from

1.2 Objectives

1.2.1 General Objective

To study the risk factors for macrosomic baby among pregnant patient that had delivered in Hospital Serdang

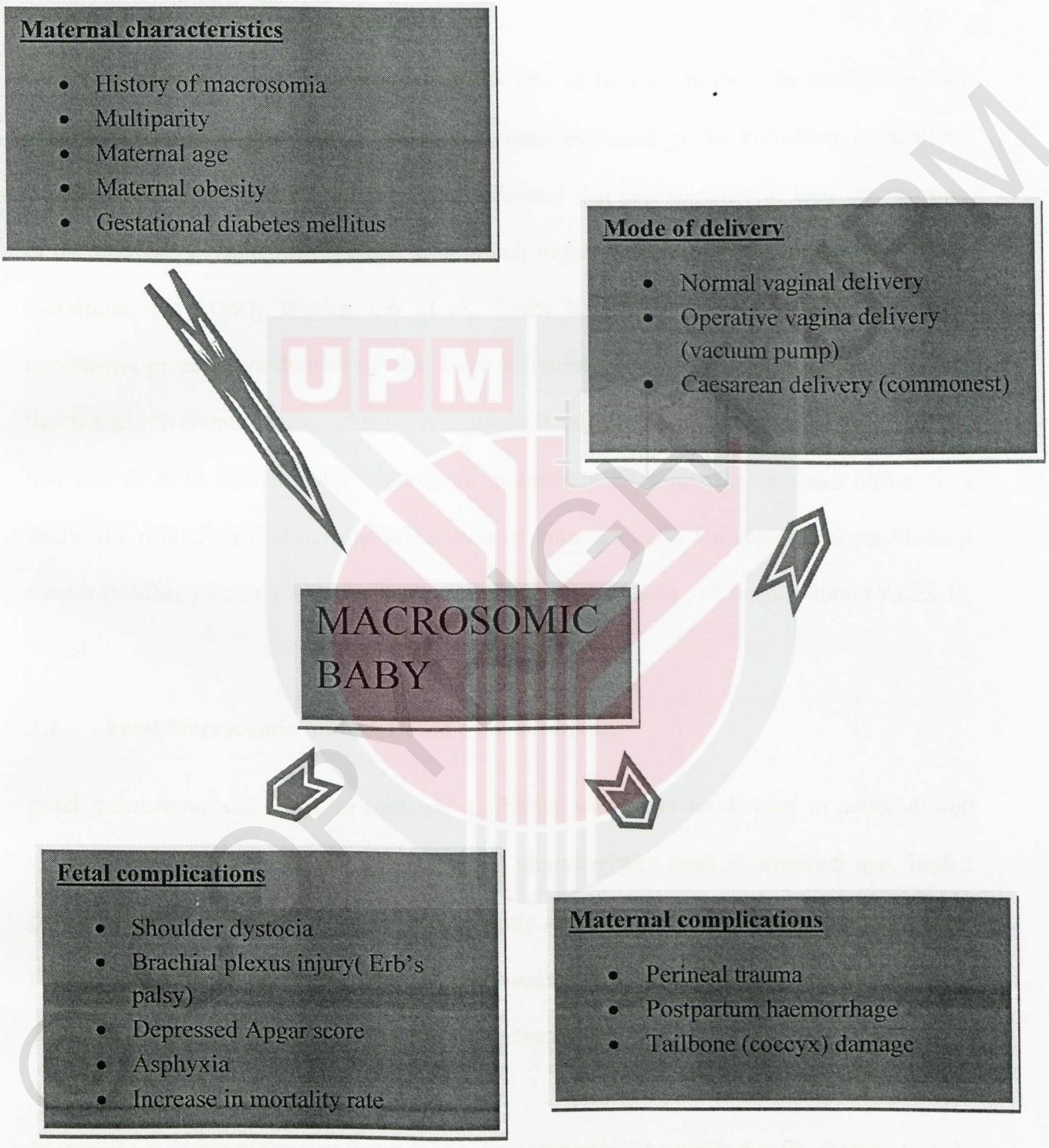
1.2.2 Specific Objectives

1. To describe the maternal characteristics
2. To describe the method used to predict fetal birth weight
3. To describe the mode of delivery
4. To describe the maternal complications
5. To describe the perinatal complications
6. To determine the association between maternal characteristics and fetal macrosomia

1.3 Hypothesis

Null hypothesis: There is no association between maternal characteristics and fetal macrosomia

1.2 Conceptual Framework



Title : Risk of fetal macrosomia

CHAPTER 2 : LITERATURE REVIEW

2.0 Literature Review

2.1 Prevalence of Fetal Macrosomia

Fetal macrosomia occurs in approximately 3-10% of hospital births. The prevalence and adverse outcomes of macrosomia have never been evaluated in the midwifery population. Qualitative interviews with midwives have indicated that the incidence of fetal macrosomia in the midwifery population appears to be much higher than that of the general population (Sandmire, H.F. 1993; Weeks, J.W et al., 1995; Nesbitt, T.S et al., 1998). Two main hypotheses given by midwives for this large difference point to the nutritional counseling that homebirth clients receive which is less emphasized in the medical model of care, and the low rate of early induction for macrosomic pregnancy in midwifery assisted births. In a study, the results showed that the prevalence of macrosomia in Universiti Malaya Medical Center (UMMC) was 1.1% during period 1st September 1999 to 31st August 2000 (Yadav H, 2008).

2.2 Fetal Macrosomia and Maternal Characteristics

Fetal macrosomia can result in obstetric morbidity which can be divided to maternal and neonatal categories. However, some maternal characteristics such as maternal age, higher parity of mother, positive history of macrosomic delivery, maternal obesity and gestational diabetes mellitus can increase the risk of macrosomia. In order to reduce the complications of fetal macrosomia, we have to clarify the risk factors first.

2.2.1 Maternal Age

Maternal age is one of the risk factor for fetal macrosomia. There was a study showed that the mothers who delivered the macrosomic baby were significantly older. The study showed maternal age with more than 35 years old was a significant risk factor of fetal macrosomia.

The mean maternal age for the study group was 28.3±5.6 years old and for the control group was 26.7±5.28 years old, with p=0.0001. There was 11.9% of mother more than 35 years old in the study group and 7.4% in the control group, with p=0.002 (Akin Y et al., 2010). Another study showed that maternal age with 35 years old and above was 60% for the macrosomia and was 21% in the control group. This result was comparable with a study done by Hejy-Ebrahim-Tehrani et al. In a study conducted by Peipert and F.Jeffrey, whether the women have complications of neither pregnancy nor labour, the caesarean rates increased with maternal age. The odds ratio were 1.6 (95% confidence interval [CI] 0.9-2.7) for the women aged 30-34 and 2.3 (95% CI 1.1-4.8) for the 35 and older age group (Peipert et al.,1993). Besides that, in another study showed that older women had a significant impact on fetus such as fetal macrosomia stillbirth and low Apgar score (Spellacy et al., 1986). Hence, maternal age is a risk factor for macrosomia (Hejy-Ebrahim-Tehrani et al., 2007).

2.2.2 Higher Parity

Multiparity and grand multiparity have greater risk of fetal macrosomia(GIBSON JR et al., 1952). A significant association between multiparity with fetal macrosomia was observed in a study. Multiparity was significantly associated with fetal macrosomia in study group (13.2%) compared to control group (9.5%) (H. M. Ehrenberg et al., 2004).A research done on macrosomic newborns showed that multiparity increases the risk of fetal macrosomia. The mean parity for the study group was 2.6±0.07 while for the control group was 2.1±0.04 with p=0.0001(Akin Y et al., 2010).

2.2.3 Ethnicity

We may not realize that ethnicity also can become a reason for delivery of macrosomic baby. In a study that was conducted in 1995, it shows that macrosomia developed in 50% of the neonates of Latino women versus 19% of neonates of African-American women (relative risk 2.68; 95% confidence interval 1.57–4.59) (Caril J Homko et al., 1995).

2.2.4 Previous Macrosomia

A positive history of macrosomia has effect on future pregnancy. A mother with a previous positive history of macrosomic baby will have 5-10 times more likely of having a subsequent macrosomic baby as compared to the mother of negative history on macrosomic baby. Besides that, gestational diabetes mellitus is a risk factor for fetal macrosomia. The result of a study showed that a positive history of macrosomia was ten times higher in study group compared to the control group (Hejy-Ebrahim-Tehrani et al., 2007). In a research done by Mahin Najafian and Maria Cheraghi, it shows that positive history of macrosomia was one of the major risk factor for fetal macrosomia and there is significant association between previous history of macrosomia and fetal macrosomia ($P< 0.0001$)(Mahin Najafian et al., 2012). Another research reported on the positive history of macrosomia is the most common leading maternal cause to fetal macrosomia (H. D. Modanlou et al., 1980).

2.2.5 Maternal Obesity

Maternal obesity is a risk factor associated with fetal macrosomia. In other study, morbidly obese women were noted to have significantly adverse perinatal outcomes such as macrosomia and higher rate admission to Neonatal Intensive Care Unit (NICU) (A.S Kumari, 2001).A research found out that it was 75% of maternal obesity in the study group as compared to the control group (16%). Besides, it was also noted in another study that maternal obesity is in the increased risk for macrsomia delivery as compared to normal weight mother, which is 16.8% versus 10.5% (H. M. Ehrenberg et al., 2004).

2.2.6 Established Diabetes Mellitus

Fetal macrosomia occurs despite nearly normal maternal blood glucose levels in women with diabetes treated with insulin. Some amounts of antibody-bound insulin are transferred from mother to fetus during pregnancy in some women with insulin-dependent diabetes mellitus. In a study stated that diabetes is a risk factor for large for gestational age delivery which is

significant (P< 0.0001)(Hugh M. Ehrenberg et al., 2004). In another study showed that there is a strong association between mother who having diabetes mellitus and fetal macrosomia with prevalence of 4.2% (MA Abdul et al., 2005).

2.2.7 Gestational Diabetes Mellitus

Gestational diabetes mellitus is one of the strongest risk factors associated with fetal macrosomia. Diabetic mothers who give birth to a macrosomic baby have a greater amount of total body fat, thicker upper-extremity skin fold measurements, and smaller ratios of head to abdominal circumference than macrosomic baby of nondiabetic mothers (Spellacy WN et al., 1985).

A study was done on the relationship between fetal gender, birth weight and gestational diabetes mellitus (GDM) (Knights S et al., 2000) (James WH., 2001). Based on the results, fetal with male gender is associated with increased GDM rate and increased birth weight. In fact, GDM has an effect on the birth weight of baby. The results also showed a significant difference between male birth weight and female birth weight in mother with GDM. Besides, even after controlled the maternal age and other risk factors associated with GDM, there is a general association between male bearing pregnant mothers with GDM. GDM was significantly higher in male bearing pregnant mothers compared to female bearing pregnant mothers, with a male to female sex ratio of 1.4 (95%CI:1.2-1.7, p<0.001). Male birth weights (4026±835g) were higher than female birth weights (3597±734g) in GDM pregnant mothers, with a mean difference of 428g (p<0.001) (Di Renzo et al., 2007).

In another study, the results showed that macrosomia was more than two times likely in male gender baby (OR 2.05, 95%CI 1.35-3.12). Male baby is generally slightly heavier than

female baby and most babies who weigh more than 4500g are in male gender (Hong JU et al., 2009).

2.3 Method of Diagnosis for Fetal Macrosomia

Accurate method of diagnosis for a macrosomic fetus is desirable in our efforts to avoid the perinatal complications that are associated with traumatic delivery. Biometric measurements of fetal parts such as biparietal diameter, femur length, head or abdominal circumference with ultrasonography in conjunction with regression equations can predict the birth weight (Combs CA et al., 2000). Alternatively, the measurement of fundal height and a review of obstetric history as part of routine prenatal care can be used to estimate fetal weight (Ong HC et al., 1972). Besides, asking parous patients, based on their experience with a previous pregnancy, to approximate the weight of a term fetus (Chauhan SP et al., 1992). In a study, an ultrasound diagnosis of macrosomia is consistent with fetal outcomes in 15% to 79% of cases among nondiabetic women. In diabetic women, the ultrasound is consistent with fetal outcome in 44% to 81% of cases. In women without diabetes, clinical use of fundal height and Leopold's is correct in 40% to 53% of cases, whereas in diabetic patients it is correct in 61% to 86% of cases (Chauhan S et al., 2005).

2.4 Fetal Macrosomia and Obstetric Morbidity

Having a big baby, for sure it will be a huge challenge for the mother as it is not easy to deliver a macrosomic baby. They may find some difficulties in delivering the baby. So, in the process of delivering, both the mother and the newborn may end up in some kind of complications.

2.4.1 Perineal Laceration

Firstly, some of the complications faced by the mother are perineal laceration, primary postpartum haemorrhage and damage of the tailbone. Perineal laceration is caused by overstretching of the vagina during the delivery and causing tears in the perineal tissue between the vagina and the rectum. Usually, by delivering a macrosomic baby, the mother will face first or second degree of laceration (Mulik V et al., 2003).

2.4.2 Postpartum Hemorrhage

Besides laceration, the mother also could experience postpartum haemorrhage. This is due to uterine fatigue causing inadequate retraction of the uterus that is important to stop bleeding. Damage to the tail bone also can occur to mother delivering a macrosomic baby. This is one of the rare complications in which the coccyx or the tailbone of the vertebral column is damaged but it is not a serious complication.

2.4.3 Shoulder Dystocia and Brachial Plexus Injury

Neonates actually have a higher rate of complications compared to the mother who delivered them. The most common type of complications among neonates is shoulder dystocia. It is a situation where, after the delivery of head, the anterior shoulder of the infant cannot pass below the pubic symphysis or having difficulties passing below the pubic symphysis. Usually, shoulder dystocia will result in upper trunk of brachial plexus injury. This condition is known as Erb's Duchenne paralysis. In a survey, prevalence of brachial plexus injury increase steadily from 0.8% to 2.86% in fetuses having birth weight more than 4000g (Luigi Raio et al., 2003).

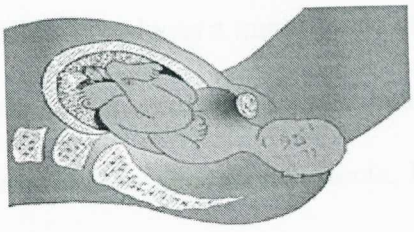


Figure 2: Shoulder dystocia

(Midwife thinking : mothers, birth, babies and midwifery)

Pathophysiology of shoulder dystocia

In human birth, the anatomy of the maternal pelvis necessitates serial adjustments of the position of the fetal head throughout its descent and passage through the birth canal (Rosenberg K et al., 2002). At the level of the inlet, the greatest dimension of the typical gynecoid pelvis is the transverse diameter. At the pelvic outlet, it is the obstetric conjugate, which is oriented anteroposteriorly. Thus, the fetal head initially enters the pelvis in an occiput transverse position, and through the cardinal movements of engagement, descent, flexion and internal rotation, has turned 90◦ to the occiput anterior position by the time it reaches the pelvic outlet. Of note, the planes of the pelvic inlet and outlet are skew rather than parallel. Thus, the path from inlet to outlet has more of a J-shaped curvature rather than a direct axially-oriented cylinder. This latter curvilinear feature of the gynecoid pelvis causes the bony landmarks of the pubic symphysis, ischial spines and pelvic outlet to lie in different planes, with each bony landmark progressively lying forward of the more superior landmark. This alignment is akin to threads of a screw, requiring a winding type forward progressing motion as the head and body traverse the birth canal. This is accomplished by the subsequent cardinal movements of extension, external rotation and finally expulsion. It is these latter movements that accomplish delivery of the shoulders following emergence of the head through the introitus. Crowning at the introitus typically occurs during extension. It is here that the posterior shoulder naturally becomes deviated from the head during routine delivery,

which has been shown experimentally to produces a quantifiable stretch in the brachial plexus (Allen R et al., 2005). This lateral deviation is corrected as the posterior shoulder successfully negotiates the hollow of the sacrum. During shoulder dystocia, less lateral deviation of the posterior shoulder relative to the head occurs than in routine deliveries. This results from the shoulder's inability to move as freely within the hollow of the sacrum, likely as a result of its larger dimension. However, downward traction placed on the head will deviate the anterior shoulder laterally relative to the head to a greater degree than would occur in routine deliveries. This increased lateral separation of the head and neck occurs because the anterior shoulder becomes fixed behind the pubic symphysis, and will not progress forward along with the head as it would in a routine delivery. Similarly, upward traction placed on the head will produce lateral deviation of the posterior shoulder relative to the head that is greater than would occur in normal deliveries because, although not obstructed, the posterior shoulder has not advanced as far into the hollow of the sacrum as in a routine delivery.

Management of Shoulder Dystocia

Maternal manoeuvres

McRoberts' positioning - Sharp flexion of the maternal thighs against the abdomen is usually accomplished with the aid of one or two assistants who remove the mother's legs from the footrests and, by flexing the hips, manually tilt the pelvis cephalad by about 15 degrees (Gonik B et al., 1983).

Fetal Manoeuvres

Anterior Rubin's manoeuvre - Pressure is applied directly to the posterior aspect of the anterior shoulder within the birth canal just behind the pubic symphysis. The shoulder is adducted toward the chest, rotating the shoulders approximately 30◦ to the oblique diameter of the pelvis (Hankins GDV et al., 1995).

A study showed that fetal manipulation appears to be the best method for non traumatic resolution insofar as it takes better advantage of pelvic geometry and requires less traction to complete the delivery than maternal manoeuvres. It can eliminate the need to repeat traction on the fetal head, by instead applying the traction to the fetal trunk (Gurewitsch et al., 2006).

2.4.4 Fetal Asphyxia

Apgar score is a practical method of evaluation of the condition of the neonate one minute after delivered and a rating of ten points described the best possible condition with two points each given for respiratory effort, reflex irritability, muscle tone, heart rate and colour (Virginia Apgar, 1953).

Respiratory Effort

For a neonate who was apneic at 60 seconds after birth received a score of zero, while who breath and cry lustily received a score of two. While for all other types of respiratory efforts such as irregular, shallow ventilation was scored one (Virginia Apgar, 1953).

Reflex Irritability

Reflex irritability referred to the response to stimuli, usually tested by suctioning the oropharynx and nares with a soft rubber catheter which called forth a response of facial grimaces, sneezing or coughing (Virginia Apgar, 1953).

Muscle Tone

A completely flaccid neonate was scored zero, and one with good tone while two with spontaneously flexed arms and legs which resisted extension (Virginia Apgar, 1953).

Heart Rate

A heart rate of 100-140 was considered good and given a score of two. For a rate less than 100 get a score of one and if no heart beat could be seen, felt or heard the score was zero (Virginia Apgar, 1953).

Colour

All neonates are obviously cyanotic at birth. The cyanosis disappearance depends on two signs previously considered: respiratory effort and heart rate. A score of two was given only when the entire neonate was pink (Virginia Apgar, 1953).

SIGN	SCORE 0	SCORE 1	SCORE 2
Colour	Blue, pale	Body pink; extremities blue	Completely pink
Heart rate	Absent	<100 beats/min	>100 beats/min
Reflex irritability	No response	Grimace	Cry
Muscle tone	Limp, flaccid	Some flexion of extremities	Active, well-flexed
Respiratory effort	Absent	Gasping; slow, irregular	Regular, good lusty cry

Adapted from: Casey BM, McIntire DD, Leveno KJ. The Continuing Value of the Apgar Score for the Assessment of Newborn Infants. NEJM2001; 344(7):467-471.

Meanwhile, the Apgar score at birth of a macrosomic baby is depressed. The Apgar score of a newborn is considered low when below 7 in the first or fifth minute. Foetal asphyxia is a condition where there is impairment of gases exchange during labour that will lead to progressive hypoxia of the newborn. It is caused by interruption to blood flow into the placenta due to uterine contractions that compresses uterine blood vessels. This will lead to oxygen deprivation in the fetus.

2.4.5 NICU

Macrosomic neonates were more likely needed of neonatal intensive care than normosomic neonates (Heiskanen et al., 2006). In a study, the results showed that among the 11,575 live births over the three year period, 1350 neonates were admitted to the NICU for various reasons. Of the total 823 live born macrosomic neonates, 75 cases (9.1%) were admitted into the NICU. Among the 848 live born control subjects, only 39 (4.6%) were admitted.

Statistical analysis showed a significant difference between macrosomics and the control group (p =0.0004) (OR: 2.08, 95% CI: 1.4-3.1). The admission frequency of macrosomic deliveries into the NICU was almost two-fold that of the controls (Akin Y et al., 2010). A higher incidence of NICU admissions for neonates with a birth weight >4500 g compared with newborns with a birth weight of <4000 g (9.3% vs 2.7%) was reported by another study (Mulik V et al., 2003).

2.4.6 Neonatal Mortality

The neonatal mortality rate also is increased in the case of macrosomic baby delivery. In one of study conducted by the Adesina OA, Olayemi O at the University College Hospital, Ibadan, Nigeria, the perinatal mortality among macrosomic babies was 11.4/1,000 (Adesina OA et al., 2003). Stillbirth can also happen among fetus who is macrosomic. It is a condition where the fetus has died in the uterus. Sometimes, the word miscarriage is used to describe stillbirth.

2.5 Fetal Macrosomia and Mode of Delivery

In a research, the results showed that performing elective cesarean delivery on every woman with fetal macrosomia in fear of the remote possibility of a permanent neurological injury seems a high price for patients and the health care system to pay (Nocon JJ et al., 1993; Rouse DJ et al., 1999; Sandmire HF et al., 1988). Nesbitt et al. reported that vaginal delivery rate was 61% (Nesbitt et al., 1998). Other studies showed that the incidence of shoulder dystocia in vaginal delivery women was 15.5% (Lipscomb KR et al., 1995; El Madany AA et al., 1991; Berard J et al., 1998; Acker DB et al., 1985).

CHAPTER 3 : METHODOLOGY

3.0 Methodology

3.1 Study location

The study was carried out in Hospital Serdang, Selangor.

3.2 Study design

The study design was an unmatched case control study.

3.3 Study duration

The study duration of our research started from March to September 2013. The data collection was done from 22 July to 1 August 2013.

3.4 Sampling

3.4.1 Study population

Study population was all pregnant patients that have delivered in Hospital Serdang from 1 January 2012 to 31 December 2012, those who delivered a macrosomic babies (define as birth weight of more than 4000g) formed the case group, with control group who delivered a normal weight baby (2000-3999g).

3.4.2 Sampling population

Inclusion criteria: pregnant patients who delivered a macrosomic babies at term (37^{th} – 42^{th} week)

Exclusion criteria: pregnancies with multiple gestations, preterm neonates and either prenatal or postnatal diagnosis of fetal structural and chromosomal abnormalities.

3.4.3 Sampling unit

Sampling unit was a pregnant woman who delivered in Hospital Serdang, Selangor, 2012

3.4.4 Sampling frame

Sampling frame was all pregnant women who delivered in Hospital Serdang, Selangor, 2012

3.4.5 Sampling method

The sampling method used was convenient sampling for both cases and control

3.4.6 Sample size

$$n = \{z_{1-\alpha/2}[\sqrt{2P^*_2(1-P^*_2)}] + z_{1-\beta}[\sqrt{P^*_1(1-P^*_1) + P^*_2(1-P^*_2)}]\}^2 / (P^*_1-P^*_2)^2$$

Where:

P^*_1 = proportion of exposed in cases, i.e. $[(OR)\ P^*_2] / [(OR)\ P^*_2 + (1-P^*_2)]$

P^*_2 = proportion of exposed in controls

OR = odds ratio

$Z_{(1-\alpha/2)}$ = 95%CI = 1.96

$Z_{(1-\beta)}$ = power = 80% = 0.84

From the study by Ezegwui HU et al.,

P^*_1 = 0.3945

P^*_2 = 0.125

OR = 4.56

$$n = \{1.96\ [\sqrt{(4.56\times0.125\times0.875)}] + 0.84\ [\sqrt{0.3945\ (1-0.3945) + 0.125(0.875)}]\}^2 / (0.3945-0.125)^2$$

$= \{[1.96\ (0.7062)] + [0.84\ (0.5901)]\}^2 / (0.0726)$

$= 3.5338 / 0.0726$

= 49 cases + 49 controls

= 98 and 10% of non response sample

= 108

3.5 Instrument and data collection

3.5.1 Instruments

The data was collected by using a proforma that covers all the data that affects or may affect the maternal characteristics and obstetric morbidity among patients having macrosomic baby.

3.5.2 Data collection techniques

The obstetric and neonatal data of the study population were extracted from Hospital Serdang's Obstetric and neonatal electronic databases.

Maternal information collected was:

1. Socio demographics including age, ethnicity and BMI
2. Obstetric history- parity, history of macrosomia and shoulder dystocia, history of diabetes, previous obstetric surgery
3. Events from current pregnancy- gestational diabetes, gestational age at delivery, prenatal diagnosis of macrosomia (clinical diagnosis defined as any record of large for dates in patient notes, and ultrasound diagnosis defined as estimated fetal weight equal or greater than 90th centile), prolong second stage of labour (defined as more than two hours for primigravida and more than one hour for multigravida), induction of labour and indications, mode of delivery and indications where appropriate
4. Neonatal information: baby's gender and birth weight

Primary Outcome Measures:

1. Maternal complication- perineal trauma by degree, postpartum haemorrhage and length of hospital stay

2. Neonatal complications- shoulder dystocia, brachial plexus injury, clavicular fracture, humeral fracture, one minute and five-minute Apgar score, seizures, admission to NICU, length on NICU stay, perinatal mortality

3.5.3 Quality control

The quality control was done by doing pretest to the proforma to ensure that the proforma contain all the necessary data that have to be collected. The pretest was done before the period of data collection.

3.6 Data analysis

Information from the proformas filled into mastersheet using the SPSS version 21. The association between maternal risk factors, modes of delivery, obstetric and perinatal outcome of fetal macrosomia will be analysed by using standard descriptive statistical calculations and chi-square test.

3.7 Study Ethics

Approval for ethical review was submitted to Universiti Putra Malaysia Ethical Committee and Hospital Serdang, Selangor.

3.8 Variables

3.8.1 Independent variables

Maternal risk factors

3.8.2 Dependent variables

Macrosomic baby delivery among patients in Hospital Serdang

3.9 DEFINITION OF TERMS

Intrapartum	Occurring during labor and delivery
Apgar score	A system of evaluating a newborn's physical condition by assigning a value (0, 1, or 2) that is performed 1 minute and again 5 minute after birth to each of five criteria: heart rate, respiratory effort, muscle tone, response to stimuli, and skin color.
Shoulder dystocia	Vaginal cephalic delivery that requires additional obstetric manoeuvres to deliver the fetus after the head has delivered and gentle traction has failed. (Green-top 42)
Asphyxia	Respiratory failure in the newborn, a condition caused by the inadequate intake of oxygen before, during, or just after birth.
Multiparity	the production of several offspring in one gestation
Degree of perineal laceration	• First degree laceration: laceration is limited to the fourchette and superficial perineal skin or vaginal mucosa • Second degree laceration: laceration extends beyond fourchette, perineal skin and vaginal mucosa to perineal muscles and fascia, but not the anal sphincter • Third degree laceration: fourchette, perineal skin, vaginal mucosa, muscles, and anal sphincter are torn • Fourth degree laceration: fourchette, perineal skin, vaginal mucosa, muscles, anal sphincter, and rectal mucosa are torn
Erb's Duchenne paralysis	Paralysis of the upper trunk (C5, C6) of the brachial plexus
Hypoxia	Insufficient levels of oxygen in blood or tissue

CHAPTER 4 : RESULTS

4.0 Results

There were a total of 204 cases of fetal macrosomia out of 10461 deliveries in Hospital Serdang during last year. The incidence of fetal macrosomia was 1.95%. In our study, there were 70 cases and 70 controls.

4.1 Maternal characteristics

Table 1 shows the maternal characteristics. Out of a total of 140 samples in our study, 21 (15.0%) mothers were belongs to the advanced age group, 110 (78.6%) were Malay mothers, 9 (6.4%) mothers had 6 or more children, 4 (2.9%) mothers with established diabetes mellitus, while 35 (25.0%) mothers had gestational diabetes mellitus, and 17 (12.1%) mothers had a history of macrosomic baby.

Table 1: Maternal Characteristics

Maternal characteristics	Frequency (n)	Percentage (%)
Age group		
Advanced (≥35 years old)	21	15.0
Lower (<35 years old)	119	85.0
Total	**140**	**100.0**
Ethnicity		
Malay	110	78.6
Non-malay	30	21.4
Total	**140**	**100.0**
Parity		
Grandmultiparous	9	6.4
Non-grandmultiparous	131	93.6
Total	**140**	**100.0**
Established diabetes mellitus		
Yes	4	2.9
No	136	97.1
Total	**140**	**100.0**
Gestational diabetes mellitus		
Yes	35	25.0
No	105	75.0
Total	**140**	**100.0**

History of macrosomic baby		
Yes	17	12.1
No	123	87.9
Total	**140**	**100.0**

4.2 Method used to predict fetal birth weight

Out of a total of 140 samples in our study, 72 (51.4%) methods used on the mothers were used clinical estimation, while 7 (5.0%) mothers were estimated by ultrasound estimation. There was 5 (3.6%) mothers used both the clinical and ultrasound estimation. However, 56 (40.0%) mothers did not used neither clinical nor ultrasound estimation to predict the fetal weight with referred to Table 2.

Table 2: Method used to predict fetal birth weight

Method used to predict fetal birth weight	Frequency (n)	Percentage (%)
Clinical estimation	72	51.4
Ultrasound estimation	7	5.0
Both	5	3.6
None	56	40.0
Total	**140**	**100.0**

4.3 Mode of delivery

According to Table 3, 92 (65.7%) mothers had undergone with spontaneous vaginal delivery (SVD), 41 (29.3%) mothers undergone lower segment caesarean section (LSCS), while 7 (5.0%) mothers undergone instrumental delivery.

Table 3: Mode of delivery

Mode of delivery	Frequency (n)	Percentage (%)
SVD	92	65.7
LSCS	41	29.3
Instrumental delivery	7	5.0
Total	**140**	**100.0**

4.4 Maternal outcomes

Table 4 shows the maternal outcomes. There was no mother with either third or fourth degree of perineal laceration. However, there was 4 (2.9%) mothers had postpartum hemorrhage (PPH) after delivery.

Table 4: Maternal outcomes

Maternal outcomes	Frequency (n)	Percentage (%)
3rd degree tear		
Yes	0	0.0
No	140	100.0
Total	**140**	**100.0**
4th degree tear		
Yes	0	0.0
No	140	100.0
Total	**140**	**100.0**
Postpartum hemorrhage (PPH)		
Yes	4	2.9
No	136	97.1
Total	**140**	**100.0**

4.5 Perinatal outcomes

Table 5 shows the perinatal outcomes. Out of a total of 140 samples in our study, 3 (2.1%) newborns had lower 1st minute Apgar score which is below seven, while only 1 (0.7%) newborn had lower 5th minute Apgar score. There were 8 (5.7%) newborns with shoulder dystocia, 1 (0.7%) newborn with brachial plexus injury, but none of the newborn had humeral or clavicle injury. There was 4 (2.9%) newborns had hypoglycemia. Sixty five (46.4%) newborns were admitted to NICU after they were born. None of the newborn had electrolyte imbalance or hypoxic ischemic encephalopathy, same goes to the perinatal death.

Table 5: Perinatal complications

Perinatal complications	Frequency (n)	Percentage (%)
1st minute Apgar score		
Lower	3	2.1
Normal	137	97.9
Total	**140**	**100.0**
5th minute Apgar score		
Lower	1	0.7
Normal	139	99.3
Total	**140**	**100.0**
Shoulder dystocia		
Yes	8	5.7
No	132	94.3
Total	**140**	**100.0**
Brachial plexus injury		
Yes	1	0.7
No	139	99.3
Total	**140**	**100.0**
Humeral fracture		
Yes	0	0.0
No	140	100.0
Total	**140**	**100.0**
Clavicle fracture		
Yes	0	0.0
No	140	100.0
Total	**140**	**100.0**
Hypoglycemia		
Yes	4	2.9
No	136	97.1
Total	**140**	**100.0**
Electrolyte imbalance		
Yes	0	0.0
No	140	100.0
Total	**140**	**100.0**
Admission to NICU		
Yes	65	46.4
No	75	53.6
Total	**140**	**100.0**

Hypoxic ischemic encephalopathy		
Yes	0	0.0
No	140	100.0
Total	**140**	**100.0**
Perinatal death		
Yes	0	0.0
No	140	100.0
Total	**140**	**100.0**

4.6 Association between maternal characteristics and fetal macrosomia

Table 6 shows the association table between maternal age group and baby birth weight. Mothers with advanced age in the study group accounted for 21.4% compared with 8.6% in the control. Fetal macrosomia was 2.909 times higher in the advanced maternal age group compared to lower maternal age group (95% CI: 1.056-8.011). There was a statistically significant association between maternal age group and fetal macrosomia (p=0.033).

Table 6: Association table between maternal age group and baby birth weight

Maternal age group	**Baby birth weight**		**Total, n (%)**	**p-value**
	Macrosomia (≥4kg), n (%)	**Normal birth weight baby (2-3.99kg), n (%)**		
Advanced (≥35 years old)	15 (21.4)	6 (8.6)	**21 (15)**	0.033*
Lower (<35 years old)	55 (78.6)	64 (91.4)	**119 (85)**	
Total	**70 (100.0)**	**70 (100.0)**	**140 (100.0)**	

*significant, p<0.05

Table 7 shows the association table between ethnicity of mother and baby birth weight. Malay mother in the study group accounted for 82.9% compared with 74.3% in the control. This was not statistically significant (p=0.217) and there was no association between ethnicity of mother and fetal macrosomia.

Table 7: Association table between ethnicity of mother and baby birth weight

Ethnicity	**Baby birth weight**		**Total, n (%)**	**p-value**
	Macrosomia (≥4kg), n (%)	**Normal birth weight baby (2-3.99kg), n (%)**		
Malay	58 (82.9)	52 (74.3)	**110 (78.6)**	0.217
Non-malay	12 (17.1)	18 (25.7)	**30 (21.4)**	
Total	**70 (100.0)**	**70 (100.0)**	**140 (100.0)**	

Table 8 shows the association table between parity and baby birth weight. Grand multiparous mother (mother with 6 or more children) in the study group accounted for 8.6% compared with 4.3% in the control. This was not statistically significant (p=0.493).

Table 8: Association table between parity and baby birth weight

Parity group	**Baby birth weight**		**Total, n (%)**	**p-value**
	Macrosomia (≥4kg), n (%)	**Normal birth weight baby (2-3.99kg), n (%)**		
Grandmultiparous (≥6)	6 (8.6)	3 (4.3)	**9 (6.4)**	0.493
Non-grandmultiparous (<6)	64 (91.4)	67 (95.7)	**131 (93.6)**	
Total	**70 (100.0)**	**70 (100.0)**	**140 (100.0)**	

Table 9 shows the association table between established diabetes mellitus and baby birth weight. Mothers with established diabetes mellitus in the study group accounted for 4.3% compared with 1.4% in the control. There was no statistically significant (p=0.620) association between established diabetes mellitus and fetal macrosomia.

Table 9: Association table between established diabetes mellitus and baby birth weight

Established diabetes mellitus	**Baby birth weight**		**Total, n (%)**	**p-value**
	Macrosomia (≥4kg), n (%)	**Normal birth weight baby (2-3.99kg), n (%)**		
Yes	3 (4.3)	1 (1.4)	**4 (2.9)**	0.620
No	67 (95.7)	69 (98.6)	**136 (97.1)**	
Total	**70 (100.0)**	**70 (100.0)**	**140 (100.0)**	

Table 10 shows the association table between GDM and baby birth weights. Mothers with GDM in the study group accounted for 32.9% compared with 17.1% in the control. Fetal macrosomia were 2.365 times higher in GDM mothers compared to non-GDM mothers (95% CI: 1.066-5.248). The association between GDM and fetal macrosomia was statistically significant (p=0.032).

Table 10: Association table between gestational diabetes mellitus (GDM) and baby birth weight

GDM	**Baby birth weight**		**Total, n (%)**	**p-value**
	Macrosomia (≥4kg), n (%)	**Normal birth weight baby (2-3.99kg), n (%)**		
Yes	23 (32.9)	12 (17.1)	**35 (25.0)**	0.032*
No	47 (67.1)	58 (82.9)	**105 (75.0)**	
Total	**70 (100.0)**	**70 (100.0)**	**140 (100.0)**	

*significant, p<0.05

Table 11 shows the association table between history of macrosomic baby and baby birth weight. Mothers with history of macrosomic baby in the study group accounted for 21.4% compared with 2.9% in the control. Fetal macrosomia were 9.273 times higher in mothers with history of macrosomic baby compared to mothers of no history of macrosomic baby (95% CI: 2.033-42.296). There was a statistically significant association between history of macrosomic baby and fetal macrosomia (p=0.001).

Table 11: Association table between history of macrosomic baby and baby birth weight

History of macrosomic baby	**Baby birth weight**		**Total, n (%)**	**p-value**
	Macrosomia (≥4kg), n (%)	**Normal birth weight baby (2-3.99kg), n (%)**		
Yes	15 (21.4)	2 (2.9)	**17 (12.1)**	0.001*
No	55 (78.6)	68 (97.1)	**123 (87.9)**	
Total	**70 (100.0)**	**70 (100.0)**	**140 (100.0)**	

*significant, p<0.05

CHAPTER 5: DISCUSSION AND CONCLUSION

5.0 Discussion and conclusion

5.1 Discussion

The incidence of macrosomia in this study was 1.95%. In Nigeria, the incidence of macrosomia was 8.1% (Ezegwui, et al., 2011). The incidence in different places is affected by ethnicity and presence of other local factors (Jazayeri, 2010).

Out of a total of 140 samples in our study, twenty one (15.0%) mothers belonged to the advanced age group. In a research conducted by Cleary-Goldman et al, 79% women who delivered were less than 35 years old age, 17% were 35-39 years of age and 4% were 40 years old and above. It also state that increasing maternal age is independently associated with specific adverse pregnancy outcomes (Cleary-Goldman et al., 2005). Then, 110 (78.6%) were Malay mothers. It is because, the main population in Serdang are the Malays. Nine (6.4%) mothers are grandmultiparous. In a hospital in Saudi Arabia, the grand multiparity accounts for 8.7% of deliveries (R. Mesleh, 1987). This shows that there are not much of difference between the rate of grand multiparous among women who delivered in Hospital Serdang and Saudi Arabia. There were four (2.9%) mothers had established diabetes mellitus, while thirty five (25.0%) mothers had gestational diabetes mellitus, and seventeen (12.1%) mothers had a history of macrosomic baby.

In this study, most of the pregnant mothers were using clinical estimation to predict the fetal birth weight. There were also many of them neither used the clinical nor ultrasound estimation as they did not admitted to the hospital.

The study showed that the proportion of macrosomic babies delivered by spontaneous vaginal route (65.7%) far outnumbered those delivered by cesarean section (29.3%) and instrumental delivery (5.0%). Hence, vaginal delivery should be attempted in suspected fetal macrosomia while reserving cesarean delivery for other obstetric indications (Adesina AO et al., 2003).

There was no third and fourth degree tear of perineal membrane in this study. However, there was four mothers had postpartum hemorrhage.

In this study, there was a few newborn had lower 1st and 5th minute apgar score which is less than 7. Although there was 8 newborn with shoulder dystocia and 1 newborn with brachial plexus injury, but there was no newborn with humeral and clavicle injury. There were four babies with hypoglycemia and 65 babies had admitted to NICU. The babies were admitted to NICU due to asphyxia and for observation. There was no perinatal death in this study.

This study showed that mothers of macrosomic babies were significantly older which agrees with other research (Akin Y et al., 2010). However, in Ibadan, Nigeria, did not find any significant association between maternal ages with macrosomia (Adesina et al., 2003).

A relationship between ethnicity of mother and baby birth weight in our study showed no significant association with macrosomic baby among the malay is 82.9% versus 17.1% baby that is macrosomic among the non-malay. In a study done in Temple University School of Medicine Philadelphia, Pennsylvania, macrosomia developed in 50% of the neonates of latino women versus 19% of neonates of African-American with (relative risk 2.68; 95% CI 1.57-4.59) which is also not significant (Caril J Homko et al., 1995). Both study showed there are no relationship between ethnicity of mother and baby birth weigth.

In this study, there was no significant association between parity with macrosomia. This was comparable to the findings of Yasmeen et al. although Mutihir et al. showed a contrary opinion (Yasmeen et al., 2005; Mutihir et al., 2005).

There was no significant association between established diabetes mellitus with fetal macrosomia in this study. However, our study showed that mothers with gestational diabetes mellitus are at risk for deliver a macosomic baby. Fetal macrosomia in diabetic mothers has been attributed to poor glucose control (Joan L et al., 2004).

This study demonstrated that many women delivering macrosomic babies had previous history of delivering a macrosomic baby compared to the control group. Women who previously delivered macrosomic baby are 5-10 times more likely to deliver a baby considered larger for gestational age in subsequent pregnancies.

5.2 Limitation

We had no data on mothers' weight and height. As we were using the secondary data, we cannot trace back the maternal weight and height. So, we cannot calculate the body mass index (BMI) of the mothers. The weight and height of mothers were not measured when they admitted to hospital. Hence, we cannot determine the association between maternal obesity with fetal macrosomia.

Non-differential misclassification bias

Due to degree of inaccuracy characterized how the information is obtained

Counfounding

Due to different experienced medical staffs in handling the delivery in Hospital Serdang

5.3 Recommendation

We recommend to any other parties who are engaging in a study or research similar to this study to greatly collect the data on maternal weight and height.

5.4 Conclusion

In conclusion, this study demonstrated that there are several maternal characteristics are the potential risk factors for fetal macrosomia. Maternal characteristics such as maternal age, gestational diabetes mellitus (GDM) and history of macrosomic baby have significant association with fetal macrosomia. Besides maternal complication for example postpartum hemorrhage, there are also perinatal complications of fetal macrosomia, such as shoulder dystocia, brachial plexus injury and etc. In order to prevent fetal macrosomia, glucose control in GDM mothers is essential.

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PROFORMA
SECTION A: MATERNAL

Patient's Demographic Data

SDNo:…… Age: ……..

Gravida:….... Para:…....

Weight: ……kg BMI: ……kg/m^2

History of macrosomia: ……

Races : ☐ Malay ☐ Chinese ☐ Indian ☐ Others

MOD : ☐ SVD ☐ LSCS ☐ Instrumental delivery

Risk Factors:

a) Maternal obesity ☐

b) Established Diabetes Mellitus ☐

c) Gestational Diabetes Mellitus ☐
   i) diet control
   ii) insulin

d) History of macrosomic baby ☐

Diagnosis of macrosomia:

a) Clinical Estimation ☐ kg

b) Ultrasound Estimation ☐ kg

Delivery details :

a) Gestational Age at delivery ☐

b) Induction of labour ☐
   Indication:……

c) Mode of delivery : SVD ☐
   LSCS ☐
   Instrumental delivery ☐

d) Indication (LSCS/Instrumental del) :……

Maternal Complications:

a)	3rd Degree Tear	
b)	4th Degree Tear	
c)	Postpartum Haemorrhage	

Perinatal compications: SD No:……

Gender:

Birth Weight :

Apgar score: 1 min:…….. 5 min:……

Outcome:

a)	Shoulder Dystocia	
b)	Brachial plexus injury	
c)	Humeral fracture	
d)	Clavicle fracture	
e)	Hypoglycemia	
f)	Electrolyte imbalance	
g)	Admission to NICU	
h)	Hypoxic Ischaemic Encephalopathy	
i)	Perinatal Death	

GANTT CHART

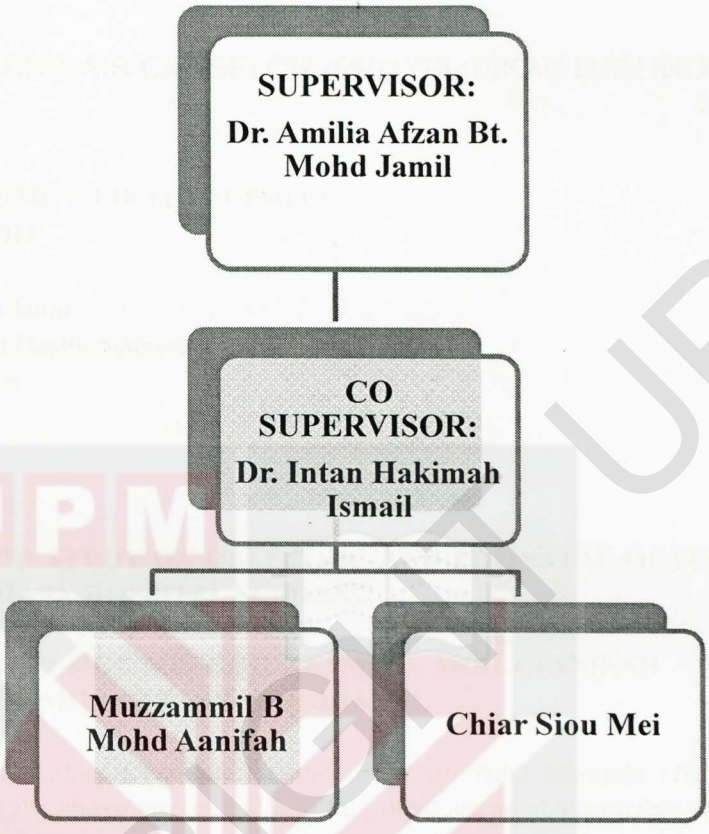
Table 1. Gantt Chart of Research Activities

Title: Study on Obstetric and Perinatal Outcomes of Fetal Macrosomia in Hospital Serdang.

No	Activities	2013						
		Mac 2013	April 2013	May 2013	June 2013	July 2013	August 2013	September 2013
1	Preparation of draft proposal							
2	Submission of draft proposal							
3	Preparation, submission and presentation of final proposal							
4	Preparation of ethical approval and permission letters to organizations							
5	Data collection and analysis							
6	Submission of data analysis and presentation							

	Activities	2013						
		Mac 2013	April 2013	May 2013	June 2013	July 2013	August 2013	September 2013
7.	Preparation of final report and scientific article							
8.	Submission of final report and scientific article							
9.	Preparation of final presentation							
10.	Final presentation							
11.	Correction of project report							
12.	Submission of project report, scientific article							

RESEARCH TEAM



BUDGET PLANNING

ITEM	PRICE
Photocopy	RM150.00
Printing	RM100.00
Hardcover and Binding	RM150.00
Total	**RM400.00**