A STUDY TO INVESTIGATE THE RELATIONSHIP BETWEEN OBSTETRIC BRACHIAL PLEXUS PALSIES AND CEPHALOPELVIC DISPROPORTION (INCLUDING FETAL MACROSOMIA)

by

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This st …en submitted in any fori …vork of others it has bee…

The res… …ngton hospital, King E… …nd R K Khan hospital… …b, of the Department of Anatomy, University of Durban-Westville, Professor J. Moodley of the Department of Obstetrics and Gynecology, Faculty of Medicine, University of Natal and in part by the late Professor K. S. Naidoo of the Department of Orthopedics, Addington hospital, Durban, South Africa.

I OFFER THIS WORK

IN ALL HUMILITY

AT THE LOTUS FEET OF MY DIVINE MASTER

BHAGAWAN SRI SATHYA SAI BABA

DEDICATION

THIS WORK IS DEDICATED TO TWO MENTORS WHO HAVE CONTRIBUTED TO BOTH MY PERSONAL AND PROFESSIONAL JOURNEY IN LIFE.

PROFESSOR KRISHNASAMY SOOBIAH NAIDOO
(1934 – 2001)

who believed in me , inspired me and developed my potential. for this, my eternal gratitude.

AND

MY FATHER ,
MR. MOGHAMBARAM PILLAY
(1933 –1998)

for orchestrating my path of education, freedom and realisation
for honouring my life with his presence & guidance.
for this my love and eternal gratitude.

ABSTRACT

In view of the lifelong impact of Obstetrical Brachial Plexus Palsies (OBPP), prevention of OBPP would be of great significance. Despite contemporary advances in antenatal planning and assessment, OBPP remains an unfortunate consequence after difficult childbirth. Permanent brachial plexus palsy is a leading cause of litigation related to birth trauma.

Objectives: To determine the incidence of Obstetrical Brachial Plexus Palsy (OBPP), Cephalopelvic Disproportion (CPD) and macrosomia in KwaZulu-Natal. As well as to investigate the relationship between OBPP and CPD, and the relationship between OBPP and macrosomia. The study also aimed to determine whether antenatal risk factors could identify those prone to OBPP.

Study design: This was a case control study that included all deliveries from 1997 to 2000 from four provincial hospitals (Addington, King Edward VIII, Prince Mshiyeni Memorial and RK Khan hospital). The outcome variable was OBPP. Results were analyzed using Statistical Program for Social Sciences (SPSS).

Results: A total of 60 infants of 76 352 deliveries sustained OBPP. The incidence of OBPP was found to be 0.72 per 1000 deliveries. The incidence of CPD was found to be 33.5 per 1000 deliveries and the incidence of macrosomia was found to be 16.7 per 1000 deliveries. Race, Maternal height > 150 cm, gravida >3, parity >4, history of a previous big baby, normal vaginal delivery, delivery by a midwife, difficult labour, inadequate or doubtful pelvic capacity, birth weight of >3700 g and gestation period > 34 weeks were significant risk factors. Logistic regression analysis showed that race, parity > 4, normal vaginal delivery and gestation period > 35 weeks were the variables most associated with

OBPP. Using linear regression model was obtained for the calculation of predictive risk scores.

Conclusion: Using standard statistical formulae the probability of OBPP can be calculated in women with significant risk factors from the logistic regression formula. This would need to be validated and could provide a useful tool for screening for OBPP thus contributing to preventing this devastating complication of birth trauma. The risk assessment profile would contribute greatly to the prediction of OBPP and the subsequent prevention of this debilitating birth injury.

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NOMENCLATURE

1. OBPP - Obstetrical Brachial Plexus Palsy
2. CPD – Cephalopelvic Disproportion
3. ADDH – Addington Hospital
4. KEH – King Edward VIII hospital
5. PMMH – Prince Mshiyeni Memorial Hospital
6. RKKH – R K Khans Hospital
7. LGA – Large for gestational age
8. C – SECTION – caesarian section
9. NVD – normal vaginal delivery
10. b.w. - birthweight

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CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND

Obstetric brachial plexus palsy is as old as mankind. Newborns with inability of movement their arms are mentioned by Hippocrates in his scripts. The lack of scientific knowledge about the cause of the disease led to prejudice against the unfortunate newborns. In ancient militaristic Sparta, babies with paralyzed limbs were thrown alive into the Kaiadas gorge, in favour of the purity of society (Terzis et al, 1999).

Birth palsy only began to pique the interest of the medical community toward the end of the 19th century. The term 'obstetrical paralysis was first coined by Duchenne in 1872 (Gilbert et al 1990).

Despite contemporary advances in prenatal planning and assessment, obstetric brachial plexus palsy remains an unfortunate consequence after difficult childbirth. Although many infants with plexopathy recover with minor or no residual functional deficits, a number of children do not regain sufficient limb function and proceed to develop functional limitations, bony deformities and joint contractures. (Michelow et al 1992). Late sequelae vary from minor loss of function to complete paralysis of the arm. In view of the lifelong impact, prevention of non-recovered Obstetrical Brachial Plexus Palsy (OBPP) would be of great importance. (Wolf et al, 2000).

With this in mind aims the following aims were formulated.

1.2 AIMS OF THE STUDY

1.2.1 To determine the incidence of Obstetric Brachial Plexus Palsy (OBPP), Cephalopelvic disproportion (CPD) and macrosomia in KwaZulu-Natal.

1.2.2 To investigate the correlation between OBPP and CPD.

1.2.3 To investigate the relationship between OBPP and fetal macrosomia.

1.2.4 To investigate whether the routine antenatal clinical monitoring and ultrasound examination is accurate in predicting CPD, birthweight and difficult deliveries.

1.2.5 To determine whether there are risk factors that can identify those infants prone to birth palsies.

1.3 MOTIVATION AND IMPORTANCE OF STUDY

King Edward VIII hospital, in Durban KwaZulu-Natal, has a brachial plexus clinic, which comprises a team of experts. The orthopedic surgeon with a special interest in surgery to the plexus, the orthopedic registrar, a physiotherapist, an occupational therapist, a social worker and a nurse. The author was part of this clinic for many years and treated most of the cases that presented at the clinic. Decisions regarding surgery were made by the team as well reinstating the patient to society, work and home was an integral aim of the team.

The author had made the following observations: that the deleterious results of OBPP were medical, psychological and socioeconomic and that it affected the both the patient and their family (Terzis et al, 1999), especially the parents who often blamed themselves for the condition and were thankful that there were no signs of cerebral damage instead of the OBPP.

However OBPP is a severe handicap in childhood and in later life. These patients with permanent injury require lifelong physiotherapy. Hence the importance of prevention cannot be overemphasized.

Birth trauma is a major source of pregnancy-related medical litigation, especially when permanent injury results. Permanent brachial plexus palsy is a leading cause of litigation related to birth trauma (Gilbert et al, 1999). According to Jakobovits (1996), the exponential increase of malpractice claims against obstetricians on account of injury to the brachial plexus in the neonate is a matter of concern for the medical profession. Iffy et al (1996), found that Erb's palsy resulting from traumatic delivery in connection with shoulder dystocia is probably the most frequent cause for malpractice claims against obstetricians in the United States.

CHAPTER TWO

REVIEW OF LITERATURE

2.1 OBSTETRIC BRACHIAL PLEXUS PALSY

2.1.1 HISTORICAL OVERVIEW - TERMINOLOGY AND ETIOLOGY

As early as 1764, Smellie suggested the obstetric origin of a paralysis of the arm, in children. He described, in a newborn, a bilateral arm paralysis, that resolved a few days later. A collection of his cases and observations in midwifery were published in 1779 (quoted from Terzis, 1999).

In 1851, Danyau, from France, described the post-mortem findings in an infant born with birth palsy, who had haematomas within the plexus, without rupture or avulsion of the plexus (quoted from Terzis, 1999).

Duchenne de Boulogne, in 1872, first correlated excessive traction of the brachial plexus during delivery to upper arm paralysis, based on clinical similarities with total flaccid paralysis of upper limbs in adults, following trauma. He baptized the condition Obstetrical Brachial Plexus Palsy (OBPP) in his book *Traite de L'electrisation Localisee*, in which he described in detail four cases of proximal root paralysis occurring as a result of delivery and attributed the injury to traction on the arm (from Terzis, 1999).

Two years later in 1874, Wilhelm Heinrich Erb, the foremost German neurologist of his time, described a case of brachial plexus palsy, in a lecture, at the University of Heidelberg. He described the case of an adult who developed traumatic neuritis and also described one of his own obstetrical cases. This classic case became known as "Erb`s Palsy". Erb's description of paralysis of the uppermost portion of the brachial plexus is remembered mainly for its postscript (Brody, 1969). As an after-thought to his discussion, Erb acknowledged Duchenne`s prior description and noted that birth trauma is one of the causes of such paralysis. If an eponym should attach to the condition it might reasonably be Duchenne-Erb's palsy (Kay 1998).

Klumpke, in 1885, described the paralysis of the lower roots and highlighted the involvement of the sympathetic fibres in the paralysis (from Terzis, 1999).

Theories on the cause and factors leading to OBPP have abounded. Since Sever's paper in 1925, of 1,100 cases of obstetric paralysis on the etiology, pathology, clinical aspects and treatment, the medically community firmly believes that direct or indirect compression from delivery instruments or fingers with subsequent traction to the roots or both, is the most likely cause.

2.1.2 EPIDEMIOLOGY

The incidence of OBPP varies considerably. Adler and Patterson reported a decreasing incidence of the condition in New York between the years 1938 (1.56 per 1000 live births) to 1962 (0.38 per 1000 live births). Seddon, also reported a declining incidence in 1975, in Edinburgh, as well as Bennet and Harold who found an incidence of 0.61 per 1000 live births, in London.

In 1984, Levine et al reported a decline of injury to the fetus during parturition since Rubin et al in 1964, found that 1 of every 143 deliveries resulted in major birth injury. The authors suggested that the liberal use of caesarian section as a substitute for midforceps and vaginal breech deliveries might have contributed to a lowered neonatal morbidity and mortality. However in this retrospective study of 10 775 infants, from 1974 to 1977 and from 1979 to 1981, an incidence of 2,6 per 1000 was reported for brachial plexus injury.

Gordon et al, in 1973, New York, in a cohort study of, 31 700 live-born offspring found a rate of 1.89 per 1000 live births. Further to this Bager, (1997), in a study of 1 564 307 infants, noted a significant increase in the rate of OBPP in Sweden from 1.4 per 1000 deliveries in 1980 to 2.3 per 1000 live births in 1994.

Acker et al (1988) reviewed 32,468 patients over a 10-year period (1975 to 1985) and found an incidence of 0.68 per 1000 deliveries in Boston. A five-year review of the incidence and associated perinatal factors in birth trauma, by Perlow et al, in 1996, of 19 370 consecutive deliveries revealed, for OBPP, an incidence of 0.9 per 1000 live births and 1.1 per 1000 cephalic born singletons. Gherman et al (1998) at the University of Southern California, reviewed 58 565 deliveries and reported an incidence of 4.4 per 1000 vaginal births. More recently (1999), Gilbert et al, reviewed all deliveries in the state of California. Among 1,094, 298 women who delivered during the two year period, 1611 (0.15%), a diagnosis of OBPP was recorded giving an incidence of 1.5 per 1000

live births. These figures suggest that annually approximately 5 420 newborns are affected by OBPP in the United States.

A pilot study in the Netherlands in 1989, by Sloof estimated an incidence of 2 per 1000 births. A recent study by Wolf et al (2000), in Amsterdam, of 13 366 infants, to investigate the risk factors of OBPP related to recovery revealed an incidence of 4.6 per 1000 live births. Al-Rajeh and colleagues (1990) looked at the incidence of OBPP in Eastern Saudi Arabia and found a frequency of 1.19 per 1000 cases.

Bager (1997), in Sweden reported a significant increase in the incidence of OBPP from 0.0014 per 1000 in 1980 to 0.0023 per 1000 deliveries in 1994.

A review of developing countries revealed an incidence of 3.6 per 1000 live births in Libya, in a study of 7829 babies and 1.6 per 1000 livebirths in Kuala Lumpur, Malaysia, in a study of 26 176 neonates. There is no literature on the incidence of OBPP in South Africa.

In general the incidence number accepted by the World Health Organisation is between 0.1 and 0.2 per 1000 births, with higher numbers occurring in under-developed regions.

2.1.3 CLASSIFICATION

A. LESIONS:

C5-6; Erb' s palsy or Erb/Duchenne palsy, (Mcfarland et al, 1986), the arm is adducted and internally rotated at the shoulder, the elbow is extended, the forearm pronated, and the wrist (and sometimes fingers) flexed (Erb, 1874). This is the classic "waiters tip posture" (Kay,1998). Sensation is sometimes defective around the elbow. (Sjoberg et al, 1988).

- C5-7; as above, although the elbow may be slightly flexed. Vasomotor control and digital sensation are usually spared (Terzis & Papakonstantinou, 1999)

- C8-T1; Klumpke paralysis, the hand has a clawed appearance due to hyperextension of the metacarpophalangeal joints. The extensor digitorum is unopposed by the lumbricals and interossei and extends the metacarpophalangeal joints; the flexor digitorum superficialis and profundus are unopposed by the lumbricals and interossei and flex the middle and terminal phalanges, respectively. There is loss of sensation along the medial side of the arm, forearm and medial two fingers. But good shoulder and elbow movement is present (Snell,1973)

- C5-T1; the arm is totally flail with a claw hand. The arm has a marbled appearance due to vasomotor disturbance. It may or may not be accompanied by Horner's syndrome. (Sign of Claude Bernard-Horner). The limb is totally anaesthetic.

Narakas classified obstetric brachial plexus lesions initially into five groups and then into four, based on the examination 2-3 weeks after birth:

- Group I: C5-6; paralysis of shoulder and biceps.
- Group II: C5-7; paralysis of shoulder, biceps and forearm extensors.
- Group III : C5-T1; complete paralysis of limb
- Group IV: C5-T1; as above with Horner's syndrome.

(Narakas 1986)

OTHER TYPES

- Mixed or partial palsies (Sjoberg et al 1988)

B. NERVE DAMAGE

Two types of nerve damage

Seddon (1943)	Sunderland (1978)
Neuropraxia: non-degenerative incontinuity	I. Blocked conduction with axonal continuity
Axonotmesis: degenerative lesion in continuity	II. Axonal degeneration with intact tubules III. Axonal degeneration plus Tubular damage but intact fascicular architecture
Neurotmesis: complete functional disruption	IV. Axonal and tubular damage plus disrupted fascicular architecture but intact epineurium V. Complete anatomical section

(Harris, 1983)

2.1.4 PATHOLOGY AND ASSOCIATED INJURIES

The diagnosis of OBPP is usually easy to make. Right after birth, the infant is found to have a flail upper arm, usually following a difficult delivery. Before committing to a diagnosis of OBPP, however, other pathology should be excluded, such as upper limb fracture, clavicular fracture, tetraplegia, hemiparesis, other central nervous system lesions, infections of the shoulder, or osteomyelitis (Terzis et al, 1999).

The report of 1,100 cases of OBPP by Sever (1925) revealed that there were generally two well-recognized types of paralysis. The more common, the upper arm type, consists of a lesion that involves the fifth and sixth cervical roots and the suprascapular nerve and produces a paralysis of the muscles of the upper arm only, with exception of the supinators. The less usual type, the so-called lower arm, or whole arm type, is the result of injury not only to the fifth and sixth cervical roots, but to the seventh and eighth, and possibly the first thoracic as well. There occasionally occurs the pure lower arm type of paralysis without any involvement of the upper cords of the plexus, the so-called Klumpke's paralysis. These cases show a paralysis, usually the result of stretching of the plexus from overextension of the arm in cases of face presentation, and due to injury to the lower cords of the plexus. It is in this type that one sees inequality of the pupils, owing to the fact that the sympathetic fibres from the deep cervical ganglionic plexus enter the spinal cord through the first dorsal and, at times, through the eighth cervical roots. Injury to these roots leads to an unopposed action of the motor occuli nerve.
Pathologically, in milder cases, the stretching or tearing forces result in a greater or less degree of haemorrhage or edema into the nerve sheaths. In others there may be a rupture of the perineural sheath, accompanied by haemorrhage into the substance of the nerve trunk, associated with a tearing apart or separation of the nerve fibres. The latter condition leads to permanently impaired function and to the formation of scar tissue in the nerve track. In the more severe cases of the upper arm type, there is a partial or complete division of the fifth and sixth cervical roots, which leads to a more permanent form of paralysis than usual, and the formation of a more extensive area of scar tissue.

The force producing these lesions is variable and so the lesions vary accordingly. The nerve roots often frayed out inside the sheath instead of being torn across evenly, and in this way the lesion may be incomplete at any given cross section of a nerve, but involves different fibres at different levels. This scar tissue contracts in time and not only prevents the regeneration of nerves by its contraction, but may press on and destroy the few fibres that may have escaped the original injury.

The whole arm type, is the result of a lesion involving all the nerves of the plexus and in the distinctly lower arm type, in which the lower arm and hand alone are involved (Klumpke's paralysis), the lesion involves the eighth cervical and first dorsal roots alone. This type generally results from traction applied in a breech case with the arm extended or to traction in the axilla in a vertex presentation. Pathologically the conditions are similar to those seen in the other types, depending on the severity of the injury. No case in which surgery has been performed has failed to show a definite pathologic lesion of the brachial plexus, definitely corresponding to the muscles involved.

Sever (1925) also found various associated conditions due to cord injury. These injuries followed vaginal deliveries by breech extraction and were caused by traction and lateral flexion of the trunk. The conditions varied from paralysis of both arms, partial or complete, due to injury to the plexus, to section of the cord and paraplegia below the point of injury. Many patients showed a moderate degree of spasticity of the legs with adductor spasm suggesting a cortical lesion as well and were of sufficient frequency not to be overlooked.

According to McFarland et al (1986), differentiation of the types of injuries is based upon which cervical roots are involved. Duchenne-Erb's palsy is an upper brachial plexus injury involving cervical roots of C5 to C6. Bellini (1963) has, also reported associated unilateral paralysis of the diaphragm. Klumpke's palsy, a lower brachial plexus type involving roots from C7 to T1, has a much poorer prognosis but is far less common than Erb's. More frequent are the mixed palsies, partial or total, affecting the whole arm (C5-C8) (Sjoberg-1988)

Duchenne originally described the paralyses in newborns. Duchenne, described these injuries in deliveries attended by a difficult presentation of the arm or prolonged traction

by an index finger inserted into the child's axilla and found paralysis of the deltoid, biceps and brachialis as well as infraspinatus (quoted from Brody, 1969)

Erb reported similar findings, in1874, that is, paralysis of the deltoid, biceps, brachialis, infraspinatus and brachioradialis muscles as well as significant weakness in all muscles supplied by the radial nerve and a secondary contracture of the pectoralis major muscle. Erb said " how and when the lesion comes about is difficult to say. However, it seems unlikely to me that the insertion of the finger into the axilla could lead to this characteristic pattern of muscle paralyses since the suprascapular nerve, which supplies the infraspinatus, cannot be involved in such trauma. It seems to me more probable that the version and extraction usually necessary for carrying out the so-called *Prague manipulation* is the most frequent cause of this type of 'delivery paralysis'. The fork-like grip of the fingers on the neck, with moderately energetic manipulation by the obstetrician, can easily compress the roots of the brachial plexus and the plexus itself so that a more or less persistent paralysis ensues." The participation in the paralysis of infraspinatus muscle, the nerve of which originates from the fifth and sixth cervical nerves in the uppermost portion of the brachial plexus, provides decisive evidence that the source of the paralysis lies above the arm and in the neck, close to the scalene muscles. He also added, the possible direct compression of the plexus by the clavicle as another theory (Erb, 1874).

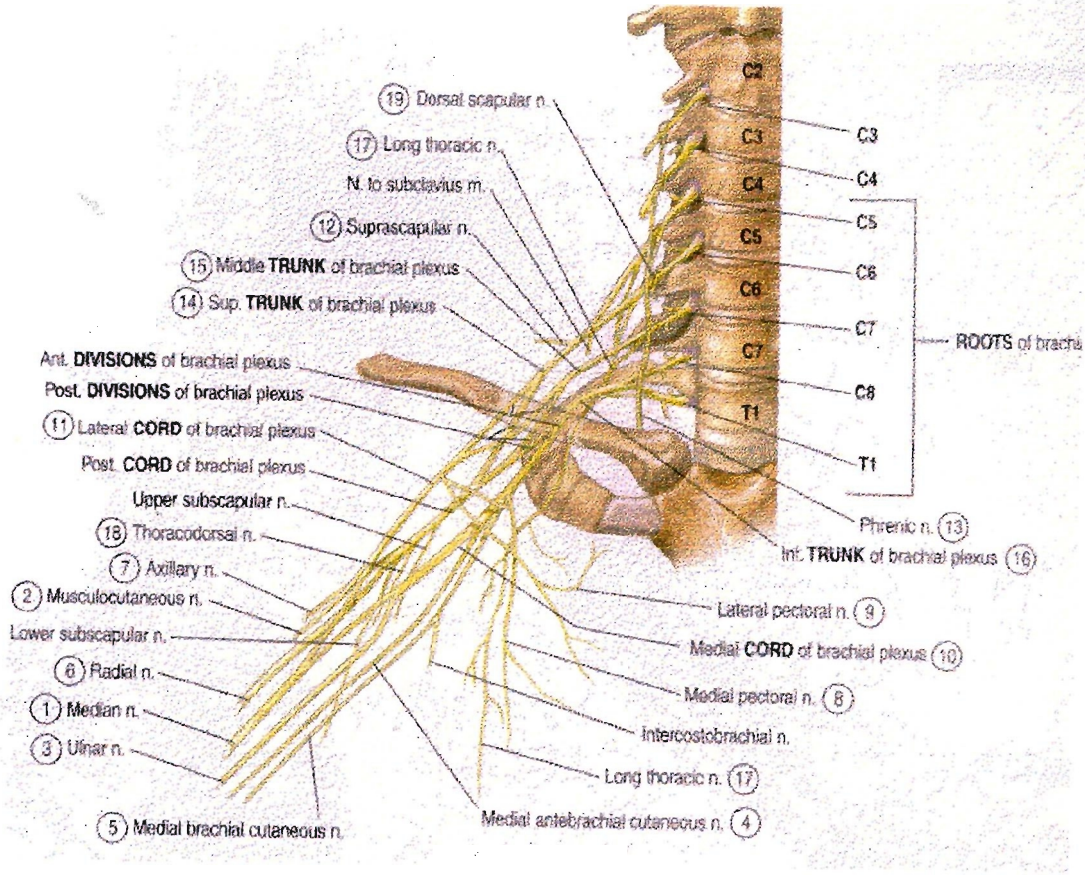
The report by Khatree et al (1988), of the associated features in 8 cases of Erb's palsy represents an incidence of 0.42 per 1000. The associated features were elevated diaphragm, sternomastoid tumour, pneumomediastinum and Horner's syndrome. This compares with an incidence of 0.2 per 1000 and 0.6 per 1000 in a study by Gordon et al (1973), which included facial nerve palsy as one of the associated risk factors as well.

Miller et al (1993) investigated the value of magnetic resonance (MR) imaging in diagnosing traumatic pseudomeningocele. Five newborn infants with brachial plexopathy secondary to traumatic delivery underwent MR imaging of the spine and serial neurologic examinations. Cervical MR images showed focal collections of cerebrospinal lateral to

the spinal cord and extending into the neural foramina in 4 out of 5 infants. The seventh cervical nerve root was most commonly involved. In all four of these infants, the pseudomeningoceles were on the same side as the neurologic deficit and are seen in the absence of root avulsion. The infant with the negative MR images showed nearly complete neurologic recovery. The authors deduce that this small series indicates that MR imaging may have prognostic value in infants with obstetric brachial plexus injury.

The injury most commonly associated with OBPP is fracture of the ipsilateral clavicle. Other associated injuries include haematomas of the sternocleidomastoid muscle, humerus fractures, persistent phrenic nerve palsy, contralateral brachial plexus injury, facial nerve palsy (Terzis et al, 1999) and fractures of the metacarpal bones (Eng et al, 1978).

Figure 1: Anatomy of the Brachial Plexus depicting sites of injury.
[Olson, 1996]



2.1.5 RISK FACTORS

The identification of risk factors that place patients at risk for OBPP is crucial if strategies aimed at preventing the occurrence of this condition are to be developed (Pollack et al 2000). Several studies have described risk factors for OBPP.

Sever (1925) identified difficult and prolonged labour in 584 of 1100 cases, as the predisposing factor of the greatest importance in the causation of OBPP. Other factors reported were the use of forceps and shoulder dystocia in the vertex presentation as predisposing factors.

Gordon et al (1973), reported the following obstetric risk factors: pre-eclampsia (32%), chronic hypertension (14%), diabetes (5%), breech presentation (14%), prolonged first and second stage labour (37%), fetal distress and shoulder dystocia (51%). A significant percent of brachial plexus injuries occurred in the black population (68 %) those gravidas at the extremes of height and prepregnant weight. The pediatric factors were female sex, birthweight greater than 3.500 grams, apgar scores below 4 and finally the subjective judgement of "difficult delivery" by the obstetrician.

An appraisal of risk factors in a developing country, Libya, by Soni et al (1985), found a proportional increase in the incidence of OBPP with advancing maternal age and parity. With advanced maternal age and parity there is a greater risk of difficult delivery, due to uterine inertia coupled with higher incidence of maternal diabetes and large fetus resulting in OBPP. (Tan 1973).

McFarland et al (1986), in a case-control study of 210,947 cases confirmed the association of high birth weight with Erb's palsy and further refined the risks associated with fetal macrosomia and method of delivery. The highest risk factor that should be avoided is the performance of midpelvic delivery. Midforceps delivery carried the highest risk for OBPP. Vacuum extraction was also associated with a very high relative risk of Erb's palsy. Delivery by a non-medical doctor (midwife, nurse, corpseman) should an

increased risk with delivery by an osteopath showing a significantly higher risk than delivery by a medical doctor.

An attempt to evaluate the relationship between the incidence of OBPP and clinical experience was made by Acker et al (1988). The data suggested that recently graduated physicians, especially if placed in a high volume practice, are more likely to deliver neonates with OBPP than those with more experience. An important observation made was that no cases of OBPP occurred with physicians in practice for between seven and fifteen years. Acker et al (1988) noted that both breech (especially breech extraction) and vertex deliveries carried a higher risk for upper brachial plexus neuropathies.

A prospective study by Boo et al (1991), of 26,176 infants in Kuala Lumpur, Malaysia, found that brachial plexus injuries was significantly more common in neonates born to multiparous mothers than to primigravida mothers and that breech delivery and increasing birthweight were the two most important risk factors.

Ubachs et al (1995), in their study of 378 infants with OBPP, to determine whether the anatomy of an obstetric brachial plexus lesion is causally related to the preceding obstetric history, found that breech delivery seemed to cause the more localized pure C5-6 lesions and they were mainly avulsions. Total lesions were noted almost exclusively in the cephalic presentation group, with nerve rupture and nerve avulsion seen equally frequently. The authors believe that unilateral overstretching of the angle of the neck and shoulder, in the group with total lesions, led to a more extensive damage, which involved the lower spinal nerves of the plexus. They further explained this phenomenon by the tight attachment of the spinal nerves C5 and C6 to the transverse processes of the cervical vertebrae. As a result of that, unilateral overstretching in the shoulder dystocia preferentially leads to an extraforaminal lesion of the upper spinal nerves and often to an avulsion of the lower spinal nerves C8-T1. A different mechanism was considered in breech-extraction. Hyperextension of the cervical spine and consequently a forced extensive moment or elongation of the spinal cord in such a delivery, combined with the relatively strong attachment of the spinal nerves C5 and C6 to their transverse processes might cause, an avulsion by acting directly on the nerve roots between their attachment to

the cord and their fixed entry in the intervertebral foramen. Sunderland (1991) describes this as the central mechanism of an avulsion.

Geutjens et al (1996) investigated the association between OBPP and breech delivery, in Paris. Of the 379 babies who had undergone exploration of their brachial plexus, 36 had been born by breech delivery. The series revealed a higher percentage of avulsion type lesions in the infants with breech presentation (81%) than those with cephalic presentation (0.5%) and estimates that breech deliveries carry a five times greater risk of OBPP.

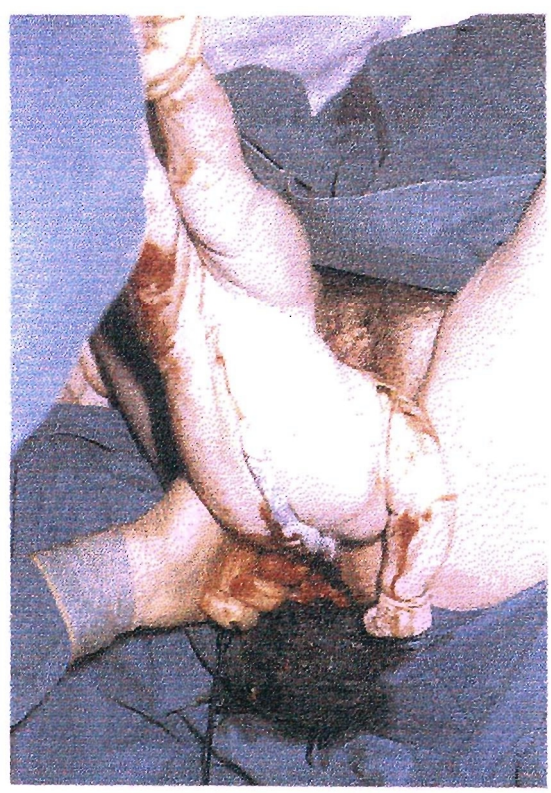


Plate 1: Breech delivery depicting the stage at which Obstetrical Brachial Plexus Injury could occur. [Al-Azzawi, 1990]

Perlow et al (1996) reviewed the incidence and associated perinatal factors, of birth trauma over five-year period to identify the existence of associated perinatal factors with clavicular fractures, facial nerve injury and brachial plexus injury. In their study significant perinatal variables identified, were consistent with those in previous reports; grand multiparity, gestational diabetes, instrument delivery, shoulder dystocia, fetal macrosomia, prematurity, post-maturity, breech delivery and oxytocin use, however the significant findings of meconium and neonatal hyperbilirubinemia were not previously reported. The significant association of neonatal hyperbilirubinemia with clavicular fractures and brachial plexus injury is probably due secondary to extravasation of blood due to trauma in conjunction with transient deficiencies in the neonate's ability to metabolize bilirubin.

Bager (1997) in his series of investigation found an obvious risk factor for the fetus to be that of asphyxia related to the often prolonged and difficult birth process leading to brachial plexus palsy. He commented that the documentation of fetal distress and immediate intervention after birth was often sparse and that the only consistent documentation of neonatal distress is the Apgar score or transfer to neonatal care also being and indication of complications. After studying these factors, he found that more than one-third of the newborn infants with OBPP was referred for neonatal care because of varying levels of post-natal distress related to the difficult birth process. With this background one would expect to find at least some children with a combination of OBPP and cerebral damage. Bager, further indicated that the series was too small to draw any conclusions. However, Iffy et al (1996), reported that it was the high number of observations provided by medico-legal reviews that allowed a clear identification of a close relationship between brachial plexus injury and brain damage. During a period of 15 years (1976-1991), from 23 American states 95 cases of OBPP were found, of which 17 were combined with cerebral palsy. This is extremely selected material, but indicates a risk of brain damage associated with OBPP.

The permanent injuries of Erb's palsies are the source of almost all litigation related to shoulder dystocia. Gherman et al (1998), sought to determine whether Erb's palsies occurring without a documented antecedent shoulder dystocia differed from those associated with shoulder dystocia with respect to maternal and fetal characteristics. Their data provided evidence that not all Erb's palsies were traction related and most importantly the high rate of persistence among those Erb's palsies without shoulder dystocia. Two cases of facial nerve palsy and brachial plexus injury, in the absence of shoulder dystocia following spontaneous vaginal delivery from an occipitoanterior position, suggested that pressure of the fetal cheek and shoulder against the symphysis pubis produced the nerve injuries.

Gilbert et al (1999), in a study of more than one million deliveries, found both individual and collective risk factors associated with the diagnosis of OBPP. These include high birth weight (macrosomia), breech presentation, and shoulder dystocia, multiparity, prolonged labour, assisted delivery, and previous child with OBPP and diabetes mellitus. In macrosomic infants, shoulder dystocia was associated with OBPP, but in low and normal weight infants, " other malpresentation" (non-breech), was diagnosed more frequently than shoulder dystocia. The authors surmised that there are potentially multiple causes of OBPP, including shoulder dystocia, malpresentation, diabetes and operative vaginal delivery.

In a recent case-control study, by Wolf et al (2000), it was observed that univariate risk factors are of low predictive value and that previous studies had not addressed the interaction between variables by multivariate analysis. They concluded that birth weight was the most important variable in predicting OBPP and that female sex, second stage of labour greater than one hour, diabetes and non-Caucasian origin were also important risk factors. According to the authors differences in body proportions of the mother or the infant could be the underlying cause of the increased risk of OBPP occurring in infants of non-Caucasian origin. Gordan et al (1973) also found that infants of black gravidas have a higher risk for OBPP. However both these studies did not include cephalo-pelvic

disproportion as a risk factor. The authors commented that fetopelvic disproportion is associated with large fetal size even in the absence of gross pelvic contraction.

2.2 MACROSOMIA

The major fetal morbidity associated with macrosomia is OBPP. All management schemes that attempt to deal with the fetus with macrosomia are, in fact, attempts to prevent the occurrence of OBPP.

Macrosomia is defined variously as birthweight of ≥ 4000g, or that above the 90th or the 95th percentile birthweight for gestation. Boyd (1983), in his study of 942 macrosomic infants, defined macrosomia as a birthweight of 4000g or more. His results showed that macrosomia was 1.5 to 2 times more frequent than the normal rate in women who:

1) were multiparous and 35 or more years of age
2) had a prepregnant weight exceeding 70 kg
3) had a ponderal index (weight/height) in the upper tenth percentile
4) had a height exceeding 169 cm
5) gained weight during pregnancy exceeding 20 kg and
6) delivered seven days or more post term

Parks and Ziel (1978), who proposed macrosomia as an indication for primary caesarian section, in their study of 110 macrosomic infants, demonstrated that pregravid obesity only and not maternal weight gain during pregnancy, was a significant etiologic factor in the development of fetal macrosomia. Their study did not identify any completely satisfactory tests or procedures for prenatal recognition of macrosomic infants and stated that there remains no substitute for clinical judgement.

Spellacy et al (1985), in his study of 574 macrosomic infants (>4500g) confirmed the above authors findings of maternal age, parity, length of gestation and weight. There was a significantly higher frequency of diabetes (gestational and insulin-dependent types) and obesity was the most frequent factor. The author concluded that macrosomia is a significant risk factor for the infant in terms of shoulder dystocia.

McFarland et al (1986), in a case control study of 106 infants with Erb's palsy, showed that birth weight was a significant risk factor regardless of which method of delivery was used. A high birth weight infant (4001-4500 g) had 2.5 times the risk of incurring an upper brachial plexus injury compared with normal size infants (2501-4000 g). The risk for infants greater than 4500 g increased another tenfold. The authors concluded that neonatal birth weight remained the strongest predictor of Erb's palsy. Nearly all of the brachial plexus injuries in this study were the result of shoulder dystocia.

Rydhstrom et al (1989), evaluated the efficacy of current methods in identifying fetuses with a weight > 5700 g, and studied the perinatal mortality and morbidity in relation to the mode of delivery. For the 113 cases of macrosomic infants tall, parous women with high prepregnancy weight and excessive weight gain constituted a high- risk group, however the predictive potential of these parameters were not sufficient to identify individual cases. The authors feel that the obstetrician has limited means to identify, with acceptable accuracy, the macrosomic fetus in the antenatal period.

Walle et al (1993), investigated the associated risk factors, prediction and prognosis of obstetric shoulder injury, in 340 infants with shoulder injury, clavicular fracture and brachial plexus palsy. On comparing the maternal characteristics: weight, height, weight gain during pregnancy and Body Mass Index (BMI, kg/m2), it was found that at the beginning of pregnancy the case mothers were, on the average, more obese than controls. BMI of the case mothers was significantly higher than that of the controls. Weight gain during pregnancy was significantly higher among case mother, which caused significantly higher weight at the end of pregnancy.

The macrosomic infant is at increased risk for cephalo-pelvic disproportion, shoulder dystocia, brachial plexus injury and perinatal asphyxia. The antenatal diagnosis of macrosomia poses a dilemma because there is no clear consensus regarding the three management options: elective caesarian delivery, induction of labour and expectant management. (Combs et al 1993).

Antenatal diagnosis of macrosomia is problematic because less than half of mothers, delivered of such infants has identifiable risk factors. Moreover, the accuracy of both clinical and ultrasonographic estimation has been disappointing at the extremes of birth weight, often resulting in caesarian delivery of nonmacrosomic infants (Weeks et al 1995).

Johnstone et al (1996) also found that clinical and ultrasound measurements are poor predictors of eventual birthweight. They concluded that regular serial scanning and clinical examination does not always diagnose the macrosomic fetus in diabetic pregnancy and that clinical examination is as predictable as ultrasound measurements.

Ecker et al (1997) examined the relationship between birth weight and brachial plexus injury and estimated the number of caesarians needed to reduce such injuries. They found that the number incidence of OBPP in the group of diabetic mothers were higher than those without diabetes and that the incidence of OBPP rose as the weight of the neonate increased. Multivariate analysis demonstrated that increasing birthweight; maternal diabetes and vaginal delivery were associated independently and significantly with and increased risk of OBPP. Of the factors examined, caesarian delivery was associated with the most marked decreased in the risk of brachial plexus injury. They concluded that OBPP is the appropriate outcome to examine, in evaluating protocols that recommend caesarian delivery for macrosomia and that clinical judgment and appropriate caution should replace any hard- and- fast rule requiring caesarian delivery.

The often-quoted correlation between high birthweight and brachial plexus palsy is clearly verified in the study by Bager (1997), who conducted a population-based study to investigate the contemporary pattern of perinatally acquired brachial plexus palsy, in Sweden. The study was based on three sets of data: the national series of OBPP, the regional series of OBPP and the interviews with mothers in the regional series. Having found a significant increase in the incidence of brachial plexus palsy over the 15-year period, he proceeded with a detailed analysis of the children with brachial plexus palsy born during the period 1988-1991. During this period, he found that the incidence of

brachial plexus palsy was 45 times higher at a birthweight of >4500 g, than at a birthweight of <3500 g. the author concluded that the analysis showed that 50% of the children with OBPP were macrosomic and that if high birthweight could be predicted as well as a fetus at risk of OBPP, this would only cover 50% of the cases. In the other 50%, birthweight alone did not imply a relationship to OBPP and other factors have to be explored, such as the relationship between fetus and pelvic outlet or the process of delivery.

2.3 SHOULDER DYSTOCIA

Shoulder dystocia is a true obstetric emergency and unless appropriately managed carries a high risk of fetal and maternal morbidity. Unfortunately there are no definitive or reliable indicators to forecast this obstetric condition until delivery of the fetal head. Once diagnosed, shoulder dystocia must be resolved rapidly if severe injury or infant death is to be avoided (Sandmire et al, 1988)

Shoulder dystocia is defined as failure of the shoulders to deliver after delivery of the head despite standard maneuvers. This infrequently encountered obstetric emergency varies in incidence from 0.15 to 0.6 % of all deliveries. Infants experiencing shoulder dystocia are known to have serious immediate and long-term morbidity (Benedetti et al 1978). The incidence of perinatal death among these infants ranges from 0 to 2.6 %, with an incidence of permanent injury of up to 13%.

The reported prevalence of shoulder dystocia in the delivery of oversized infants has varied from 6% at Los Angeles County General Hospital in 1966 to 27% at Chicago Lying-In Hospital between 1931 and 1939.

Sandmire et al (1988), in a case-control study of 73 cases of shoulder dystocia, reviewed the literature on the incidence, associated risk factors and complications on this subject. The incidence from 1922 to 1986 was reviewed and ranged from 23.9 in neonates with a birthweight greater than 4500 g to 0.04 in neonates with a birthweight of between 2501-3999 g.

Benedetti et al (1978) documented an independent relationship between birthweight greater than 4000 g and shoulder dystocia as well as an association between prolonged labour second stage of labour and midpelvic delivery and shoulder dystocia.

According to McFarland et al (1986), Erb's palsy is usually a complication of shoulder dystocia. Almost all, of the 106 cases of OBPP, in their study were as a result of shoulder

dystocia. Their conservative estimate of the incidence of shoulder dystocia was 3 in 1000 vaginal births.

Gross et al (1987), referred to shoulder dystocia as a" fetal- physician risk". The frequency of shoulder dystocia increases with each increment of fetal weight with highest incidence occurring with a birthweight of 4000 g or more. The characteristics of pregnancies delivered vaginally can be stratified into those with no shoulder dystocia and shoulder dystocia with and without trauma. The latter two groups had significantly lower one-minute Apgar scores than the first group. This is important, since the definitions and thus the reported frequencies of shoulder vary between individual physicians and institutions. There is not likely to be any agreement among studies on the definition of the degree of difficulty in delivering the shoulders that is necessary to diagnose shoulder dystocia. However, difficulty in delivering the shoulders, in combination with fetal injury, is more likely to be accepted as true dystocia. The different definitions used are probably the major reason for the variation in frequency reported by several authors (Gross et al 1987).

The results of a study by Rydhstrom et al (1989), indicate that fetal outcome is poor when the birthweight reached 5700 g. 50 % of the recorded fetal deaths were due to shoulder dystocia. They also emphasized that up to 50 % of all deliveries with shoulder dystocia involve a fetus with a birthweight < 4000 g.

Weeks et al (1995), refer to shoulder dystocia as among the most feared of obstetric complications. They also concur that nearly half of all cases of shoulder dystocia occur at birth weights < 4000 g. They found that inspite of induction of labour and an increased caesarian rate, the incidence of shoulder dystocia and birth trauma was not reduced, which is in keeping with recent literature that shoulder dystocia and birth trauma cannot reliably be predicted in the antenatal period.

Macrosomia is a major risk factor for shoulder dystocia and shoulder dystocia is a major risk factor for brachial plexus palsy, according to Gonen et al (1996). This study

corroborates other studies in terms of risk factors and shows that most episodes of shoulder dystocia and birth trauma occur in nonmacrosomic newborns, and therefore their prevention is practically impossible.

Sandmire et al (1988), in their review of literature on the fetal complications in shoulder dystocia, found a high incidence of brachial plexus palsy (11.8 %), neonatal deaths (2.9 %) and stillbirths (7.9 %). Other fetal complications were severe asphyxia and meconium aspiration.

Bahar (1996), in a case-controlled study of 160 cases of shoulder dystocia, found that previous history of shoulder dystocia was a highly significant factor. The study also confirmed that maternal diabetes is and important risk factor. The author suggested that disproportionate growth increased with macrosomia. He did not find any significant differences in head and chest circumference between cases and controls, but found a significant difference in the shoulder width and the head-shoulder proportion. The author suggests that head- shoulder disproportion may be instrumental in the development of shoulder dystocia and that these measurements will only be useful in the prediction of shoulder dystocia if they are performed antenatally on the fetus.

Kastler et al (1993) studied the ability of Magnetic resonance imaging (MRI) to predict fetal shoulder width (FSW). MRI was chosen because FSW is not accessible by sonography and measurement by CT is not accurate and that where the radiation to the fetus (and maternal ovary) is significant, the safety of MRI during third trimester pregnancy has not been seriously questioned. In 26 cases FSW was performed and compared with calliper measurements at term. The MRI FSW and birth measurement correlation was excellent. ($p = 0.0005$). MRI, FSW also correlated significantly with birth weight. ($p = 0.00005$). The authors also conducted a feasibility study on the use of MRI to measure FSW. An arbitrary "cut off point" was set at which vaginal delivery was precluded. If the MRI determined FSW was <20mm larger than the pelvic inlet diameter, vaginal delivery was performed. This approach allowed successful vaginal delivery in all patients. It also supported clinical decisions to allow vaginal delivery in five women in

whom physical examination, sonography and pelvimetry indicated a caesarian section. The authors concluded that the method of FSW measurement using MRI is reliable and fast, as well as having the potential to evaluate shoulder dystocia and that its role in screening for shoulder dystocia needs to be established by a large prospective study.

Beall et al (1998) elected to develop an objective definition for shoulder dystocia because research on prediction and management of shoulder dystocia is difficult because of the lack of a standard definition. They quantified the time intervals for all events of vertex vaginal delivery from crowning to delivery of the placenta and found that a head-to-body time interval of > 60 seconds was 2 SDs above the mean and described a subpopulation with a significantly increased risk of high birthweight, subjectively recognized shoulder dystocia and low 1-minute Apgar score. The authors validated this timing criterion with two consecutive studies. More importantly is that fifty- percent of those deliveries that required maneuvers did not have documentation in the medical record of a shoulder dystocia. The reason for this poor correlation is uncertain but may be related to poor record keeping, a desire to avoid additional documentation requirements and fear of litigation.

The largest study until 1998, of shoulder dystocia, by Gherman et al (1998), of the impact of obstetric maneuvers for the alleviation of shoulder dystocia and associated fetal morbidity, found that approximately one quarter of all infants experiencing shoulder dystocia experienced nerve or bone injury. Brachial plexus injury occurred regardless of the procedure used to disimpact the shoulder, which is in accordance with the previous study by McFarland (1986).

Kees et al (2001) found an unacceptably high number of cases with Erb's palsy following shoulder dystocia. In these cases following a combined delivery by midwife and physician, it was difficult to determine when the injury occurred. The authors suggested that it might have been due to undue force by the midwife prior to calling for help or to lack of experience with the shoulder delivery drill by the medical staff. The authors concluded that shoulder dystocia creates a complex clinical scenario and that certain

cases can be prevented by careful selection of patients for caesarian section. However to lessen the degree and incidence of this sometimes unexpected possibility, all labour ward staff should be strongly urged to become familiar as possible techniques for freeing the shoulders.

2.4 OTHER CAUSES OF BRACHIAL PLEXUS PALSY IN THE NEWBORN

Theories on the cause and factors leading to brachial plexus palsy in neonates have abounded. Ombredanne, at the beginning of the century, suggested congenital reasons for this injury (Terzis et al, 1999).

A number of studies have evaluated the development of brachial plexus palsy injury after vaginal delivery. As mentioned earlier in the review of literature, these reports of risk factors have included diabetes mellitus, fetal macrosomia, instrumented midpelvic delivery, prolonged second stage of labour, postmaturity, multiparity and shoulder dystocia. Brachial plexus palsy has also been reported in babies delivered by Caesarian section. It was difficult to determine if this was due to excessive force when delivering the infant from the uterus or whether the palsy is due to other factors (Brown, 1987)

Koenigsberger (1980) reported two cases of brachial plexus injury, in which electromyographic evidence suggested that this type of injury was indeed intrauterine. The findings were based on the exhibition of electrical evidence of denervation. The first case involved a full-term baby delivered vaginally with, clinical Erb's (C5-C6) palsy at birth. Motor nerve conduction velocities (MNCVs) in both arms were normal, but needle studies of the deltoid, biceps and brachioradialis muscles revealed multiple fibrillations and positive waves in addition to a greatly reduced number of units in the muscles involved. EMG on the left was normal.

The second case involved an infant, delivered by caesarian section, noted at birth to have upper arm muscle weakness, loss of movement of the hand and a Horner syndrome. EMGs on day 4 showed fibrillation of the hand muscles. On day 15, MNCVs on the affected arm were slow from elbow to hand as well as from the brachial plexus. Fibrillations were present in large numbers in the first dorsal interosseous and adductor pollicis muscles. All studies of the unaffected side were normal. The control infants showed no evidence of denervation. However three other babies with clinical brachial plexus injury had normal EMGs. The author presumed that these babies sustained their injury at birth. As it takes ten days for denervated muscle to exhibit electrical evidence of

denervation hence the author presumed that the birth injury might have taken place in utero and that intrauterine positioning, amniotic bands or other causes might involved.

Jennett et al (1992) in Phoenix, Arizona, sought data to dispute or support the probable intrauterine origin of brachial plexus palsy. Data for 57,597 births occurring from 1977 to1990 were analyzed for maternal age, parity, delivery mode, gestational age, birth weight, Apgar scores, need for admission to intensive care nursery and shoulder dystocia. 39 infants were diagnosed with brachial plexus impairment, which ranged from weakness of an upper extremity to a specific diagnosis of Erb's palsy. According to the authors the term brachial plexus impairment rather than brachial plexus injury was used advisedly, inasmuch as the latter term carries with it the connotation that direct physical trauma is always involved. One group with shoulder dystocia and brachial plexus impairment was contrasted with another group without mention of shoulder dystocia and brachial plexus impairment. The authors found that brachial plexus impairment was not associated with recognition of difficulty with delivery and conceded that a lack of recognition of shoulder delivery problems may be involved in some of the brachial plexus impairment cases. However, maternal age was five times greater in the non-shoulder dystocia group and nulliparity twice as common. The authors deduced that although the presence of uterine anomalies could not be determined from the available data, uterine maladaptation associated with young maternal age and nulliparity might well be associated with a higher incidence of intrauterine pressures resulting in nerve impairment.

2.5 CEPHALOPELVIC DISPROPORTION (CPD)

2.5.1 DEFINITION AND INCIDENCE

One of the main issues with regard to vaginal birth is the size of the fetus relative to the size of the maternal pelvis, thus the concept of cephalopelvic disproportion (CPD).

If the duration of labour exceeds the accepted norm or if intervention has to be made either before or during labour, the condition is defined as dystocia. Dystocia may result from:

- 'Faults' in fetus
- An abnormal size or shape of the pelvis.
- Inefficient uterine contractions

(Llewellyn-Jones, 1994).

Everett (1975) reported an incidence of 3.4 % for cephalopelvic disproportion in Dar es Salaam, among 622 primigravidae.

Frame et al (1985) noted an incidence of 29 % for CPD, of 351 live singleton births, in a multiracial study in Paddington, London.

Aitken et al (1986), in a study in Sierra Leone, New Guinea, revealed an incidence of 7.1 % for CPD of 550 primigravidae.

Tadesse et al (1996) found an incidence of 29.2 % of cephalopelvic disproportion among 318 cases of caesarian section.

Liselele et al (2000) found in Zaire that 7.0 % of 605 deliveries by nulliparous women were complicated by CPD while the proportion of other complications were 2.5 %.
The study by Wadhawan et al (1982), of the obstetric problems in the adolescent Zambian mother in Lusaka, revealed a higher incidence of cephalopelvic disproportion in mothers aged 12 –15 years (3.6 %) compared to the group, aged 12 – 19 years (2 %).

Various factors that seemed to be responsible were pelvic immaturity contracted pelvis and good-sized babies (3000g).

A study in Ethiopia by Kumbi et al (1999), to investigate and compare the difference in pregnancy outcome in teenage pregnancies and pregnancy in an older age group revealed that the rate of CPD was higher in teenage mothers than their older counterparts. The study also showed that one out of five deliveries in teenagers were assisted either instrumentally or operatively.

2.5.2 CONTRACTED PELVIS

Contracted pelves are common among African patients especially those with a height of less than 152 cm. The pelvic contraction is usually greatest at the brim and it is here that most of the disproportion will occur (Guidelines for the management of the obstetric patient, 1997).

Contracted pelvis is a common cause of dystocia. In a contracted pelvis, one or more of the diameters in one or more planes are shorter than normal. The contraction may be at the brim of the pelvis, cavity or at the outlet, or the brim, cavity and the outlet may all be involved.

The contraction may be symmetrical or asymmetrical, thus causing several varieties of deformity. It is not possible to state definitely what constitutes a normal pelvis, as it depends on several factors and varies in different countries.
The two principal causes of pelvic deformity are errors of development, which include those due to nutritional and environmental factors in early life and those due to diseases of the pelvic bones. Pelvic deformities are also produced or aggravated by abnormalities in the spine or lower limbs.

A pelvis may be normal according to measurements but the fetal head may be too big for that pelvis. The result in labour is the same as in a contracted pelvis. Hence, in discussing diagnosis of contracted pelvis, diagnosis of cephalopelvic disproportion is included and it is customary to talk in terms of CPD rather than contracted pelvis.
(Mudaliar and Menon's Clinical Obstetrics)

The size and shape of the pelvis is related to general physique and is determined by both genetic and environmental factors. In several ethnic groups, short stature has been shown to be related to low socio-economic status. (WHO, 1965).

2.5.2 PELVIC MENSURATION

Although cephalopelvic disproportion cannot be detected until labour has been in progress for some time, it is useful to know beforehand whether or not to anticipate its presence.

Due to the shape of the contracted pelvis the true conjugate, or distance between the sacral promontory and the nearest point on the back of the pubic symphysis is smaller than the transverse diameter. This measurement cannot be made clinically but is generally related to the diagonal conjugate, which is the measurement between the sacral promontory and the under-surface of the pubic symphysis. The diagonal conjugate can be estimated with fair accuracy. When the measurement is 11.5 cm or less, it means there is a true conjugate of 10 cm. (true conjugate = diagonal conjugate minus 1.5 cm). Measurements of $\leq$ 10cm indicate a contracted pelvis (Guidelines for the management of the obstetric patient, 1997)

External pelvimetry of the brim to diagnose pelvic contraction was shown to be of poor accuracy in relation to the actual diameters and this method is now seldom employed. Internal pelvimetry by instruments was cumbersome and as the margin of error was not small is also seldom employed. Internal pelvimetry by vaginal examination is a valuable method of assessing pelvic capacity. The capacity of the pelvis at all levels is important and more information can be obtained by radiography i.e. X- ray pelvimetry. (Mudaliar and Menon).

Due to the possible oncogenic hazard of fetal irradiation Federle et al (1982), investigated the feasibility of replacing the conventional method of X-ray pelvimetry with low-dose digital radiographs (DR), generated on a computerized tomography scanner, (DR pelvimetry). Clinical studies of 10 patients confirmed the following: the correct interspinous distance was determined by cursor measurement on the first and only CT section obtained, the presentation and lie of the fetus were accurately depicted, including extension or flexion of the fetal head, measurements of AP and transverse diameters of

the maternal pelvis were easily made by cursor placement and that the average time required to obtain the digital radiographs and single axial section was 10 minutes, including positioning and viewing the scans. The authors concluded that due the fact that DR was fully competitive in cost with conventional pelvimetry and the risks of conventional pelvimetry, someday DR would replace conventional studies.

In 1987 Kitzmiller et al conducted a feasibility study of the use of computed tomography (CT) to measure the width of the fetal shoulders and to predict large birth weight in infants of diabetic mothers. Pelvimetry was performed according to the technique described by Federle et al (1982), on 25 insulin-treated diabetic women. The rationale for measuring the width of the fetal shoulders was to identify infants at risk for shoulder dystocia if vaginal delivery was attempted. Fetal shoulder width predicted by CT measurement correlated with direct postnatal measurements ($p = 0.01$). Using CT shoulder width measurement of more than 13 cm to predict birth weight above 4000 g obtained a sensitivity of 100 % and a specificity of 75 %. Using CT shoulder width measurement of more than 14 cm to predict birth weight above 4200 g yielded a sensitivity of 100 % and a specificity of 87 %. The authors suggest that a prospective clinical trial is needed to determine whether using these measurements would help reduce the risk of shoulder dystocia in infants of diabetic mothers of moderate and large weight.

Bauer et al (1988) prospectively analyzed pelvic assessment in 201 primigravidae, during the third trimester to detect patients likely to suffer from cephalopelvic disproportion. If the sacral promontory (SP) was reached by the index finger (9.0 –9.5 cm true conjugate) the pelvis was regarded as "suspect". The patients were divided into three groups: (1) SP not reached; (2) SP just reached; (3) SP easily reached. There was no difference in the rate of caesarian section between the controls and the patients who had been followed antenatally. However, a vast difference was noted in the rate of caesarian section among the patients followed depending on pelvic findings (0% for normal pelvis, 15% for those in whom the SP was just reached, and 56% among the women whose SP was palpated easily. The authors suggest that mutual pelvic assessment, i.e. trying to reach the SP with the examiner's index finger, has the potential to detect CPD in all women and believe that

it, is a simple method associated with a high sensitivity and a very high specificity to detect patients at risk for CPD, that would reduce fetal and maternal mortality as well as reduce costs in health care facilities.

Liselele et al (2000) conducted a study to assess external pelvimetry and maternal height as predictors of cephalopelvic disproportion in Zaire. Maternal height < 150 cm and values closest to the 10^{th} percentile of the population for pelvic distances was used as cut off to identify women at risk for cephalopelvic disproportion. A Breisky pelvimeter was used for external pelvic measurements. They found in addition to height, the intertrochanteric diameter and transverse diagonal measurement to be the best predictor of CPD in nulliparous women.

2.5.3 PREDICTORS OF CEPHALOPELVIC DISPROPORTION

Bernard (1952) carried out a prospective study on two groups of pregnant women, in Scotland. The one group over 164 cm in height, did not experience any difficulties in labour related to cephalopelvic disproportion, while the other group, under 151 cm in height experienced major difficulties. Radiological pelvimetry confirmed diminished size and showed flattening of the pelvic brim in the group of short women.

Everett (1975), in Dar es Salaam, studied the mean height of pregnant women to determine if short stature was related to cephalopelvic disproportion. Of the 622 primigravidae, the mean height was 148.5 cm. The group that had a caesarean section for cephalopelvic disproportion was studied separately and the mean height amongst this group was 141 cm and the mean birthweight was 3050 g.

Frame et al (1985) studied a total of 351 women to assess maternal height and shoe size as predictors of pelvic disproportion. The population included substantial proportions of several racial groups. (European, Mediterranean, Black African, Indo-Pakistani, Oriental). For each racial group, women in the smallest shoe size group had the highest proportion of caesarean sections. This study demonstrated the interrelated importance of shoe size and birthweight. Most of the various measures of pelvic adequacy showed a statistically significant relation with foot size. The authors concluded that shoe size alone could not be considered as a sensitive indicator of pelvic inadequacy and that the smaller the shoe size, the greater the likelihood of a caesarean section, with a relative risk of 8.6 in a woman with shoe size <4.5 compared with a woman with shoe size >6.

Cephalopelvic disproportion resulting in obstructed labour is a major cause of maternal and perinatal mortality and morbidity in Sierra Leone, New Guinea. Aitken et al (1986) studied the relationship between the height of primigravidae and the need for caesarean section for cephalopelvic disproportion. 550 primigravidae who delivered in Sierra Leone, were analyzed to determine the level of maternal height that would most efficiently screen women for high risk of cephalopelvic disproportion. A height of 152,4

was chosen as it identified 84.6 % of the women who would get CPD, the specificity was greater (45%) and would select 55 % normals. The authors suggested antenatal pelvic assessment by a doctor as an additional screening method.

Due to the increase in the rates of delivery by caesarian section, Tadesse et al (1996), conducted a prospective hospital-based study, in Ethiopia, to obtain base-line data on the rates of caesarian section, pregnancy out-come, major indications for caesarian section and caesarian section complications. They reported that due to the high incidence of CPD, the chance of repeat caesarian was statistically significant with a chi-square of 22.79 and a P value of < 0.001.

Harrison et al (1985) investigated the growth during pregnancy in Nigerian teenage primigravidae. They found that teenage primigravidae continue to grow taller during pregnancy and that during the natural course of their pregnancies there is a link between nutritional supplementation and maternal skeletal growth. The authors concluded that, in teenage girls maternal height should not be used to predict obstetric performance in the same way as is customarily done for pregnant women who have finished growing.

Another factor investigated by Boer et al (1997), was the effect of growth hormone deficiency during childhood on reproduction. 60 women who were treated for growth hormone deficiency during childhood or adolescence were followed up. Five out of ten completed pregnancies resulted in caesarian section because of cephalopelvic disproportion or arrest of labour. From this study it was concluded that disturbances in reproductive function could be expected in women treated for growth hormone deficiency during childhood.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 RESEARCH DESIGN

Based on the literature review a retrospective case-control design was used to examine the perinatal database for all cases of obstetric brachial plexus palsies, cephalopelvic disproportion and fetal macrosomia, post delivery from January 1997 to December 2000.

The design was chosen on the basis that OBPP is a condition that has multi-factorial associated risks and would provide an opportunity to study the influence of various modifiers of the exposure-disease relationship. It also provides an effective means for evaluating confounding and interaction of variables, as well as allowing some flexibility. (Mausner &Kramer, 1985).

3.2 STUDY SITES

The sample was drawn from Addington (ADDH), King Edward VIII (KEH), Prince Mshiyeni Memorial (PMMH) and R K Khan (RKKH) hospital, situated in Durban, Kwazulu- Natal. These provincial hospitals serve the Durban Metropolitan area as well as out-lying areas. King Edward VIII hospital, at the time of the study was a tertiary academic hospital, and the obstetric unit served as a referral centre for the community obstetric programme and various district and regional hospitals.

The following hospitals could not be included in the study as permission to access patient files was denied: St. Aidens Mission hospital, St Augustines hospital and Parklands hospital.

3.3 SUBJECTS AND SAMPLE SIZE

OBPP CASES

All cases of obstetric brachial plexus palsy (OBPP) diagnosed at the study sites between the years 1997 to 2000 were included the study. A total of 63 cases were analyzed. (20 from Addington hospital, 20 from King Edward VIII hospital, and 18 from R K Khan hospital). The 5 cases from Prince Mshiyeni Memorial hospital were born during the period 01/04/1997 to 30/11/1997.

CONTROLS

A total of 80 controls of cephalopelvic disproportion (CPD) were drawn from the four study sites.i.e. 20 from each site.

A total of 80 controls of macrosomic infants ($\geq$4000 g) was drawn from the four study sites.i.e. 20 from each site.

A total of 80 controls of normal infants were drawn from the four study sites.i.e. 20 from each site.

In the normal control group 49 of 80 cases were excluded as these patients had pre-existing maternal risk factors for OBPP.

3.4 METHOD OF DATA COLLECTION

Data was collected over a period of seven months and involved the completion of a data sheet. The author collected all the data. The birth register (grandfather register) for the years 1997 to 2000 was consulted at each study site, which was, obtained from the medical registry or from the labour ward. This database was consulted for cases of OBPP, CPD, macrosomia as well as the normal infants. The birth register is record of all births at that hospital and both maternal and neonatal information is recorded including details regarding labour and delivery. The file numbers for the control and OBPP cases were recorded from this register and the case history files for both neonate and mother were obtained.

Both the maternal and neonatal case history file was then reviewed for the above cases and controls. All antepartum and intrapartum characteristics as well as antenatal tests and investigation results were recorded on a data sheet.

This process was followed for all 4 study sites. However, at Prince Mshiyeni Memorial Hospital, unlike the other study sites if a neonate sustains any injuries at birth, the neonate is transferred to nursery for further examination or management. The birth register at PMMH did not record details regarding the type of birth injury sustained.

Those infants with OBPP could only be traced via the register at the neonatal nursery, which was available for the period 01/04/1997 to 30/11/1997. The rest of the registers were mislaid and or did not carry diagnoses of OBPP.

3.5 INSTRUMENTATION

Data sheets were developed by the author in order to screen for demographic data and risk factors. The questionnaire was based on information usually completed in the Kwazulu-Natal Provincial Administration antenatal examination record and maternity case record (which includes record of delivery).

The demographic data included were age, race, marital status, employment and residential status. Risk factors were divided into obstetric and paediatric factors. Obstetric factors included antenatal history (including physical characteristics), antepartum and intrapartum characteristics. Pediatric factors included physical characteristics, Apgar scores and condition post delivery. (see Appendix 1).

3.6 DATA ANALYSIS

The data was analyzed using the statistical package for the social sciences (SPSS), for windows and with the assistance of Ms. I. Naidoo, department of Information Technology, University of Durban-Westville and Ms. C. Connolly, department of Biostatistics, Medical Research Council. (Statisticians)

3.7 ETHICAL CONSIDERATIONS

The study was carried out under the following conditions:

3.7.1 Ethical clearance was obtained from the University of Durban-Westville.

3.7.2 Permission to access patient records was granted by the chief medical superintendent of Addington, King Edward VIII, Prince Mshiyeni Memorial and R K Khan hospitals.

3.7.3 Ethical clearance was obtained from the University of Natal –Medical School.

3.8. LIMITATIONS OF THE STUDY

3.8.1 RECORD KEEPING

Addington hospital had kept a meticulous set of records until December 1998. The format of the birth register changed and most diagnoses as well as other obstetrical information were omitted. Owing to this problem, calculation of the incidence of CPD and Macrosomia was limited to the years 1997 and 1998.

At PMMH the nursery registers for the period January 1997 to March 1997 and from November 1997 to December 2000 could not be traced either at the nursery or at the medical registry and this accounts for the low number of OBPP cases at this hospital.

3.8.2 DESTRUCTION OF MEDICAL RECORDS

The period of study was dictated by the fact that records at King Edward VIII hospital and R K Khan hospital can be accessed for a period of 4 years from the date of the proposed study, thereafter due to a lack of adequate archival storage space the records are destroyed, through recycling. However at R K Khan hospital medical records for 1997 were accidentally destroyed. Hence 8 cases had incomplete information. Data for those 8

cases were obtained from the grandfather register that had most of the obstetric information but lacked the antenatal examination details. At KEH one of the cases could not be analyzed completely as the maternal case history file dated back to 1993, and was destroyed, 3 other cases could not be included in the study. (files were destroyed for 2 cases and 1 case could not be traced.)

CHAPTER FOUR

RESULTS

4.1 STUDY SAMPLE

4.1.1 TOTAL SAMPLE

The total sample for this study included:

a) The total number of deliveries for the years 1997 to 2000, inclusive, at Addington, King Edward VIII and RK Khan hospitals.

Table 1: TOTAL NUMBER OF DELIVERIES FOR ADDH, KEH & RKKH. (1997 –2000)

HOSPITALS		TOTAL NO. OF DELIVERIES
ADDH		24 391
KEH		30 399
PMMH		45 128
RKKH		17 231
TOTAL		121 480

Key: ADDH – Addington Hospital
KEH – King Edward VIII Hospital
RKKH – R K Khan Hospital
PMMH – Prince Mshiyeni Memorial Hospital

4.1.2 CONTROL GROUP SAMPLE

The control group comprised of 141 cases. This group consisted of the following:

TABLE 2: NUMBER OF PATIENTS IN THE CONTROL GROUPS

Controls	Frequency	Percent
Normal	21	14.9
Macrosomic	60	42.55
CPD	60	42.55
Total	141	100

Key: CPD – Cephalopelvic Disproportion

The control group comprised of the following:

The normal group consisted of infants that were less than 3500g and the mothers that did not present with any antenatal, maternal risk factors.

The big baby or macrosomic group consisted of infants that were greater than 3500g or were diagnosed as a macrosomic baby.

The cephalopelvic disproportion (CPD) group consisted of those women who were diagnosed clinically with CPD either intrapartum or post-delivery.

4.1.4 SAMPLE GROUP AT PMMH (for the period 01/04/1997 to 30/11/1997)

The number of deliveries, controls and cases of OBPP at PMMH are as follows:

TABLE 4: NUMBER OF DELIVERIES AND CASES AT PMMH (01/04/1997 – 30/11/1997)

PMMH	CASES
DELIVERIES	8791
CONTROL -NORMAL	10
CONTROL - CPD	20
CONTROL - MACROSOMIA	20
OBPP	5

Key: PMMH – Prince Mshiyeni Hospital

The statistics for the OBPP group at PMMH is presently separately because; data for a 7-month period cannot be compared to data from other hospitals, which was over a 4-year period.

The incidence of OBPP at PMMH is 0.057% or 0.57 per 1000 deliveries for the period 01/04/1997 to 30/11/1997.

4.1.3 SAMPLE SELECTED TO CALCULATE INCIDENCE OF CPD AND MACROSOMIA

The total number of deliveries for the period 1997 to 1998, at the 4 study sites was reviewed for cases of CPD and macrosomia. The years were chosen due to availability of complete records. The years 1999 and 2000 could not be included as the format of the birth register changed at Addington Hospital and the diagnosis of CPD was missing.

Total number of deliveries, cases of macrosomia and CPD at each hospital for the years 1997 to 1998 are as follows:

Table 5: TOTAL NUMBER OF DELIVERIES AND CASES OF MACROSOMIA AND CPD AT THE STUDY SITES (1997-1998).*

HOSPITAL	TOTAL NO.OF DELIVERIES	NO. OF CASES WITH CPD (%)	NO. OF CASES WITH MACROSOMIA (%)
ADDH	10300	525 (5.097)	184(1.786)
KEH	18 966	834(4.397)	403(2.125)
PMMH	24 512	477(1.946)	309(1.261)
RKKH	7 935	229(2.886)	137(1.727)
TOTAL	61 713	2065(3.35)	1033(1.67)

Key: OBPP – Obstetrical Brachial Plexus Palsy
ADDH – Addington Hospital
KEH – King Edward VIII Hospital
PMMH – Prince Mshiyeni Memorial Hospital
RKKH – R K Khan Hospital
% - incidence per hospital

* The data for the above period are complete records. (i.e. no missing information)

The overall incidence of CPD, for the 2-year period, is 3.35 % or 33.5 per 1000 deliveries.

The hospital with the highest incidence of CPD is ADDH, 5.097% or 50.97 per 1000 deliveries. KEH had an incidence of 4.397 % or 43.97 per 1000 deliveries. RKKH had an incidence of 2.886 % or 28.86 per 1000 deliveries and PMMH had an incidence of 1.946 % or 19.46 per 1000 deliveries.

The overall incidence of macrosomia, for the 2 year period is 1.67 % or 16.7 per 1000 deliveries.

The hospital with the highest incidence of macrosomia is KEH with an incidence of 2.125 % or 21.25 per 1000 deliveries. ADDH had an incidence of 1.786 % or 17.86 per 1000 deliveries. RKKH had an incidence of 1.727 % or 17.27 per 1000 deliveries. PMMH had an incidence of 1.261 % or 12.61 per 1000 deliveries.

4.1.4 SAMPLE GROUP OF DELIVERIES AND THE INCIDENCE OF OBPP

TABLE 6: INCIDENCE OF OBPP

HOSPITAL	No. of OBPP cases	Total no. of deliveries	incidence per hospital	Overall incidence
ADDH	20	24 391	0.82	0.25
KEH	23	30 399	0.76	0.32
RKKH	18	17 231	1.04	0.22
TOTAL	61	72 021		0.85

Key: incidence = per 1000 deliveries

OBPP – Obstetrical Brachial Plexus Palsy

ADDH – Addington Hospital

KEH – King Edward VIII Hospital

RKKH – R K Khan Hospital

The overall incidence of OBPP is 0.85 per 1000 deliveries.

RK Khan hospital had the highest incidence of OBPP among the hospitals, 0.104 % or 1.04 per 1000 deliveries (18 / 17231). Addington hospital had an incidence of 0.08% or 0.8 per 1000 deliveries (20 / 24391). King Edward VIII hospital had an incidence of 0.76 % or 0.76 per 1000 deliveries (23/30 399).

Table 6, indicates that the total number of OBPP cases at KEH was 23. Of the 23 cases, 16 were traced via the Medical Registry and 7 cases via the Brachial Plexus Clinic. The brachial plexus clinic data, at the physiotherapy department in KEH, revealed a total of 48 cases of OBPP, from 1997 to 2000.

TABLE 7: AREAS OF REFERRAL FOR OBPP CASES AT THE BRACHIAL PLEXUS CLINIC (KEH).

HOSPITALS / CLINICS	No. of OBPP cases
KEH	11
RKKH	5
PMMH	3
St. MARY'S HOSPITAL	3
PHOENIX COMMUNITY H.C.	3
MOSVOLD HOSPITAL	3
EMPANGENI HOSPITAL	3
MAHATMA GANDHI M.H.	2
KWA MASHU POLY CLINIC	2
STANGER HOSPITAL	2
KOKSTAD HOSPITAL	1
KWA DABEKA CLINIC	1
NTUZUMA CLINIC	1
NKANDLA HOSPITAL	1
CZEZA	1
GREY'S HOSPITAL	1
PIETERSBURG HOSPITAL	1
FABANTO HOSPITAL	1
ST. BENEDICTINE HOSPITAL	1
IXOPO HOSPITAL	1
FLAGSTAFF HOSPITAL	1
TOTAL	48

Key: KEH – King Edward VIII hospital

RKKH – RK Khans Hospital

PMMH – Prince Mshiyeni Memorial Hospital

H.C. - Health Clinic

With reference to Table 7, the 48 cases of OBPP were referred from the areas as indicated. Of the 48 cases 11 cases born at KEH, of which 7 cases were not diagnosed at birth.

The 5 cases from RKKH were included in the study. Of the 3 from PMMH only 2 were included in the study for analysis. The 1 case was born in the year 2000 and not included in the study for reasons explained earlier.

4.2 DEMOGRAPHICS

The area of residence for the total sample was depicted according to the Durban Unicity's demarcation of the boundaries and classification of the Durban Metropolitan Area (DMA).

TABLE 8: REGION OF RESIDENCE

			CONTROLS AND OBPP CASES				
			Normal	macroso-mic	CPD	OBPP	Total
REGION OF RESIDENCE	SOUTH OF DURBAN	Count	17	28	37	17	99
		% within GROUP	54.8%	35.0%	46.3%	27.4%	39.1%
		% of Total	6.7%	11.1%	14.6%	6.7%	39.1%
	NORTH OF DURBAN	Count	3	17	13	21	54
		% within GROUP	9.7%	21.3%	16.3%	33.9%	21.3%
		% of Total	1.2%	6.7%	5.1%	8.3%	21.3%
	WEST OF DURBAN	Count	4	16	11	11	42
		% within GROUP	12.9%	20.0%	13.8%	17.7%	16.6%
		% of Total	1.6%	6.3%	4.3%	4.3%	16.6%
	CENTRAL DURBAN	Count	5	17	19	11	52
		% within GROUP	16.1%	21.3%	23.8%	17.7%	20.6%
		% of Total	2.0%	6.7%	7.5%	4.3%	20.6%
	OUT OF KZN	Count	2	2		2	6
		% within GROUP	6.5%	2.5%		3.2%	2.4%
		% of Total	.8%	.8%		.8%	2.4%
Total		Count	31	80	80	62	253
		% within GROUP	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	12.3%	31.6%	31.6%	24.5%	100.0%

Key: OBPP – Obstetric Brachial Plexus Palsy
CPD – Cephalopelvic Disproportion
KZN – KwaZulu Natal

The total sample includes the cases and controls (n =254), of which 39.1% resided in the southern region, 21.3% in the northern regions, 20.6% resided in the central region of the DMA, while 16.6 % resided west of Durban and 2.4 % were from the outlying areas e.g. Transkei. 1 case did not any information regarding the place of residence.

35% of the controls with macrosomia were from the southern region of the DMA while 21.3% each from the central and northern region of the DMA. There were 20% from the region west of Durban and 2.5 % from the outlying regions.

Among the CPD controls, the majority (46.3%) resided in southern region of the DMA and 23.8% in the central region. There were 16.3 % from the northern region and 13.8 % from the region west of Durban.

For the OBPP group it was found that 33.9% were from the northern region of the DMA and 27.4 % from the southern region of the DMA. There were 17.7 % each that resided in the western and central regions of the DMA. There 3.2 % residing in regions out of KwaZulu-Natal and 1 case did not have an address recorded.

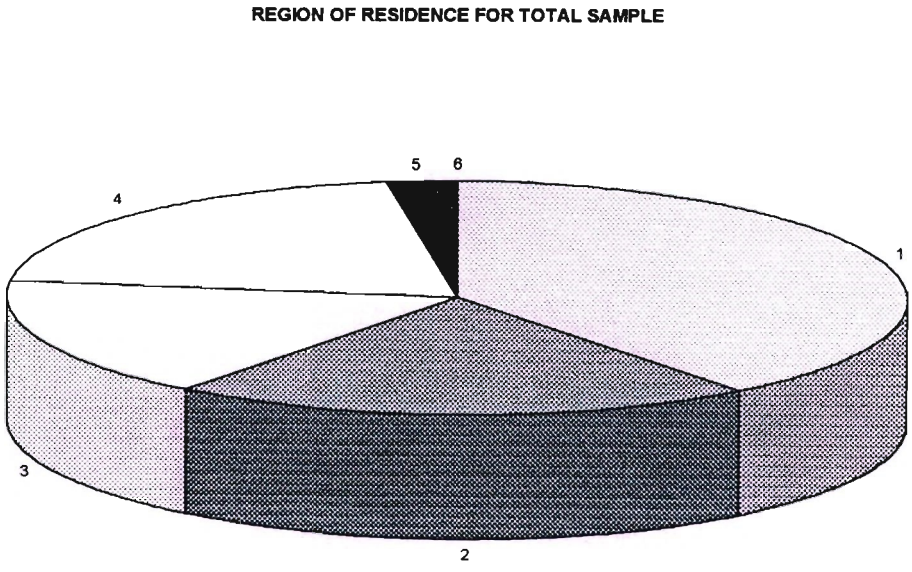


FIGURE 2: REGION OF RESIDENCE FOR TOTAL SAMPLE

TABLE 9: RACIAL DISTRIBUTION

			control and OBPP groups		
			CONTROL groups	OBPP group	Total
RACE	AFRICAN	Count	176	46	222
		% within CONTROL & OBPP GRPS	92.1%	73.0%	87.4%
		% of Total	69.3%	18.1%	87.4%
	INDIAN	Count	11	14	25
		% within CONTROL & OBPP GRPS	5.8%	22.2%	9.8%
		% of Total	4.3%	5.5%	9.8%
	COLOUREDS	Count	4	3	7
		% within CONTROL & OBPP GRPS	2.1%	4.8%	2.8%
		% of Total	1.6%	1.2%	2.8%
Total		Count	191	63	254
		% within CONTROL & OBPP GRPS	100.0%	100.0%	100.0%
		% of Total	75.2%	24.8%	100.0%

Key: OBPP - Obstetric brachial Plexus Palsy

CPD - Cephalopelvic disproportion

The majority of the population, 87.4% were South African Blacks, 9.8% South African Indians and 2.8% Coloureds. The percentage of OBPP among the Africans was 73%, 22.2 % among the Indians and 4.8 % among Coloureds. The chi-square test for this crosstabulation was significant with a p value of 0.000.

TABLE 10: MATERNAL HEIGHT COMPARED TO THE CONTROL AND CASES.

			CONTROL & OBPP GROUPS		
			CONTROL group	OBPP group	Total
MATERNAL HEIGHT	< =150 cm	Count		8	8
		% within CONTROL & OBPP GRP		34.8%	10.0%
		% of Total		10.0%	10.0%
	> 150 cm	Count	57	15	72
		% within CONTROL & OBPP GRP	100.0%	65.2%	90.0%
		% of Total	71.3%	18.8%	90.0%
Total		Count	57	23	80
		% within CONTROL & OBPP GRP	100.0%	100.0%	100.0%
		% of Total	71.3%	28.8%	100.0%

Key: OBPP- Obstetrical Brachial Plexus Palsy

Maternal heights were documented in 40% (80/199) of the antenatal charts. In the OBPP group 39.7% (23/58) recorded the maternal height antenatally.

Of those recorded, 90% (72/80) were >150 cm in height and 10% (8/80) were ≤ 150 cm. Among the OBPP group 65.2% (15/23) were greater than 150 cm and 34.8 % (8/23) were ≤ 150 cm. This was statistically significant with both the Pearson chi square and the Fisher's exact tests (p= 0.000).

TABLE 11: AGE CATEGORIES FOR THE CONTROL AND OBPP GROUPS

			CONTROL AND OBPP GROUPS		
			CONTROL group	OBPP group	Total
age categories	14 -19 years	Count	14	6	20
		% within age categories	70.0%	30.0%	100.0%
		% within CONTROL & OBPP GRP	10.1%	12.2%	10.6%
		% of Total	7.4%	3.2%	10.6%
	20 - 30 years	Count	80	18	98
		% within age categories	81.6%	18.4%	100.0%
		% within CONTROL & OBPP GRP	57.6%	36.7%	52.1%
		% of Total	42.6%	9.6%	52.1%
	31 - 38 years	Count	40	21	61
		% within age categories	65.6%	34.4%	100.0%
		% within CONTROL & OBPP GRP	28.8%	42.9%	32.4%
		% of Total	21.3%	11.2%	32.4%
	> 38 years	Count	5	4	9
		% within age categories	55.6%	44.4%	100.0%
		% within CONTROL & OBPP GRP	3.6%	8.2%	4.8%
		% of Total	2.7%	2.1%	4.8%
Total		Count	139	49	188
		% within age categories	73.9%	26.1%	100.0%
		% within CONTROL & OBPP GRP	100.0%	100.0%	100.0%
		% of Total	73.9%	26.1%	100.0%

Key: OBPP – Obstetrical Brachial Plexus Palsy

N.B. This table does not include those cases from PMMH.

Maternal age ranged from 14 years to 48 years for the total sample and from 21 years to 30 years for the normal control group. (See annexure) The majority of the mothers (52.1%) ranged between 20 to 30 years of age, 32.4 % were between 31 and 38 years, 10.6 % were between 14 to 19 years and 4.8 % were > 38 years of age.

Among the OBPP group the majority, 42.9% (n=21), were between 31 to 38 years of age, 36.7% were between 20 to 30 years, 12.2% were between 14 to 19 years and 8.2% were > 38 years of age.

Among the control group at PMMH 64% (32/50) were between 20 to 30 years, 18 % (9/50) were between 14 to 19 years, 16% (8/50) were between 31 to 38 years and 2 %(1/50) were > 38 years of age.
Within the OBPP group, at PMMH, 3 cases (60%) were between 20 to 30 years of age, 1 case was between 31 to 38 years and 1 case was > 38 years.

TABLE 12: MEANS FOR MATERNAL AGE

MATERNAL AGE

GROUP	Mean	N	Std. Deviation	Minimum	Maximum	Range
Normal	25.4286	21	2.8385	21.00	30.00	9.00
Macroso -mic	29.8814	59	6.2920	18.00	43.00	25.00
CPD	26.0169	59	6.3802	14.00	40.00	26.00
OBPP	29.1429	49	7.5443	16.00	47.00	31.00
Total	27.9787	188	6.6195	14.00	47.00	33.00

Key: OBPP – Obstetrical Brachial Plexus Palsy
CPD – Cephalopelvic disproportion

The mean maternal age for the normal control group was 25.4 years. The standard deviation being 2.8. The mean maternal age for the macrosomic group was 29.9 years and for the CPD group was 26 years.

The mean maternal age for the OBPP group was 29.1 years, with the minimum age being 16 and the maximum age being 47 years.
The mean maternal age for the sample group at PMMH was 25.36 years. The mean maternal for the OBPP group was 29.4 years, with a minimum of 24 and a maximum of 39 years.

Regarding the marital status of the women whose babies were diagnosed with OBPP. It was found that 59.6% of the women were single or single parents, 36.8% were married and 3.5% were divorced.

4.3 CLASSIFICATION OF BIRTH INJURY AND ASSOCIATED INJURIES.

TABLE 13: BIRTH INJURIES IN BOTH CONTROLS AND CASES

			CONTROLS AND OBPP CASES				
			Normal	Big baby	CPD	OBPP	Total
BIRTH INJURIES	YES	Count		1		58	59
		% within BIRTH INJURIES		1.7%		98.3%	100.0%
		% of Total		.5%		29.3%	29.8%
	NO	Count	21	59	59		139
		% within BIRTH INJURIES	15.1%	42.4%	42.4%		100.0%
		% of Total	10.6%	29.8%	29.8%		70.2%
Total		Count	21	60	59	58	198
		% within BIRTH INJURIES	10.6%	30.3%	29.8%	29.3%	100.0%
		% of Total	10.6%	30.3%	29.8%	29.3%	100.0%

Key: OBPP – Obstetrical Brachial Plexus Palsy
CPD – Cephalopelvic Disproportion

Of the sample group (excl. PMMH) 29.4 % (58/197) had sustained birth injuries while 70.6% did not sustain any injuries. Of the 29.4%, 98.3 % (58/59) sustained OBPP injuries at birth and 1.7% (1/58), from the macrosomic group at KEH sustained a cephalohaematoma. The comparison of birth injuries was statistically significant using the Pearson chi square test (p= 0.000). It was found that 2 patients did not have any written record of birth injuries, 1 from the CPD group and 1 from the OBPP group, this was regarded as missing information.

At PMMH, there were 5 cases that sustained OBPP injuries only.

TABLE 14: DIAGNOSIS & DESCRIPTION OF BIRTH INJURIES IN THE OBPP GROUP

			GROUP	
			OBPP	Total
DESCRIPTION OF BIRTH INJURY	ERB'S	Count	14	14
		% of Total	24.1%	24.1%
	BRACHIAL PLEXUS INJURY	Count	37	37
		% of Total	63.8%	63.8%
	DIAGNOSIS MISSED	Count	5	5
		% of Total	8.6%	8.6%
	BRACHIAL PLEXUS INJURY & OTHER BIRTH INJURIES	Count	2	2
		% of Total	3.4%	3.4%
Total		Count	58	58
		% of Total	100.0%	100.0%

Key: OBPP – Obstetrical Brachial Plexus Palsy

Of the 58 cases of OBPP 24.1% had a diagnosis of Erb's palsy. Of the 63.8 % that were diagnosed as brachial plexus palsy without localizing the lesion. The diagnosis was missed in 8.6% of the cases, i.e. 3 cases at KEH and 2 cases at ADDH. Within those cases that sustained additional birth injuries, 1 case at ADDH sustained a fracture to the left humerus and 1 case at RKKH sustained a cephalohaematoma.

Among the sample at PMMH none of the infants in the control groups, sustained any additional birth injuries. Within the OBPP group, 1 case was diagnosed with a fracture to the left humerus and another case was diagnosed with a fracture to the right humerus as well soft tissue damage to the right hand.

4.4 ANTE-NATAL & INTRA PARTUM RISK FACTORS

TABLE 15: ANTENATAL HISTORY FOR OBPP GROUP

			OBPP group	Total
ANC HISTORY	UNBOOKED	Count	7	7
		% within CONTROL & OBPP GROUPS	15.6%	15.6%
		% of Total	15.6%	15.6%
	POOR	Count	9	9
		% within CONTROL & OBPP GROUPS	20.0%	20.0%
		% of Total	20.0%	20.0%
	GOOD	Count	29	29
		% within CONTROL & OBPP GROUPS	64.4%	64.4%
		% of Total	64.4%	64.4%
Total		Count	45	45
		% within CONTROL & OBPP GROUPS	100.0%	100.0%
		% of Total	100.0%	100.0%

Key: OBPP – Obstetric Brachial Plexus Palsy
CPD – Cephalopelvic Disproportion

Information regarding record of attendance, at an antenatal clinic was available for 77.6 % (45/58) of the OBPP cases. This factor was missing in 22.4 % of the cases. Of those cases that attended a clinic, 64.4 % had a record of good attendance (>5 visits), 20 % had a record of poor attendance and 15.6% were unbooked patients.

At PMMH, for the OBPP group, 3 cases had a good record of antenatal attendance and 1case a poor record. File notes were missing regarding 1 case.

TABLE 16: RECORDING OF RISK FACTORS FOR BOTH CONTROL & OBPP GROUP.

			CONTROL AND OBPP GROUPS		
			CONTROL group	OBPP group	Total
RISK FACTORS	CPD	Count	56	2	58
		% within CONTROL & OBPP GROUPS	70.0%	5.9%	50.9%
		% of Total	49.1%	1.8%	50.9%
	MACRO-SOMIA	Count	14	2	16
		% within CONTROL & OBPP GROUPS	17.5%	5.9%	14.0%
		% of Total	12.3%	1.8%	14.0%
	OTHER RISK FACTORS	Count	10	12	22
		% within CONTROL & OBPP GROUPS	12.5%	35.3%	19.3%
		% of Total	8.8%	10.5%	19.3%
	NONE	Count		18	18
		% within CONTROL & OBPP GROUPS		52.9%	15.8%
		% of Total		15.8%	15.8%
Total		Count	80	34	114
		% within CONTROL & OBPP GROUPS	100.0%	100.0%	100.0%
		% of Total	70.2%	29.8%	100.0%

Key: OBPP – Obstetric Brachial Plexus Palsy

CPD – Cephalopelvic Disproportion

Table 16 indicates that 50.9% (58/114) had CPD recorded as a risk factor. Macrosomia was considered a risk factor 14% (16/114) of the sample group and 19.3% had other risk factors recorded.

Among the control group the other risk factors included eclampsia, asthma, diabetes, previous caesarian section, previous home deliveries and fetal distress.

Among the OBPP cases the other risk factors included were breech, multiparity, unbooked case and grandmultiparity. Some of the risk factors recorded in the notes of the OBPP cases, that were not risk factors for OBPP included pregnancy induced hypertension and family history of epilepsy.
There was a significant number of cases 52.9 % (18/54) that did not record any risk factors for OBPP among the OBPP group. (p=0.000).

For the OBPP group at PMMH, 2 of the 5 cases recorded macrosomia as a risk factor, 1 case recorded a transverse lie of the fetus as a risk factor and 2 did not record any risk factors.

There was a low frequency of diabetics in this study. There were 4.2 % diabetics among the controls and 5.4 % among the OBPP cases, which was not statistically significant.

TABLE 17: GRAVIDITY AMONG CONTROL AND OBPP GROUPS

			CONTROL & OBPP GROUPS		
			CONTROL group	OBPP group	Total
gravidity categories	gravida 1-4	Count	74	21	95
		% within CONTROL & OBPP GROUPS	52.5%	43.8%	50.3%
		% of Total	39.2%	11.1%	50.3%
	gravida >4	Count	67	27	94
		% within CONTROL & OBPP GROUPS	47.5%	56.3%	49.7%
		% of Total	35.4%	14.3%	49.7%
Total		Count	141	48	189
		% within CONTROL & OBPP GROUPS	100.0%	100.0%	100.0%
		% of Total	74.6%	25.4%	100.0%

Key: OBPP – Obstetric Brachial Plexus Palsy

The majority (52.5% or n=74) of the control group had a gravidity of between 1 to 4 and 47.5% had more than 4 pregnancies.

For the OBPP group the majority (56.3%, n= 27) had a gravidity of >4 and 43.8 % had between 1 to 4 pregnancies.

A report of the means of each control group revealed that the mean gravidity for the normal and CPD group was 2. The mean gravidity for the OBPP and macrosomic group was 3. This group also had a maximum of 8 for the macrosomic infants and 9 for the OBPP infants. The normal and CPD group had a maximum of 3 and 7 respectively. (see annexure 2)

At PMMH, gravidity ranged between 1 and 5 for the control group and ranged between 1 and 7 for the OBPP group. 4 cases of the OBPP group had a gravida of ≤ 3 and 1 case >5.

TABLE 18: AGE AND GRAVIDITY FOR CONTROL & OBPP GROUPS

			gravidity categories		
			gravida < 5	gravida >4	Total
age categories	14 -19 years	Count	20		20
		% within age categories	100.0%		100.0%
		% of Total	10.9%		10.9%
	20 - 30 years	Count	64	31	95
		% within age categories	67.4%	32.6%	100.0%
		% of Total	35.0%	16.9%	51.9%
	31 - 38 years	Count	9	50	59
		% within age categories	15.3%	84.7%	100.0%
		% of Total	4.9%	27.3%	32.2%
	> 38 years	Count		9	9
		% within age categories		100.0%	100.0%
		% of Total		4.9%	4.9%
Total		Count	93	90	183
		% within age categories	50.8%	49.2%	100.0%
		% of Total	50.8%	49.2%	100.0%

Crosstabulation of maternal age and gravidity showed that 51.9% (95/183) were between 20 to30 years of age, 32.2% (59/183) were between 31 to38 years, 10.9% (20/183) were between 14 to 19 years and 4.9% (9/183) were older than 38 years. For the category 20 to 30 years 67.4% of the women had a gravida between 1 and 4. In the category 31 to 38 years 84.7% of this group had more than 4 pregnancies. All those cases in the older than 38 years had a gravidity of >4.

Among the OBPP group 38.6% (17/44) were between 31 to 38 years of age and had a gravidity of >4, 27.3% (12/44) were between 20 to 30 years with a gravidity of $\leq$ 4, 13.6% were between 14 to 19 years and had a gravidity of $\leq$ 4. 6.8% were between 20 to 30 years and had a gravidity of >4 and 4.5% were between 31 to 38 years and had a gravidity of $\leq$ 4.

TABLE 19: PARITY FOR CONTROL AND OBPP GROUPS

			CONTROL & OBPP GROUPS		
			CONTROL group	OBPP group	Total
parity categaries	primigravid	Count	41	11	52
		% within CONTROL & OBPP GROUPS	29.1%	22.4%	27.4%
		% of Total	21.6%	5.8%	27.4%
	parity 1-2	Count	66	25	91
		% within CONTROL & OBPP GROUPS	46.8%	51.0%	47.9%
		% of Total	34.7%	13.2%	47.9%
	parity 3-7	Count	34	13	47
		% within CONTROL & OBPP GROUPS	24.1%	26.5%	24.7%
		% of Total	17.9%	6.8%	24.7%
Total		Count	141	49	190
		% within CONTROL & OBPP GROUPS	100.0%	100.0%	100.0%
		% of Total	74.2%	25.8%	100.0%

Key: OBPP – Obstetrical Brachial Plexus Palsy

The majority (46.8 % or 66/141) of the control group had a parity of between 1to 2, 29.1% (41/141) were primigravids and 24.2% (34/141) has a parity of 3 to 7.

The majority (51% or 25/49) of the OBPP group had a parity of 1to2, 26.5% (13/49) had a parity of 3 to 7 and 22.4% (11/49) were primigravids.

For the sample at PMMH, parity ranged from 0 to a parity of 6. In the OBPP group 4 cases had a parity of 1-2 and 1 case parity of 6.

TABLE 20: DESCRIPTION OF PARITY IN ALL GROUPS

PARITY

GROUP	Mean	N	Std. Deviation	Minimum	Maximum	Range
Normal	.9524	21	.8646	PRIMIG RAVID	2.00	2.00
macroso-mic	2.2333	60	1.4999	PRIMIG RAVID	7.00	7.00
CPD	1.1833	60	1.4671	PRIMIG RAVID	6.00	6.00
OBPP	1.8776	49	1.5496	PRIMIG RAVID	5.00	5.00
Total	1.6684	190	1.5190	PRIMIG RAVID	7.00	7.00

Key: OBPP – Obstetric Brachial Plexus Palsy

CPD – Cephalopelvic Disproportion

Parity ranged from primigravidae to 7 for the sample group not including PMMH. The mean parity for the macrosomic and OBPP group was 2.

TABLE 21: MATERNAL AGE COMPARED TO PARITY FOR THE OBPP GROUP

			parity categaries			
			primigravid	parity 1-2	parity 3-7	Total
age categories	14 -19 years	Count	5	1		6
		% within age categories	83.3%	16.7%		100.0%
		% of Total	11.1%	2.2%		13.3%
	20 - 30 years	Count	6	9		15
		% within age categories	40.0%	60.0%		100.0%
		% of Total	13.3%	20.0%		33.3%
	31 - 38 years	Count		10	10	20
		% within age categories		50.0%	50.0%	100.0%
		% of Total		22.2%	22.2%	44.4%
	> 38 years	Count		1	3	4
		% within age categories		25.0%	75.0%	100.0%
		% of Total		2.2%	6.7%	8.9%
Total		Count	11	21	13	45
		% within age categories	24.4%	46.7%	28.9%	100.0%
		% of Total	24.4%	46.7%	28.9%	100.0%

Crosstabulation of maternal age and parity for the OBPP group revealed that 77.7 % (15/45) of the cases were between the ages 20 to 38 years, of which 19/21 cases had a

parity of between 1 and 2. Of the 8.9 % that were > 38 years 75% (3/4) cases had a parity of between 3 and 7.

TABLE 22: PREVIOUS C-SECTION IN THE CONTROL AND OBPP GROUP

			CONTROL & OBPP GROUPS		
			CONTROL group	OBPP group	Total
PREVIOUS C-SECTION	YES	Count	23		23
		% within CONTROL & OBPP GROUPS	16.3%		12.0%
		% of Total	12.0%		12.0%
	NO	Count	118	51	169
		% within CONTROL & OBPP GROUPS	83.7%	100.0%	88.0%
		% of Total	61.5%	26.6%	88.0%
Total		Count	141	51	192
		% within CONTROL & OBPP GROUPS	100.0%	100.0%	100.0%
		% of Total	73.4%	26.6%	100.0%

Key: C-Section – caesarian section
OBPP – Obstetrical Brachial Plexus Palsy

A caesarian section had been previously performed in16.3% (23/141) of the controls and 83.7 % (118/141) did not have a previous caesarian section.

Table 18 indicates that there 11 primigravids among the OBPP group. None of the women in the OBPP group had a previous caesarian section. There were 30 cases of the OBPP group that delivered previously by normal vaginal delivery. These values were statistically significant for the Fisher's exact test. ($p = 0.000$).

In the PMMH sample 9/50 cases among the controls delivered previously by caesarian section and none of the OBBP case had a history of a previous delivery by caesarian section.

TABLE 23: PREVIOUS MACROSOMIC BABY IN CONTROL AND OBPP GROUP

			CONTROL & OBPP GROUPS		
			CONTROL group	OBPP group	Total
PREVIOUS MACROSOMIC BABY	YES	Count	30	7	37
		% within CONTROL & OBPP GROUPS	22.1%	14.6%	20.1%
		% of Total	16.3%	3.8%	20.1%
	NO	Count	106	41	147
		% within CONTROL & OBPP GROUPS	77.9%	85.4%	79.9%
		% of Total	57.6%	22.3%	79.9%
Total		Count	136	48	184
		% within CONTROL & OBPP GROUPS	100.0%	100.0%	100.0%
		% of Total	73.9%	26.1%	100.0%

Key: OBPP – Obstetrical Brachial Plexus Palsy

In the control group 77.9% (106/136) did not have a previous macrosomic infant while 22.1% did have a previous macrosomic infant. 85.4% (41/48) of the cases for OBPP did not have a previous macrosomic infant while 14.6% (7/48) did.

Among the sample at PMMH, 13/50 controls had a previous macrosomic baby and 1 from the OBPP group.

TABLE 24: INFANT BIRTHWEIGHT FOR ALL GROUPS

			GROUP				
			Normal	macros-omic	CPD	OBPP	Total
infant birth weight	2000 - 3499 g	Count	19		30	15	64
		% within GROUP	90.5%		50.0%	26.3%	32.3%
		% of Total	9.6%		15.2%	7.6%	32.3%
	3500 - 4500 g	Count	2	53	28	35	118
		% within GROUP	9.5%	88.3%	46.7%	61.4%	59.6%
		% of Total	1.0%	26.8%	14.1%	17.7%	59.6%
	4510 - 5500 g	Count		7	2	7	16
		% within GROUP		11.7%	3.3%	12.3%	8.1%
		% of Total		3.5%	1.0%	3.5%	8.1%
Total		Count	21	60	60	57	198
		% within GROUP	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	10.6%	30.3%	30.3%	28.8%	100.0%

Key: OBPP – Obstetric Brachial Plexus Palsy

CPD – Cephalopelvic Disproportion

In the macrosomic group 88.3 % (53/60), weighed between 3500g and 4500g. In the CPD category 50% (30/60), of the infants weighed between 2000g and 3499g. In the OBPP group 61.4 % (35/57) weighed between 3500g and 4500g while 12.3 % had a birthweight of > 4500g.

For the PMMH sample infant birthweight ranged from 2000g to 5050g. Among the control groups, birthweight for the all the normal and CPD cases ranged between 2000g to 3499g, all the macrosomic group birthweight weighed between 4000g and 5500g. In the OBBP group 3/5 cases were between 3500g to 4500g and 2/5 cases were between 4510 and 5050g.

TABLE 25: MEANS FOR BIRTHWEIGHT IN CONTROLS & OBPP GROUPS

BIRTH WEIGHT

GROUP	Mean	N	Std. Deviation	Minimum	Maximum
Normal	3.0264	21	.3861	2.40	3.50
macro-somic	4.2360	60	.2779	4.00	5.20
CPD	3.5177	60	.5446	2.00	4.65
OBPP	3.7905	57	.6843	2.09	5.30
Total	3.7618	198	.6362	2.00	5.30

Key: OBPP – Obstetric Brachial Plexus Palsy
CPD – Cephalopelvic Disproportion

Infant birthweight for the total sample ranged from 2000 g to 5300 g. The mean birthweight for the normal group was 3026g, for the macrosomic group it was 4236g, for the CPD group it was 3517g and for the OBPP group the mean birthweight was 3791g. The maximum birthweight for the macrosomic and OBPP group was 5200g and 5300g respectively.

For the PMMH group the mean birthweight for the normal group was 3100g, for the CPD group was 3130g, for the macrosomic group was 4230g and for the OBPP group was 4310g. The OBPP cases ranged from 3600g to 5050g and the macrosomic group ranged from 4000g to 5000g. (see annexure)

TABLE 26: MACROSOMIC CONTROL & OBPP GROUP COMPARED TO INFANT BIRTHWEIGHT

			GROUP		
			macro-somic	OBPP	Total
infant birth weight	1000 - 3499 g	Count		15	15
		% within GROUP		26.3%	12.8%
		% of Total		12.8%	12.8%
	3500 - 4500 g	Count	53	35	88
		% within GROUP	88.3%	61.4%	75.2%
		% of Total	45.3%	29.9%	75.2%
	4510 - 5500 g	Count	7	7	14
		% within GROUP	11.7%	12.3%	12.0%
		% of Total	6.0%	6.0%	12.0%
Total		Count	60	57	117
		% within GROUP	100.0%	100.0%	100.0%
		% of Total	51.3%	48.7%	100.0%

Key: OBPP – Obstetrical Brachial Plexus Palsy

Crosstabulation of the birthweights with the macrosomic control and OBPP group, it was found that the majority (88.3% or 53/60) of the macrosomic control group had a birthweight of 3500g to 4500g. The majority (61.4% or 35/57) of the OBPP group had a birthweight of 3500g to 4500g. Chi-square test revealed these figures to be significant, p= 0.000.

At PMMH the majority of the OBPP cases (80% or 4/5) had a birthweight of between 4000g and 5500g

TABLE 27:DESCRIPTIVES FOR INFANT BIRTHWEIGHT

Descriptive Statistics

	BIRTH WEIGHT	Valid N (listwise)
N	198	198
Range	3.30	
Minimum	2.00	
Maximum	5.30	
Mean	3.7618	
Std. Deviation	.6362	
Variance	.405	

The birthweight for the total sample (excl. PMMH) ranged from 2000g to 5300g. The mean birthweight for the sample was 3762g.

The birthweight at PMMH ranged from 2500 g to 5050 g.

TABLE 28: DESCRIPTIVES OF ESTIMATED BIRTHWEIGHT

Descriptive Statistics

	ESTIMATED BIRTHWEIGHT	Valid N (listwise)
N	26	26
Range	2.50	
Minimum	1.50	
Maximum	4.00	
Mean	3.1246	
Std. Deviation	.6845	
Variance	.469	

The estimated birthweight that was reported was determined either by ultrasonography or clinically, by the attending obstetrician. The estimated birthweight ranged from 1500g to 4000g. The mean estimated birthweight was 3125g.

At PMMH the mean estimated birthweight was 3190g, the median was 3400g and ranged from 1000g to 4500g.

TABLE 29: ESTIMATED BIRTHWEIGHT COMPARED TO BIRTHWEIGHT

			infant birth weight			
			1000 - 3499 g	3500 - 4500 g	4510 - 5500 g	Total
estimated birthweight	1000 - 3499 g	Count	7	6	1	14
		% within infant birth weight	70.0%	37.5%	33.3%	48.3%
		% of Total	24.1%	20.7%	3.4%	48.3%
	3500 - 4500 g	Count	3	8	1	12
		% within infant birth weight	30.0%	50.0%	33.3%	41.4%
		% of Total	10.3%	27.6%	3.4%	41.4%
Total		Count	10	16	3	29
		% within infant birth weight	100.0%	100.0%	100.0%	100.0%
		% of Total	34.5%	55.2%	10.3%	100.0%

Crosstabulation of the estimated birthweight and the actual birthweight post delivery, revealed that the estimated birthweight correlated with the actual birthweight for 7 of 29 infants with a weight of 1000g to 3499g. The estimated birth weight correlated with the actual birthweight in 8 of 29 infants with a weight of 3500g to 4500g.

At PMMH, of the 13 cases that had recorded an estimated birthweight, 2 cases were estimated between 1000g and 2000g and had an actual birthweight of >3500g. Of the 6 cases estimated between 3000g and 3500g, 4 cases were > 3500g. (refer to annexure)

TABLE 30: OVER AND UNDER ESTIMATION OF BIRTHWEIGHT.

% under /over estimation of birthweight		BIRTH WEIGHT	ESTIMATED BIRTHWEIGHT
est bw < bw	Mean	3.7842	2.9737
	N	19	19
	Std. Deviation	.6909	.7030
est bw = bw	Mean	3.6000	3.6000
	N	1	1
	Std. Deviation	.	.
est bw > bw	Mean	3.2850	3.5233
	N	6	6
	Std. Deviation	.5049	.4908
Total	Mean	3.7555	3.1246
	N	29	26
	Std. Deviation	.6943	.6845

Key: bw – birthweight
est. bw – estimated birthweight

Further examination of the estimated and actual birthweight of uncategorized data, revealed that only 1/26 cases was accurately estimated regarding birthweight. There was a significant difference between the mean estimated birthweight and the birthweight post delivery. The birthweights were under estimated by a mean of 811g and over estimated by mean of 238g.

At PMMH, in 11 cases the birthweight was under estimated by a mean of 1032 g and over estimated in 1 case by a mean of 100 g.

TABLE 31: SUSPECTED BIG BABY FOR THE OBPP GROUP

			OBPP group	Total
SUSPECTED BIG BABY	YES	Count	6	6
		% within GRP	12.8%	12.8%
			12.8%	12.8%
	NO	Count	41	41
		% within GRP	87.2%	87.2%
			87.2%	87.2%
Total		Count	47	47
		% within GRP	100.0%	100.0%
			100.0%	100.0%

Key: OBPP – Obstetrical Brachial Plexus Palsy

Of the 47 cases in the OBPP group, 6 were suspected of having a macrosomic fetus.

TABLE 32: SUSPECTED MACROSOMIC INFANT COMPARED TO INFANT BIRTHWEIGHT

			infant birthweight		
			1000 - 3499 g	3500 - 5500 g	Total
SUSPECTED BIG BABY	YES	Count	1	5	6
		% within infant birthweight	7.1%	15.2%	12.8%
		% of Total	2.1%	10.6%	12.8%
	NO	Count	13	28	41
		% within infant birthweight	92.9%	84.8%	87.2%
		% of Total	27.7%	59.6%	87.2%
Total		Count	14	33	47
		% within infant birthweight	100.0%	100.0%	100.0%
		% of Total	29.8%	70.2%	100.0%

Of the 6 women, in Table 30, who were suspected of having a large for gestational age fetus (LGA), 5 infants had a birthweight of >3500g.

Of those that were not suspected of having a LGA fetus, 59.6% (28/47) delivered infants > 3500g.

The odds ratio for a suspected macrosomic fetus is 1.220 (95% CI 0.806-1.846)

Among the PMMH sample 1 out of 5 cases was suspected of a macrosomic fetus and delivered an infant of birthweight >4000g. Of those not suspected of a macrosomic fetus 3 out of 5 cases delivered infants of birthweight >4000g. (refer to annexure)

Ultrasonography was performed on 30.8 % of the group with OBPP. of those cases whose birthweights were estimated 46.7 % were based on clinical examination only and 53.3% were based on both clinical and ultrasonic estimates.

TABLE 33: SUSPICION OF CPD IN THE OBPP GROUP

			OBPP group	Total
SUSPECTED CPD	YES	Count	5	5
		% within GRP	9.6%	9.6%
		% of Total	9.6%	9.6%
	NO	Count	47	47
		% within GRP	90.4%	90.4%
		% of Total	90.4%	90.4%
Total		Count	52	52
		% within GRP	100.0%	100.0%
		% of Total	100.0%	100.0%

Key: OBPP – Obstetrical Brachial Plexus Palsy.

CPD – Cephalopelvic Disproportion

Suspicion of CPD in the OBPP was examined. Non parametric tests showed that of the 52 cases, (information was missing in 5 cases), only 9.6% (n =5) were suspected of CPD and p = 0.000. 90.4 % of the cases of OBPP were not suspected of CPD, as indicated in table 23. The binomial test for these figures were significant (p =0.000). None of the OBPP cases at PMMH were suspected of CPD.

TABLE 34: ESTIMATED PELVIC CAPACITY FOR CASES SUSPECTED OF CPD

			SUSPECTED CPD		
			YES	NO	Total
ESTIMATED PELVIC CAPACITY	NOT DONE	Count	1	31	32
		% within ESTIMATED PELVIC CAPACITY	3.1%	96.9%	100.0%
		% within SUSPECTED CPD	25.0%	73.8%	69.6%
		% of Total	2.2%	67.4%	69.6%
	INADEQUATE	Count	1	4	5
		% within ESTIMATED PELVIC CAPACITY	20.0%	80.0%	100.0%
		% within SUSPECTED CPD	25.0%	9.5%	10.9%
		% of Total	2.2%	8.7%	10.9%
	DOUBTFUL	Count	2	7	9
		% within ESTIMATED PELVIC CAPACITY	22.2%	77.8%	100.0%
		% within SUSPECTED CPD	50.0%	16.7%	19.6%
		% of Total	4.3%	15.2%	19.6%
Total		Count	4	42	46
		% within ESTIMATED PELVIC CAPACITY	8.7%	91.3%	100.0%
		% within SUSPECTED CPD	100.0%	100.0%	100.0%
		% of Total	8.7%	91.3%	100.0%

Key: CPD – Cephalopelvic Disproportion

With reference to table 32, of those suspected of CPD 25 % (1/4) cases did not have the pelvic capacity estimated. Of those that were estimated 50% were found to be doubtful and 25% to be inadequate. One case did not have any record of an examination of the pelvis.

Among the OBPP group at PMMH none of the cases were suspected of CPD. There 2 cases with an estimated pelvic capacity that was inadequate and 2 cases that were considered doubtful and 1 case did not have any record of the pelvic examination.

TABLE 35: ESTIMATED PELVIC CAPACITY IN THE OBPP GROUP

			OBPP	
			OBPP PRESENT	Total
ESTIMATED PELVIC CAPACITY	NOT DONE	Count	31	31
		% within OBPP	68.9%	68.9%
	INADEQUATE	Count	5	5
		% within OBPP	11.1%	11.1%
	DOUBTFUL	Count	9	9
		% within OBPP	20.0%	20.0%
			20.0%	
Total		Count	45	45
		% within OBPP	100.0%	100.0%

Key: OBPP – Obstetrical Brachial Plexus Palsy

For the OBPP group 68.9% (31/45) did not have an assessment of the pelvic capacity prior to delivery. 9/45 cases were assessed and considered to be doubtful regarding the capacity and 5/45 were considered to be inadequate. 13 cases did not record any details regarding assessment of the pelvic capacity.

At PMMH, the estimate pelvic capacity was considered inadequate in 2 cases and doubtful in 2 cases for the OBPP group.

TABLE 36: SUSPECTED CPD IN THE SHOULDER DYSTOCIA CASES

			SHOULDER DYSTOCIA		
			SHOULDER DYSTOCIA	no shoulder dystocia	Total
SUSPECTED CPD	YES	Count	1	4	5
		% within SHOULDER DYSTOCIA	3.8%	15.4%	9.6%
		% of Total	1.9%	7.7%	9.6%
	NO	Count	25	22	47
		% within SHOULDER DYSTOCIA	96.2%	84.6%	90.4%
		% of Total	48.1%	42.3%	90.4%
Total		Count	26	26	52
		% within SHOULDER DYSTOCIA	100.0%	100.0%	100.0%
		% of Total	50.0%	50.0%	100.0%

Key: CPD – Cephalopelvic Disproportion

There were 25/52 cases that were not suspected of CPD but had a diagnosis of shoulder dystocia and 1/5 cases that were suspected of CPD had a diagnosis of shoulder dystocia.

Within the OBPP group at PMMH, 3 cases out of 5 were not suspected of CPD but had a diagnosis of shoulder dystocia.

TABLE 37: ESTIMATED PELVIC CAPACITY FOR THE SHOULDER DYSTOCIA CASES.

			SHOULDER DYSTOCIA		
			SHOULDER DYSTOCIA	no shoulder dystocia	Total
estimated pelvic capacity	not done	Count	18	14	32
		% within estimated pelvic capacity	56.3%	43.8%	100.0%
		% within SHOULDER DYSTOCIA	78.3%	60.9%	69.6%
		% of Total	39.1%	30.4%	69.6%
	inadequate/ doubtful	Count	5	9	14
		% within estimated pelvic capacity	35.7%	64.3%	100.0%
		% within SHOULDER DYSTOCIA	21.7%	39.1%	30.4%
		% of Total	10.9%	19.6%	30.4%
Total		Count	23	23	46
		% within estimated pelvic capacity	50.0%	50.0%	100.0%
		% within SHOULDER DYSTOCIA	100.0%	100.0%	100.0%
		% of Total	50.0%	50.0%	100.0%

For those cases that did not have an assessment of their pelvic capacity, 56.3% (18/32) had a diagnosis of shoulder dystocia. The 35.7% who had an inadequate or doubtful pelvic capacity also had a diagnosis of shoulder dystocia.

The odds ratio for shoulder dystocia was 1.575 (95% CI 0.732-3.389).

At PMMH, within the OBPP group 2 out of 3 cases of shoulder dystocia had a pelvic capacity that was inadequate and 1 case had a doubtful pelvic capacity.

TABLE 38: ESTIMATED PELVIC CAPACITY AND INFANT BIRTHWEIGHT

			infant birthweight		Total
			1000 - 3499 g	3500 - 5500 g	
estimated pelvic capacity	not done	Count	7	25	32
		% within estimated pelvic capacity	21.9%	78.1%	100.0%
		% within infant birthweight	53.8%	75.8%	69.6%
		% of Total	15.2%	54.3%	69.6%
	inadequate/ doubtful	Count	6	8	14
		% within estimated pelvic capacity	42.9%	57.1%	100.0%
		% within infant birthweight	46.2%	24.2%	30.4%
		% of Total	13.0%	17.4%	30.4%
Total		Count	13	33	46
		% within estimated pelvic capacity	28.3%	71.7%	100.0%
		% within infant birthweight	100.0%	100.0%	100.0%
		% of Total	28.3%	71.7%	100.0%

For the OBPP group 54.3% (25/46) cases did not have an estimate of their pelvic capacity and delivered infants with a birthweight of >3500g. The 57.1% (8/14) of cases whose pelvic capacity was considered to be doubtful or inadequate, delivered infants with a birthweight >3500g.

For the OBPP group at PMMH, 2 out of 4 cases that were considered to have an inadequate pelvic capacity delivered infants with birthweights >3500g and of the 2 cases whose pelvic capacity was considered doubtful 1 case delivered an infant with a birthweight between 3500g and 4000g, the other case delivered an infant with a birthweight of between 4500g and 5500g.

TABLE 39: BIRTHWEIGHT FOR THE CPD GROUP

			GROUP	
			CPD	Total
INFANT BIRTHWEIGHT	1000 - 3999 g	Count	45	45
		% within infant birthweight	100.0%	100.0%
		% within GROUP	75.0%	75.0%
		% of Total	75.0%	75.0%
	4000 - 5500 g	Count	15	15
		% within infant birthweight	100.0%	100.0%
		% within GROUP	25.0%	25.0%
		% of Total	25.0%	25.0%
Total		Count	60	60
		% within infant birthweight	100.0%	100.0%
		% within GROUP	100.0%	100.0%
		% of Total	100.0%	100.0%

Key: CPD – Cephalopelvic Disproportion

The majority of the CPD, 75% (45/60) cases had a birthweight of < 4000g, while 25% (15/60) had a birthweight of between 4000 g and 5500 g.

These figures were highly significant for the non-parametric chi-square and binomial tests; both tests had a p value of 0.000.

TABLE 40: WEEKS OF GESTATION COMPARED TO CONTROL & OBPP GROUPS

			CONTROL & OBPP GROUPS		
			CONTROL group	OBPP group	Total
no. of weeks gestation categories	< 35 weeks gestation	Count	3	5	8
		% within CONTROL & OBPP GROUPS	2.2%	9.8%	4.2%
		% of Total	1.6%	2.6%	4.2%
	>=35 weeks gestation	Count	136	46	182
		% within CONTROL & OBPP GROUPS	97.8%	90.2%	95.8%
		% of Total	71.6%	24.2%	95.8%
Total		Count	139	51	190
		% within CONTROL & OBPP GROUPS	100.0%	100.0%	100.0%
		% of Total	73.2%	26.8%	100.0%

Key: OBPP – Obstetrical Brachial Plexus Palsy.

The majority (90.2% or 46/51) of the OBPP group had a gestation period ≥ 35 weeks. The majority (97.8% or 136/139) of the control group also had a gestation period ≥ 35 weeks. This was statistically significant with a p value of 0.031 for the Fisher's exact test.

The mean gestation period for the OBPP group was 38.7 weeks, with a range of 28-41 weeks and a 95% confidence interval of 38.1 – 39.3 weeks.

All of the cases of OBPP and the majority 98.2% (49/55) of controls at PMMH had a gestation period > 34 weeks.

The reason for admission was recorded as labour, show, rupture of membranes or other reasons, which ranged from pregnancy induced hypertension to cardiac or asthmatic conditions. The reason for admission for the majority of control (49.6% or 69/139) and OBPP (73.3% or 33/45) was due to labour.

The majority of the cases and controls at PMMH were admitted to hospital due to labour.

TABLE 41: FIRST STAGE OF LABOUR FOR BOTH CONTROL AND OBPP GROUPS

			CONTROL & OBPP GROUPS		
			CONTROL group	OBPP group	Total
FIRST STAGE OF LABOUR	0.25-4.92	Count	29	11	40
		% within CONTROL & OBPP GROUPS	45.3%	25.0%	37.0%
		% of Total	26.9%	10.2%	37.0%
	5-9.67	Count	22	23	45
		% within CONTROL & OBPP GROUPS	34.4%	52.3%	41.7%
		% of Total	20.4%	21.3%	41.7%
	10-25	Count	13	7	20
		% within CONTROL & OBPP GROUPS	20.3%	15.9%	18.5%
		% of Total	12.0%	6.5%	18.5%
Total		Count	64	44	108
		% within CONTROL & OBPP GROUPS	100.0%	100.0%	100.0%
		% of Total	59.3%	40.7%	100.0%

Key: OBPP – Obstetrical Brachial Plexus Palsy

The duration of the first stage of labour for the majority (45.3% or 29/64) of the control group was 0.25 to 4.92 hours. The duration of the first stage of labour for the majority (52.3% or 23/44) of the OBPP group was 5 to 9.67 hours.

The first stage of labour ranged from 0.25 to 22.33 hours for the total sample. (see annexure3)

The mean duration of labour for the first stage for the OBPP group at PMMH was 8.28 hours with a maximum of 14 hours.

TABLE 42: SECOND STAGE OF LABOUR IN CONTROL & OBPP GROUP

			OBPP group	Total
SECOND STAGE OF LABOUR	0.03-0.08	Count	4	4
		% within CONTROL & OBPP GROUPS	9.1%	9.1%
	0.12-0.47	Count	31	31
		% within CONTROL & OBPP GROUPS	70.5%	70.5%
	0.5-25	Count	6	6
		% within CONTROL & OBPP GROUPS	13.6%	13.6%
Total		Count	44	44
		% within CONTROL & OBPP GROUPS	100.0%	100.0%

The duration of the second stage of labour for the majority (53.4% or 31/58) of the control group was between 0.03 and 0.08 hours (2 to 5 minutes).

The duration of the second stage of labour for the majority (70.5% or 31/44) of the OBPP cases was between 0.12 to 0.47 hours (7 to 28 minutes). These values were statistically significant (p= 0.000).

The mean duration of labour for the OBPP group was 20 minutes (0.33 hours) (95% CI 0.219-0.448). The maximum duration among this group for the second stage was 2 hours and 20 minutes and the minimum duration of the second stage was 0.08 minutes. (refer to annexure 4).

The mean duration of labour for the second stage at PMMH (OBPP group) was 5.28 hours with a maximum of 15.75 hours. (refer to annexure 5)

TABLE 43: THIRD STAGE OF LABOUR FOR BOTH CONTROL & OBPP GROUPS

			CONTROL & OBPP GROUPS		
			CONTROL group	OBPP group	Total
THIRD STAGE OF LABOUR	0.05 - 0.08	Count	53	30	83
		% within CONTROL & OBPP GROUPS	91.4%	69.8%	82.2%
		% of Total	52.5%	29.7%	82.2%
	0.09 - 0.17	Count	5	10	15
		% within CONTROL & OBPP GROUPS	8.6%	23.3%	14.9%
		% of Total	5.0%	9.9%	14.9%
Total		Count	58	43	101
		% within CONTROL & OBPP GROUPS	100.0%	100.0%	100.0%
		% of Total	57.4%	42.6%	100.0%

Key: OBPP- Obstetrical Brachial Plexus Palsy
GRP - Group

0.05 – 0.08& 0.09- 0.17 – of an hour

The total duration of the third stage of labour ranged from 3 to 10 minutes (0.05 to 0.17 hours).

The majority of both the control and OBPP group experienced the third stage of labour for a period of 3 to 5 minutes. (0.05 to 0.08 hours). For 23.3% (12/43) of the cases the duration of the third stage of labour lasted between 6 to 10 minutes.

TABLE 44: COMPARISON OF THE TOTAL DURATION OF LABOUR

			CONTROL & OBPP GROUPS		
			CONTROL group	OBPP group	Total
TOTAL DURATION OF LABOUR	.42-4.92	Count	27	11	38
		% within CONTROL & OBPP GROUPS	46.6%	21.2%	34.5%
		% of Total	24.5%	10.0%	34.5%
	5-9.75	Count	17	30	47
		% within CONTROL & OBPP GROUPS	29.3%	57.7%	42.7%
		% of Total	15.5%	27.3%	42.7%
	10-14.92	Count	12	6	18
		% within CONTROL & OBPP GROUPS	20.7%	11.5%	16.4%
		% of Total	10.9%	5.5%	16.4%
	15-19	Count	2	2	4
		% within CONTROL & OBPP GROUPS	3.4%	3.8%	3.6%
		% of Total	1.8%	1.8%	3.6%
Total		Count	58	52	110
		% within CONTROL & OBPP GROUPS	100.0%	100.0%	100.0%
		% of Total	52.7%	47.3%	100.0%

Key: OBPP – Obstetrical Brachial Plexus Palsy

The total duration of labour for most of the women in the control group (46.6% or 27/58) and the OBPP group (57.7% or 30/52) lasted between 5 to 9.75 hours. These figures were significant for the Fisher's exact test, $p = 0.005$.

TABLE 45: TOTAL DURATION OF LABOUR FOR ALL GROUPS

TOTAL DURATION OF LABOUR

GROUP	Mean	N	Std. Deviation	Minimum	Maximum
Normal	5.7735	20	3.8387	.00	13.00
Big baby	4.4469	59	4.5111	.00	18.08
CPD	.0000	59	.0000	.00	.00
OBPP	7.6204	49	3.4318	2.42	17.42
Total	4.0173	187	4.4519	.00	18.08

Key: CPD – Cephalopelvic Disproportion

OBPP – Obstetrical Brachial Plexus Palsy

The mean of the total duration of labour for the OBPP group was 7.6 hours, for the normal group was 5,77 hour and for the macrosomic group was 4.45 hours. All cases in the CPD group delivered via caesarian section. (labour=0.00)

TABLE 46: EXPECTED MODE OF DELIVERY FOR THE OBPP GROUP

			OBPP group	Total
EXPECTED MODE OF DELIVERY	NVD	Count	48	48
		% within CONTROL & OBPP GROUPS	96.0%	96.0%
	C-SECTION	Count	2	2
		% within CONTROL & OBPP GROUPS	4.0%	4.0%
Total		Count	50	50
		% within CONTROL & OBPP GROUPS	100.0%	100.0%

Key: OBPP – Obstetrical Brachial Plexus Palsy

C- SECTION – caesarian section

Of the 50 cases that had recorded the expected mode of delivery, 96% of the parturients expected to deliver vaginally and 4 % expected to deliver by caesarian section.

TABLE 47: EXPECTED MODE OF DELIVERY COMPARED TO METHOD OF DELIVERY

			METHOD OF DELIVERY		
			NVD	VACUUM EXTRACTION	Total
EXPECTED MODE OF DELIVERY	NVD	Count	46	2	48
		% within METHOD OF DELIVERY	95.8%	100.0%	96.0%
		% of Total	92.0%	4.0%	96.0%
	C-SECTION	Count	2		2
		% within METHOD OF DELIVERY	4.2%		4.0%
		% of Total	4.0%		4.0%
Total		Count	48	2	50
		% within METHOD OF DELIVERY	100.0%	100.0%	100.0%
		% of Total	96.0%	4.0%	100.0%

Key : NVD – Normal Vaginal Delivery
C-Section – Caesarian Section

Crosstabulation of the expected mode of delivery and the method of delivery revealed that 2 cases that expected to deliver via caesarian section delivered vaginally and 2 cases that expected to have a normal vaginal delivery required an assisted birth via vacuum extraction.

At PMMH, 5 cases of OBPP recorded an expected mode of delivery to be a normal vaginal delivery. Crosstabulation of the expected mode of delivery and method of delivery showed that one out of five cases delivered by caesarian section and 4/5 cases delivered vaginally.

TABLE 48: METHOD OF DELIVERY IN CONTROL AND OBPP GROUPS

			CONTROL & OBPP GROUPS		
			CONTROL group	OBPP group	Total
METHOD OF DELIVERY	NVD	Count	61	55	116
		% within CONTROL & OBPP GROUPS	43.3%	96.5%	58.6%
		% of Total	30.8%	27.8%	58.6%
	VACUUM EXTRACTION	Count	1	2	3
		% within CONTROL & OBPP GROUPS	.7%	3.5%	1.5%
		% of Total	.5%	1.0%	1.5%
	C-SECTION	Count	79		79
		% within CONTROL & OBPP GROUPS	56.0%		39.9%
		% of Total	39.9%		39.9%
Total		Count	141	57	198
		% within CONTROL & OBPP GROUPS	100.0%	100.0%	100.0%
		% of Total	71.2%	28.8%	100.0%

Key: NVD – Normal Vaginal Delivery
C-Section – Caesarian Section

The majority of the OBPP group (96.5% or 55/57) delivered vaginally. 2 of the OBPP cases were assisted via vacuum extraction. None of the OBPP cases were delivered by caesarian section although 2 cases expected to deliver via caesarian section.

At PMMH the majority of the controls delivered by caesarian section (28/50), 21/50 delivered vaginally and 1/50 was assisted by forceps. Within the OBPP group 80% (4/5) delivered vaginally and 20% (1/5) of the cases delivered by caesarian section.

TABLE 49: METHOD OF DELIVERY COMPARED TO DIFFICULT DELIVERIES

			DIFFICULT DELIVERY		
			YES	NO	Total
METHOD OF DELIVERY	NVD	Count	30	37	67
		% within DIFFICULT DELIVERY	90.9%	37.8%	51.1%
		% of Total	22.9%	28.2%	51.1%
	VACUUM EXTRACTION	Count	2		2
		% within DIFFICULT DELIVERY	6.1%		1.5%
		% of Total	1.5%		1.5%
	C-SECTION	Count	1	61	62
		% within DIFFICULT DELIVERY	3.0%	62.2%	47.3%
		% of Total	.8%	46.6%	47.3%
Total		Count	33	98	131
		% within DIFFICULT DELIVERY	100.0%	100.0%	100.0%
		% of Total	25.2%	74.8%	100.0%

Key: NVD – Normal Vaginal Delivery
C-Section – Caesarian Section

Of those cases that experienced a difficult delivery 90.9 % (30/33) were normal vaginal deliveries, 6.1 % (2/33) were delivered via vacuum extraction and 3 % (1/33) was delivered by caesarian section.

Labour was spontaneous in 55.1% of the cases for OBPP and augmented with oxytocin in 89.7% (35/39) of the cases with OBPP.

Crosstabulation for the OBPP group and difficult delivery showed that 97.2 % of the OBPP group had a difficult delivery compared to 2.6% in each of the other groups as shown in table 29. This was statistically significant (p =0.000).

Among the OBPP group at PMMH, 3 of the 4 cases that delivered vaginally were recorded as difficult deliveries and 1 case that delivered by caesarian section was also recorded as difficult.

TABLE 50: DIFFICULT DELIVERIES FOR BOTH CONTROL & OBPP GROUPS

			CONTROL & OBPP GROUPS		
			CONTROL group	OBPP group	Total
DIFFICULT DELIVERY	YES	Count	2	31	33
		% within CONTROL & OBPP GROUPS	2.0%	96.9%	25.2%
		% of Total	1.5%	23.7%	25.2%
	NO	Count	97	1	98
		% within CONTROL & OBPP GROUPS	98.0%	3.1%	74.8%
		% of Total	74.0%	.8%	74.8%
Total		Count	99	32	131
		% within CONTROL & OBPP GROUPS	100.0%	100.0%	100.0%
		% of Total	75.6%	24.4%	100.0%

Key: OBPP – Obstetrical Brachial Plexus Palsy
GRP – Group

The majority of the controls did not experience a difficult labour. Of those cases that recorded the problems encountered during labour 31 cases or 96.9% recorded a difficult delivery. This was statistically significant for the Fisher's exact test ($p = 0.000$). The odds ratio for OBPP was 92.061(95% CI 13.073-648.272).

Among the OBPP group at PMMH 4/5 cases were recorded as having difficult delivery.

TABLE 51: BIRTHWEIGHTS FOR THE DIFFICULT DELIVERIES

			infant birthweight		
			1000 - 3499 g	3500 - 5500 g	Total
DIFFICULT DELIVERY	YES	Count	12	21	33
		% within infant birthweight	21.8%	27.6%	25.2%
		% of Total	9.2%	16.0%	25.2%
	NO	Count	43	55	98
		% within infant birthweight	78.2%	72.4%	74.8%
		% of Total	32.8%	42.0%	74.8%
Total		Count	55	76	131
		% within infant birthweight	100.0%	100.0%	100.0%
		% of Total	42.0%	58.0%	100.0%

Of the 33 cases that experienced difficult deliveries, 21 (63.6%) cases produced infants with birthweights between 3500g and 5500g. Of those cases that experienced difficulties with delivery 12 (36.4%) of the 33 cases, delivered infants with birthweights less than 3500g.

TABLE 52: DELIVERY ATTENDANT FOR DIFFICULT DELIVERIES

			DIFFICULT DELIVERY		
			YES	NO	Total
DELIVERY ATTENDANT	STUDENT NURSE/ DOCTOR	Count	1	3	4
		% within DIFFICULT DELIVERY	3.0%	3.1%	3.1%
		% of Total	.8%	2.3%	3.1%
	MIDWIFE	Count	22	31	53
		% within DIFFICULT DELIVERY	66.7%	31.6%	40.5%
		% of Total	16.8%	23.7%	40.5%
	DOCTOR	Count	10	64	74
		% within DIFFICULT DELIVERY	30.3%	65.3%	56.5%
		% of Total	7.6%	48.9%	56.5%
Total		Count	33	98	131
		% within DIFFICULT DELIVERY	100.0%	100.0%	100.0%
		% of Total	25.2%	74.8%	100.0%

Crosstabulation of the delivery attendants and difficult deliveries found that 66.7% of the midwives experienced difficulties in deliveries compared to 30.3% of the doctors.

At PMMH 3 out of the 5 OBPP cases were delivered by midwives and none of these cases were supervised.

TABLE 53: DELIVERY ATTENDANT FOR CONTROL & OBPP GROUPS

			CONTROL & OBPP GROUPS		
			CONTROL group	OBPP group	Total
DELIVERY ATTENDANT	BORN BEFORE ARRIVAL	Count	2		2
		% within CONTROL & OBPP GROUPS	1.4%		1.0%
		% of Total	1.0%		1.0%
	STUDENT NURSE/ DOCTOR	Count	3	6	9
		% within CONTROL & OBPP GROUPS	2.2%	11.1%	4.7%
		% of Total	1.6%	3.1%	4.7%
	MIDWIFE	Count	47	36	83
		% within CONTROL & OBPP GROUPS	33.8%	66.7%	43.0%
		% of Total	24.4%	18.7%	43.0%
	DOCTOR	Count	87	12	99
		% within CONTROL & OBPP GROUPS	62.6%	22.2%	51.3%
		% of Total	45.1%	6.2%	51.3%
Total		Count	139	54	193
		% within CONTROL & OBPP GROUPS	100.0%	100.0%	100.0%
		% of Total	72.0%	28.0%	100.0%

Key: OBPP – Obstetrical Brachial Plexus Palsy

For the total sample most of the delivery attendants were doctors (51.3 %) and midwives (43 %) while 30 % of the deliveries were unsupervised. However, in the OBPP group, midwives delivered 66.7% of the cases with 31.6% of the deliveries being supervised, 22.2 % were delivered by the doctor and 11.1 % by either a student nurse or medical

student with 3.5% of these deliveries supervised. For this group only 30 % of the deliveries were supervised.

At PMMH, the majority of the controls were delivered by doctors (29/50). The midwives delivered 14/50 cases and 7/50 were delivered by either a student nurse or medical student. In the OBPP group 3/5 cases were delivered by a midwife, 1 case by a doctor and 1case did not record the delivery attendant.

TABLE 54: ENGAGEMENT OF FETAL HEAD IN OBPP CASES.

			GROUP	
			OBPP	Total
ENGAGEMENT	5/5	Count	17	17
		% within GROUP	70.8%	70.8%
		% of Total	70.8%	70.8%
	4/5	Count	7	7
		% within GROUP	29.2%	29.2%
		% of Total	29.2%	29.2%
Total		Count	24	24
		% within GROUP	100.0%	100.0%
		% of Total	100.0%	100.0%

There was a significant difference when comparing engagement of the fetal head in the OBPP group, using non-parametric chi-square tests (p =0.023). The majority of the OBPP 70.8 % (17/24) of the cases recorded an engagement of 5/5 and 29.2% recorded an engagement of 4/5.

Analysis of the presentation of the fetus in the OBPP group showed that the majority of presentations in the OBPP group was cephalic (72%), 12% breech, 10% shoulder and 5% face to pubis. This was statistically significant, p= 0.000. There was no significant difference in the position of the fetus.

Among the PMMH group, 3 of the 5 OBBP infants had a cephalic presentation and 1 case had a face to pubis presentation.

TABLE 55: APGAR SCORE AT 5 MINUTES IN CONTROL & OBPP GROUP

			CONTROL & OBPP GROUPS		
			CONTROL group	OBPP group	Total
APGAR SCORE AT 5 MINUTES	1-6	Count	1	10	11
		% within CONTROL& OBPP GROUPS	.7%	17.9%	5.7%
		% of Total	.5%	5.2%	5.7%
	7-10	Count	137	43	180
		% within CONTROL& OBPP GROUPS	99.3%	76.8%	92.8%
		% of Total	70.6%	22.2%	92.8%
Total		Count	138	56	194
		% within CONTROL& OBPP GROUPS	100.0%	100.0%	100.0%
		% of Total	71.1%	28.9%	100.0%

Key: OBPP – Obstetrical Brachial Plexus Palsy

The Apgar scores at 5 minutes for the control groups ranged predominantly between 7-10. Most of the cases with OBPP (76.8% or 43/56) also ranged between 7-10. There were 10/56 cases of OBPP that had an Apgar score between 1 and 6.

All of the 5 cases of OBPP cases at PMMH had a 5-minute Apgar score of between 7 and 10.

TABLE 56: MEAN APGAR SCORES AT 5 MINUTES FOR ALL GROUPS

APGAR SCORE

GROUP	Mean	N	Std. Deviation	Minimum	Maximum	Range	Median
Normal	9.1429	21	.3586	9.00	10.00	1.00	9.0000
Macro-somic	9.3276	58	.7583	6.00	10.00	4.00	9.0000
CPD	9.2712	59	.6906	7.00	10.00	3.00	9.0000
OBPP	7.7358	53	2.1497	1.00	10.00	9.00	8.0000
Total	8.8482	191	1.4411	1.00	10.00	9.00	9.0000

Key: CPD – Cephalopelvic Disproportion

OBPP – Obstetrical Brachial Plexus Palsy

The mean Apgar score at 5 minutes for the normal group was 9.1, for the macrosomic group 9.3 and for the CPD group 9.2.

The mean Apgar score at 5 minutes for the OBPP group was 7.735. The Apgar score for the OBPP group ranged from 1 to 10. The range for the macrosomic group was from 6 to 10.

The mean Apgar score between the groups was found to be statistically significant.

The mean Apgar score for the OBPP group at PMMH was 9. The score ranged from 7 to 10 for this group.

TABLE 57: APGAR AT 5 MINUTES COMPARED TO INFANTS GENERAL CONDITION

			GENERAL CONDITION			
			POOR	SATISFA-CTORY	GOOD	Total
apgar categories	1-6	Count	6	4		10
		% within GENERAL CONDITION	37.5%	2.5%		5.4%
		% of Total	3.2%	2.2%		5.4%
	7-10	Count	10	158	7	175
		% within GENERAL CONDITION	62.5%	97.5%	100.0%	94.6%
		% of Total	5.4%	85.4%	3.8%	94.6%
Total		Count	16	162	7	185
		% within GENERAL CONDITION	100.0%	100.0%	100.0%	100.0%
		% of Total	8.6%	87.6%	3.8%	100.0%

Delivery condition of the infant was recorded as satisfactory in 97.5% of the cases. On comparing the Apgar score at 5 minutes to the general delivery condition it was found to be statistically significant ($p = 0.000$).

For the OBPP group 70.4% were in a satisfactory condition and 29.6% were in a poor condition.

The heart rate at one minute greater than 100 bpm in 72% and 70% of the normal and macrosomic group respectively and 66% and 63.6% in the CPD and OBPP group respectively. Crosstabulation of the general condition and fetal heart rate at 1 minute revealed that 53.8% recorded as being in a satisfactory condition with a heart rate < 100 bpm.

TABLE 58: INFANT LENGTH FOR ALL GROUPS

INFANT LENGTH

GROUP	Mean	N	Std. Deviation	Minimum	Maximum	Median
Normal	48.9286	14	3.9118	40.00	55.00	49.5000
Macro-somia	53.2283	46	3.1406	44.00	60.00	53.0000
CPD	50.0357	42	3.0089	42.00	55.00	50.5000
OBPP	52.3077	26	4.0152	44.00	61.00	53.0000
Total	51.5234	128	3.7162	40.00	61.00	52.0000

Key: CPD – Cephalopelvic Disproportion
OBPP – Obstetric Brachial Plexus Palsy

The mean length of the infant for the normal group was 48.93 cm, with a range of 40 cm to 55 cm. The mean length of the infant for the CPD group was 50.04cm, with a range of 42 cm to 55 cm. The mean length for the macrosomic and OBPP group was 53.23 cm and 52.31 cm respectively.

The was no statistical difference between the sex of the infant and OBPP. 57.9% of the OBPP cases were male and 42.1% were female. The mean birthweight for the male infants was 3699 g and for the female infants was 3632 g. The mean length for the male infants was 37.9 cm and for the female infants was 35.3 cm.

TABLE 59: FREQUENCIES OF THE AFFECTED ARM IN THE OBPP GROUP

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	RIGHT	14	7.0	46.7	46.7
	LEFT	16	8.0	53.3	100.0
	Total	30	15.1	100.0	

There were 14 cases with the left arm affected and 16 cases with the right arm affected.

TABLE 60: FREQUENCY OF CASES REFERRED FOR PHYSIOTHERAPY

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	NO	6	3.0	20.0	20.0
	YES	24	12.1	80.0	100.0
	Total	30	15.1	100.0	
Missing	MISSING	28	14.1		
	System	141	70.9		
	Total	169	84.9		
Total		199	100.0		

Of the 30 cases of OBPP 24 were referred for Physiotherapy.

Information regarding patient follow-up was missing in 46.7% of the records, while 50% were definitely followed-up. Information regarding referral to physiotherapy was missing in 48.3% of the cases while 41.7% were followed up and 10.3% (6/58) were not referred for physiotherapy.

After adjusting for multiple risk factors it was found that women who delivered via normal vaginal delivery have a greater chance of delivering an infant with OBPP. (OR = 25.7, 95% CI: 7.2 – 92.1). Women with parity > 4 have a greater chance of delivering an infant with OBPP (OR = 2.97, 95% CI: 1.1 – 7.9).

Using logistic regression the following model was obtained to calculate the probability of OBPP.

$$\text{Probability for OBPP} = \frac{e^{\text{exponent}}}{1 + e^{\text{exponent}}}$$

- (e = 2.71828)
- exponent = constant +/- variable scores.
- Constant = -1.7

- Risk factor scores according to logistic regression:

Age <35 years- 0.411; previous macrosomic infant- 2.282; height > 150cm –0.0092; parity of 3 – 0.0697; normal vaginal delivery – 3.187

RISK ASSESSMENT PROFILE FOR OBPP:

Using all the significant risk factors obtained via logistic regression and other individually significant risk factors, the following predictive model for OBPP was obtained using linear regression.

$Y= 6.999x\ 10^{-15} + (B \times variable)$

The model was highly significant (B=1.000) and the p values for all the predictive risk factors were 0.000.

TABLE 61: PREDICTIVE RISK VALUES

RISK FACTORS	FACTORS	Predictive risk value	CONSTANT	B
RACE	AFRICAN	3	$6.999x\ 10^{-15}$	0.121
	INDIAN	2		
	WHITE& COLOURED	1		
HEIGHT	≤ 150 cm	3		0.157
	> 150cm	2		
PARITY	primigravid	1		0.374
	1 or 2	5		
	3 - 7	2		
GRAVIDA	1 - 4	2		0.331
	> 4	5		
SUSPECTED MACROSOMIA	YES	5		0.288
	NO	1		

SUSPECTED CPD	YES	5		0.248
	NO	1		
ESTIMATED PELVIC CAPACITY	INADEQUATE	10		0.601
	DOUBTFUL	5		
	NOT DONE	2		
GESTATION	≤ 35 WEEKS	0		0.198
	> 35 WEEKS	3		
AGE	< 20 YRS	2		0.223
	20 – 38 YRS	4		
	> 38 YRS	5		
ESTIMATED BIRTHWEIGHT	< 3000 g	1		0.345
	3000g –3500g	4		
	>3500g	6		
PRESENTATION	CEPHALIC	1		0.345
	BREECH	5		
	HAND	5		
	SHOULDER	5		
	FACE	5		
MISSING		1		
TOTAL		/55		

Using the model the predictive risk can be calculated for OBPP. For example, a 25 year old African women with a height < 150cm, gravida of 3, parity 2, not suspected of having a macrosomic fetus, suspected of CPD, gestation 36 weeks, with a doubtful pelvic capacity estimate, and a fetus with a cephalic presentation and estimated birthweight of 3300g would have the following predictive risk score for OBPP.

$Y = 6.999x10^{-15} + (0.223x4 + 0.157 \times 3 + 0.331x\ 2 + 0.374 \times 5 + 0.288x\ 1 + 0.248 \times 5 + 0.198 \times 3 + 0.601 \times 5 + 0.345 \times 1 + 0.345 \times 4)$

Therefore Y = 10.75

The highest score for Y is 18.55 and the lowest score is 3.11.

The scoring system using the model has not been adjusted for medium scores.

The risk scores (refer to table 61) were categorized and the mean predictive risk score for the OBPP group was compared to the normal, macrosomic and CPD groups. The following crude guide was obtained.

A score between 11 and 23 was a low predictive risk score

A score between 24 and 26 was a medium predictive risk score

A score between 27 to 55 was a high predictive risk score.

Using the above categories the model was able to predict 61% of the OBPP cases in the high-risk category, 17 % in the medium risk categories and 22 % in the low risk categories.

The model also predicted 5% of the control CPD group as risk for OBPP, 7.5% of the control macrosomic group as high risk for OBPP and 22.5% of the normal control group as a high risk for OBPP.

CHAPTER FIVE
DISCUSSION

5.1 INTRODUCTION

"After delivery of the head, fat cheeks and double chin, perhaps with a little difficulty, time passes. The child's face becomes suffused. It endeavours unsuccessfully to breathe. Abdominal efforts by the mother or by her attendants produce no advance. Gentle head traction is equally unavailing. Usually equanimity forsakes the attendants. They push, they pull, alarm increases. Eventually, 'by greater strength of muscle or some infernal juggle' 'the shoulders of a goodly child are delivered. The pallor of its body contrasts with the plum-colored cyanosis of the face and the small quantity of freshly expelled meconium about the buttocks. It dawns upon the attendants that their anxiety was not ill-founded. The baby lies limp and voiceless and only too often remains so despite all efforts at resuscitation."
Professor Morris described this clinical phenomenon at a meeting at the Royal Victoria Infirmary. The complication of shoulder dystocia is far from uncommon and more often than not an unforeseen event. Many of these babies die while others are born alive with Erb Duchenne birth palsies from which recovery is not always complete. (Morris, 1955)

The case cited above would certainly be a reason for litigation. The scenario described by Professor Morris often follows a difficult delivery and if resuscitated results in some permanent damage. Most infants, who survive, are born with OBPP as found in this study that, 50 % of the cases of shoulder dystocia were diagnosed with OBPP. Erb's palsy deriving from traumatic delivery in connection with shoulder dystocia is probably the most frequent cause for malpractice claims against obstetricians in the United States (Iffy et al, 1996).

Against the background of an ever-expanding number of litigations against medical practitioners all over the world, the exponential increase of malpractice claims against

obstetricians on account of injury to the brachial plexus in the neonate, is a matter of concern for the medical profession. (Jakobovits, 1996).

This is also a matter of concern for the paramedical profession especially physiotherapists and occupational therapists. Due to the life-long impact (Wolf et al, 2000) of OBPP, those with the diagnosis, require therapy for the rest of their lives. The therapy includes preventative (especially prevention of contractures and injuries due to imbalance or sensory impairment), curative (treatment of injuries and contractures or wounds) and rehabilitative (strengthening and preparation for reconstructive surgery). This is just to mention a part of the role played by the therapist as others roles include that of a counselor and motivator, amongst others. Therefore prevention of these injuries by the adequate monitoring of risk factors viz. Race, parity, pelvic capacity, foetal weight, history of a previous big baby and number of weeks gestation is one of the means of prevention of this disabling injury.

5.2 OVERVIEW OF SAMPLE

The database at the four study sites was reviewed. The four chosen sites are referral centres for the Durban Metropolitan region as well as various regions of KwaZulu-Natal e.g. ADDH was a referral hospital for the Ndwedwe region which includes Osindisweni and the satellite clinics. King Edward VIII hospital was a referral center for the Lower Tugela Region, which included Stanger, and Umphumulo as well as the South Local Council and the central regions. The inner and outer west regions were referred to RK Khans hospital. (according to the Proposed referral patterns between levels of care, 1997, KEH).

However, these hospitals are presently being regraded. (personal communication – Senior Matron KEH) and the referral patterns will change accordingly.

The total number of deliveries at each hospital, for the years 1997 to 2000 was reviewed. The period chosen for the calculation of the incidence was selected on the available information. At ADDH, KEH and RKKH information for the OBPP cases and controls were available for the 4-year period. However at PMMH all neonates that were diagnosed with birth injuries or trauma or deviated from the normal were referred to the nursery. The diagnosis was not recorded in the birth register. Therefore the cases of OBPP could only be traced via the registers from nursery. However the only register available was for the period 01/04/1997 to 30/11/1997. The other registers were mislaid. Therefore the data are presented as the sample, that spans a 4-year period, which includes 3 hospitals and the data from PMMH which is over a 7- month period.

Therefore the data are presented as the sample that spans a 4-year period, which includes 3 hospitals and the data from PMMH which is over a 7-month period.

The format of the registers at ADDH, changed after 1998 and most of the cases of CPD were not recorded. For this reason the incidence of CPD and macrosomia was calculated for period 1997 and 1998.

5.3 DISCUSSION OF RISK FACTORS

In addition to accessing the records at the medical registry department, whose database was confirmed by reviewing the birth registers, the paediatric computer database for the International Classification of Diseases code 767.6 was also reviewed. The 23 cases recorded for KEH was reflective of those infants born at that hospital. Of the 23 cases 16 were traced via the records of the Medical Registry Department and 7 via the Brachial Plexus Clinic at KEH. Of the 16 cases from the Medical Registry Department only 4 were referred to the Brachial Plexus Clinic. Further analysis indicated that 6 of the 16 cases received Physiotherapy as an in-patient only and 6 of the 16 cases did not receive any Physiotherapy treatment.

The parallel search at the department of Physiotherapy revealed a total of 48 cases that were referred to the physiotherapy department during the study period. Analysis of the figures revealed that 5 of these cases were referred from RKKH, 3 from PMMH, 7 cases were from satellite clinics, 16 from other provincial hospitals in Durban, 6 from areas outside of Durban and 11 from KEH. The author while working at the Brachial plexus clinic at KEH had previously observed cases, that were not diagnosed on the initial examination post-delivery, but diagnosed during the follow-up visit and then referred to physiotherapy. This was hypothesis was proven when the analysis revealed that 7 cases that were traced via the Brachial Plexus Clinic were in fact not diagnosed at birth but diagnosed as OBPP during the follow up examination at the Paediatric Out Patient Department. Of the 7 only 4 files could be found for analysis. 2 were destroyed and 1 could not be traced. In all 4 cases analyzed, it was the mother who first noticed the birth palsy.

This study records an incidence of 0.85 per 1000 deliveries for OBPP, for the period 1997 to 2000 among three provincial hospitals in the Durban Metropolitan Area.

The results of this study concur with the findings of Perlow et al (1996) who found an incidence of 0.8 per 1000 live births. The incidence found in this study is lower than that in other developing countries eg. 3.6 per 1000 live births in Libya and 1.6 per 1000 live births in Malaysia as well as the findings by Wolf et al (2000) who recorded an incidence of 4.6 per 1000 deliveries in Amsterdam. However, Acker et al (1988) recorded a lower incidence of 0.68 per 1000 deliveries in Boston, Massachusetts and amongst others, McFarland et al (1986) also recorded a lower incidence of 0.5 per 1000 deliveries.

This study found an incidence of 3.35 % or 33.5 per 1000 deliveries for CPD, which concurs with the results of Everett (1975), who found an incidence of 3.4 %, however this figure was for the primigravidae only who required caesarian section for CPD. The figure in this study is much lower than those by (Frame et al, 1985 and Tadesse et al, 1996). A point worth noting is that the figures for this study were of the cases that were diagnosed clinically and none of the cases were diagnosed via X-Ray or computerized tomography. However on consultation with the midwives of the various hospitals it was brought to the authors notice that often "failure to progress" is recorded in the birth register under the complications of labour and often CPD is the cause but nor recorded. Failure to progress in labour could be due to other causes and with this in mind the author only included those cases that was recorded as CPD. It is for the stated reasons that the incidence for CPD cannot be recorded as a true value.

The incidence of macrosomia in this study is 1.67% or 16.7 per 1000 deliveries. This compares with the study by Parks et al (1978), who found an incidence of 1.6 % or 16 per 1000 deliveries. Gonen et al (1996), found a much lower incidence of 0.5% or 5 per 1000 deliveries in Israel, however their definition of macrosomia was infants having a birthweight of 4500 g and more.

The study sample had a fair representation of cases from the various regions as demarcated by the Durban Unicity Committee. With reference to Table 7, the majority of the sample was from the southern region compared to the rest of the DMA. This area is covered by three hospitals(ADDH, KEH and PMMH).

The racial distribution was as follows 87.4 % South African Blacks, 9.8 % South African Indians and 2.8% Coloureds. Although generalizations regarding the incidence of OBPP cannot be made with regard to race, as all race groups are not adequately represented, it was discovered that a high percentage of OBPP was prevalent among the Indian population.

Among the Black population 24.6% (41/167) were diagnosed with OBPP, however among the Indian population 56% (14/25) were diagnosed with OBPP. There were 10 Indian patients diagnosed with OBPP at RK Khans hospital. The total number of deliveries for the Indian population was 6 946. Therefore the incidence for the Indian population at RK Khans Hospital is 0.144 % or 1.44 per 1000 deliveries of Indian infants.

Yet, a cohort study of 42000 gravidas, Gordon et al, 1973 found a higher percentage of OBPP cases in the black population (68%) of New York compared to the whites (24%) and other races (8%). A prospective study of 26 176 Malaysian neonates, revealed a higher percentage of OBPP among the Malay (64.3%) ethnic origin than the Chinese (30.95%) or Indians (4.76%) (Boo et al 1991).

'The smaller the woman, the smaller the pelvis' is a rule-of-thumb frequently used by obstetricians in the diagnosis of contracted pelvis (Frame et al 1985). The study by Everett et al (1975) showed a definite relationship between short stature and severe disproportion in Dar es Salaam and the authors also believed that maternal height has some value as a screening test.

However, analysis of the maternal heights for this study demonstrated that this important indicator was recorded in only 40 % (80/199) of the sample. Maternal height was recorded in only 39.7% of the OBPP cases. (refer to Table 9). A maternal height, $\leq$ 150 cm was recorded for 35 % (8/23) of the OBPP cases and none of the controls were $\leq$150 cm. Further analysis of this group revealed that, 7 of the 8 cases $\leq$150cm did not have a pelvic assessment and the pelvic capacity was considered doubtful in 1 case. Of the 15 cases of OBPP that were > 150cm, 7 cases did not have a pelvic assessment and of the 5

cases that were assessed, the estimated pelvic capacity was considered to be doubtful in 4 cases and inadequate in 1 case. Further to this, of the 57 cases that were > 150 cm 15 of the cases were from the CPD control group and 19 from the macrosomic control group. These findings concur with the study by Frame et al (1985), whose results indicated that maternal height was not a good indicator of disproportion. The literature reviewed indicates a relationship between maternal height and pelvis size especially in the Black population and the majority of the cases that were ≤ 150 cm were assessed regarding their pelvic capacity, this indicator cannot be disregarded. Therefore the recording of maternal height or shoe size antenatally would be important.

Gordon et al (1973), found that 31% of the OBPP group were between the ages 20 –24 years and 25 % were under 20 years, which is similar to the results of this study where 36.7% of the OBPP cases were between the ages 20 to 30 years. The study by Soni et al (1985) indicated that 60 % of OBPP cases were found in women < 30 and 35.7 % between 30 – 39 years. However, Boo et al (1991), reported a higher percentage (48.8 %) for OBPP in the maternal age group 31 to 40 which correlates with the results of this study where the majority (42.9%) of the women for the OBPP group were between 31 to 38 years (refer to table 10).

As stated by Everett (1975), that in East Africa the antenatal selection of patients at risk of difficulty in labour and their early referral for delivery is of vital importance. The rural antenatal clinics, where the main burden of selection lies, are usually run by junior staff and record of risk factors is essential. There was a significant finding in this study regarding attendance at antenatal clinics. The findings indicated that 64.4% (29/45) attended the antenatal clinic regularly and that 15.5 % were unbooked mothers while 20% had a record of poor attendance.

Although several studies have described risk factors for OBPP, this study demonstrates a significant finding that these risk factors are not always recorded. On investigation of the

recording of risk factors antenatally, it was revealed that 52.9% (18/34) cases did not have any record of risk factors, 12/34 cases recorded risk factors such as breech, asthma, pregnancy induced hypertension, advanced maternal age and grandmultiparity.

Further investigation confirmed that 50% of the OBPP cases that did have any risk factors recorded antenatally did in fact have a post-natal diagnosis of OBPP.

Yet the review of literature reveals a number of predisposing factors that are consistently associated with OBPP. Levine et al, 1984 recognized the importance of screening for risk factors and devised a risk assessment profile retrospectively in his study of birth trauma. The authors believe that birth injuries will continue to occur unless the obstetrician is aware of these factors.

Although Perlow et al (1996) did not find any significant differences in the maternal variables for OBPP, 31.3 % of OBPP cases was recorded among primigravidae. While McFarland et al (1986), recorded a higher incidence of OBPP among those cases with gravidae 1-2. However results of this study differ in that the majority of OBPP cases (56.3% or 27/48) occurred in women with gravida >4 and had an odds ratio of 0.770 (95% CI 0.470 – 1.261).

The results of this study regarding the number of cases with OBPP born to primigravidas (22.4 %), differed from the results of 36% of OBPP in primigravidas, by Acker et al, 1988. Higher frequencies of OBPP were recorded for gravida 2 and 3.

Most studies only review parity (Soni et al, 1985; Gherman et al, 1998; Boo et al, 1991; Ubachs et al, 1995), however this study analyzed both gravida and parity, and found both to be significant.

Boo et al, 1991 found a higher frequency of OBPP with parity 1-4, whereas Acker et al found a higher frequency among nulliparous patients. McFarland et al found a higher frequency among those with parity >2 (CI =0.6, 1.4), which differs from the results of

this study that a higher percentage of OBPP cases occurred in women with a parity of 1-2.

Houchang et al, 1980 reported that the incidence of, previous delivery of an infant with a birthweight more than 4000 g, was significantly increased in macrosomic infants. This finding corroborates the results of this study, that 27 of the 37 women who had previous macrosomic infants delivered infants with birthweights between 4000g and 5500 g. These values were statistically significant, p= 0.001, for the fisher's exact test. The odds ratio for this group was 0.270 (95%CI 0.122-0.599) and a relative risk of 1.730 (95% CI 1.37-2.27) for infants with a birthweight of 4000g to 5500g. This proves that the majority of the cases of OBPP that delivered a previous big baby subsequently delivered a macrosomic infant.

Ecker et al, (1997) confirmed the findings of previous studies that the incidence of OBPP increased with increasing birthweight. This retrospective study examined the relationship between birthweight and OBPP to estimate the number of caesarians needed to reduce such injuries, however the authors realized that in practice the estimated birthweight only was available to the practitioner. The authors stated that weights estimated before delivery, whether by ultrasound or clinical estimation are notoriously inaccurate. This confirms the results of this dissertation, on comparing the estimated birthweight and actual birthweight it was found that birthweight was estimated up to 4000g only and those infants with a birthweight > 4000g were not accurately estimated. This concurs with the findings quoted by, Sandmire (1993), in his clinical commentary on the prediction of fetal macrosomia, reviewed other authors(Delpapa et al, 1991; Benson et al, 1987; Levine et al, 1992; as quoted by Sandmire, 1993) and reports of the inaccuracy of the prediction of large for gestational age (LGA) fetus. He quotes that when the weight estimate was 4500 g, the accuracy decreased to 22% with a 95% confidence interval of 3465 – 4993 g.

The findings of this study when comparing estimated birthweight to infant birthweight revealed that for the majority of the cases birthweight was underestimated by a mean of 811 g. This differs significantly from the results of Watson et al (1988) who found a mean underestimation of 277 g.

According to Ecker et al (1997), birthweight is a predictor of brachial plexus injury. The authors found that the greatest number of injuries occurred in nondiabetic pregnancies with birthweight less than 4000g which verifies the findings of this study. The mean birthweight for the OBPP group was 3791g.The majority of the OBPP cases (61.4% or 35/57) weighed between 3500g and 4500g and 26% weighed between 2000g and 3499g.

As stated by Benedetti et al (1978), shoulder dystocia is an infrequently encountered obstetric emergency and is associated with fetal macrosomia. Of the 58 cases of OBPP, 48.28% or 28/58 cases of OBPP were caused by shoulder dystocia. According to McFarland Erb's is a usual complication of shoulder dystocia. The study by Rydhstrom et al (1989), concurs with the results of this study, that up to 50% of all deliveries with shoulder dystocia involve a fetus with a birthweight of < 4000g. This study found that 53.57 % or 15/28 cases of shoulder dystocia had a birthweight between 4000g and 5300g and 46.43% or 13/28 cases had a birthweight of between 2000g and 3999g.

Comparatively few studies have reviewed the relationship between infant size and CPD. Allbrook et al (1961) reported that among the Ganda tribe the problem of disproportion between the size of the fetal head and that of the maternal pelvis frequently results in dystocia. In this study 50% of the infants in the CPD control group had a birthweight > 3500g. Only 9.6% or 5/52 cases were suspected of CPD for the OBPP cases. Analysis of the 5 cases that was suspected with CPD, indicated that the pelvic assessment in 2 cases were considered doubtful, 1 was considered as inadequate while 2 cases was not assessed.

Further analysis of the estimated pelvic capacity for the OBPP group proved that yet another risk factor was not considered as 68.9% did have a pelvic assessment. While 31.1% of the cases were considered to have an inadequate or doubtful pelvic capacity, 22.4% did not have any record of a pelvic assessment.

Boo et al, 1991 found that 97.6% of OBPP cases occurred in gravidas with a gestation period between 37 –41 weeks which is similar to the results of this study that had a mean gestation period of 38.7 weeks with a range of 28 –41 weeks while 90.2 % of the OBPP group recorded a gestation period of > 34 weeks.

The recent study by Wolf et al (2000), found the second stage of labour > 60 minutes to be statistically significant, however results of this study differ. This study found the second stage of labour between 7 to 28 minutes to be statistically significant for the OBPP group.

Another significant finding of this study was the total duration of labour was between 10 to 18 hours for the majority of the OBPP cases (77.6%) compared to 52.6% for the control group.

At PMMH, only 2 cases had record of the duration of labour, while 1 case did not record the duration, file notes stated that the OBPP diagnosis resulted from a difficult labour and a prolonged second stage of labour. Another case did not have any evidence of a record of the duration of labour. The 5th OBPP case was delivered by caesarian section. This case of a 24-year-old who attended the antenatal clinic regularly had record of a risk factor that stated 'transverse lie'. However, the expected mode of delivery was recorded as normal vaginal delivery. When the patient was admitted due to labour, a caesarian delivery was decided, due to a hand presentation. The estimated birthweight was 3200g and the birthweight of this infant was 3600g. The infant post delivery presented with a fractured right humerus and soft tissue injuries to the right hand. The file notes did not indicate any mitigating circumstances

Analysis of the expected mode of delivery and the method of delivery revealed that, 2 cases that were expected to deliver by caesarian section delivered vaginally. The first case was a breech presentation (carries a higher risk for OBPP- Acker et al, 1988), but due to the theatre being fully booked the patient had to deliver vaginally and resulted in an infant with OBPP. The other case that expected to deliver via caesarian section and had a vaginal delivery, was a 38 year old multigravid who had a history of a previous big baby who delivered a 4900 g infant whose labour was complicated by shoulder dystocia however there was no documented reason for the change in method of delivery despite the fact that this patient presented with multiple risk factors for OBPP.

On comparing the method of delivery for all groups it was found that the majority of the OBPP and macrosomic cases were delivered vaginally while the majority of CPD cases were delivered via caesarian section. This was found to be statistically significant ($p = 0.000$) and normal vaginal delivery carries a relative risk of 11.3.

Bager et al (1997) similarly found that 77% of the mothers of infants with OBPP experienced the birth as "difficult" or " very difficult" which correlates with the statistically significant findings of this study, that the majority of the OBPP cases (97.2%) were recorded as having a 'difficult' delivery.

A statistically significant finding of this study is that the midwives delivered most of the cases of OBPP (67.2%). This is consistent with the finding by McFarland et al, 1986 who found that delivery by a non-medical doctor showed an increased risk for Erb's palsy. Further to this it was also discovered that the majority of the midwives (66.7%) experienced difficulty during delivery compared to 30.3% of the doctors. Another confounding element that was reported by Acker et al (1988) was that recently graduated physicians, especially if placed in a high-volume practice, were more likely to deliver neonate with OBPP than those physicians with more experience.

Additional analysis of the delivery attendants revealed that the majority of the CPD cases were delivered by the doctor while the majority of the OBPP cases were delivered by the midwife. The majority of the CPD cases was diagnosed antenatally and was delivered by a doctor. The significant finding that the majority of the cases did not have any risk factors recorded and that a pelvic assessment was not done for the majority it appears that the women who produced infants with OBPP were not classified as 'risk' or 'high risk' cases.

Levine et al, (1984), found that 41.7% of the OBPP cases had an Apgar score < 7, whereas in this study 17.9% of the OBPP cases had an Apgar score < 7. However, the mean Apgar score for the OBPP group was the lowest (7.74) compared to the control groups. Added to this the OBPP group also had the lowest in the range for the apgar scores i.e. an apgar score of 1 was the lowest for the OBPP group compared to the lowest for the macrosomic group which was 6.

After adjusting for multiple risk factors it was found that normal vaginal delivery carried the highest risk factor for OBPP. This factor carries a relative risk of 11.3. Suspicion of CPD in gravid women was shown to be a significant predictor of OBPP with a relative risk of 4.224. Parity greater than 4 had a two-fold risk of OBPP and a doubtful or inadequate pelvic capacity carried a relative risk of 5.

This study also indicated that Indian women carried a higher risk for OBPP than African women. However, the sample group was too small to generalize and other race groups were not demographically representative of the population of Kwa-Zulu Natal, there were very few Coloureds and no Whites.

The risk assessment profile developed by Levine et al (1984), included shoulder dystocia, infant birthweight > 4000g, midforceps or low forceps used for delivery and primigravida

as risk factors however most of the factors cannot be scored antenatally and therefore would be unable to predict the risk of OBPP antenatally. The model obtained from this study lends itself to antenatal application and could predict 61% of the OBPP cases compared to the 50 to 72% prediction by Levine et al (1984). This model also allows for low to medium risk categories and although it is highly significant for the prediction of OBPP (B=1.000). The model can include other factors that were found to be highly significant and a risk for OBPP for example normal vaginal delivery and delivery by a midwife, if this was added to the profile the scores would be would be significantly higher, however these factors cannot be predicted antenatally. The purpose of the model was identify those patients prone to deliver an infant with OBPP. The profile was designed and applied retrospectively and therefore requires refining and validating in a cohort study.

CHAPTER SIX
CONCLUSION

This dissertation records the incidence for OBPP to be 0.85 per 1000 deliveries, which is a figure that is acceptable by the World Health Organization.

This study also records the incidence for CPD to be 33.5 per 1000 deliveries, which is consistent with the literature review.

This study further records the incidence for macrosomia to be 16.7 per 1000 deliveries, which is also consistent with the literature review.

This study concurs with Levine et al (1984) that certain groups of predisposing factors are overlooked when considered separately but in combination result in OBPP.
This study has found that normal vaginal delivery carries the highest relative risk for OBPP of 11.3, also that a doubtful or inadequate pelvic estimate carries a relative risk of 5, a race of Indian has a relative risk of 2.9 and a parity of 4 carries a relative risk of 1.9.

The following risk factors were found to be significant for OBPP: race, height >150 cm., gravida >3, parity > 4, history of a previous big baby, birthweight > 3700 g, suspected CPD, inadequate or doubtful pelvic capacity, first stage of labour between 5 –9.67 hours, second stage of labour between 0.12-0.47 hours, normal vaginal delivery, difficult labour, delivery by midwife and gestation period >35 weeks.

This study did not find a significant relationship between cephalopelvic disproportion and OBPP. Those cases that were diagnosed with CPD, delivered by caesarian section, further to this the majority of the cases did not have an examination of the pelvic capacity recorded. This important risk factor that would necessitate further investigation if found to be doubtful or inadequate, yet none of the cases in this study were investigated either by computerized tomography or magnetic resonance imaging.

A significant relationship was found between shoulder dystocia and OBPP. Fifty percent of the OBPP cases were diagnosed with shoulder dystocia. According to Sandmire and Halloin (1988), unfortunately, there are no definitive or reliable indicators to forecast this obstetric condition until delivery of the head.

Using standard statistical formulae the probability of OBPP can be calculated from the logistical regression formula, for those women with the risk factors of gravida >3, parity > 4 and gestation period > 35 weeks. Other factors that were significant and carried a high risk e.g. inadequate or doubtful pelvic capacity were not included in the model but its significance must not be disregarded but rather be included in a risk assessment profile as a separate factor with a high risk count.

The antenatal selection of patients at risk of difficulty in labour and their early referral for delivery in hospital is of vital importance. To await the signs of trouble in labour is often too late, as transport may not be available to take the patient to hospital. Rural clinics are often run by inexperienced staff and simple guidelines for the selection of "At Risk" patients would improve the quality of primary health care and save the lifelong costs involved in caring for patients with OBPP.

More importantly, according to Gilbert et al (1999), OBPP is a leading cause of litigation related to birth trauma. Record keeping is an important factor in these cases and if precautions are taken and patients at risk are properly advised and counseled litigation may be prevented and the patient would have made an informed decision regarding the mode of delivery and possible prevention of OBPP.

Although a highly significant risk assessment model was obtained from this study a cohort study would be advisable to test the validity of the model and to refine the 'high' or 'medium' and 'low' predictive risk scores in the prediction of OBPP which would significantly contribute to the prevention of this injury.

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ANNEXURES

ANNEXURE 1

TABLE 1: MEANS FOR MATERNAL AGE (excl. PMMH)

MATERNAL AGE

GROUP	Mean	N	Std. Deviation	Minimum	Maximum	Median	Range
Normal	25.4286	21	2.8385	21.00	30.00	25.0000	9.00
Macro-somia	29.8814	59	6.2920	18.00	43.00	31.0000	25.00
CPD	26.0169	59	6.3802	14.00	40.00	26.0000	26.00
OBPP	29.1429	49	7.5443	16.00	47.00	31.0000	31.00
Total	27.9787	188	6.6195	14.00	47.00	28.0000	33.00

FOR SAMPLE EXCL. PMMH

TABLE 2: MEANS FOR GRAVIDITY (excl.PMMH)

GRAVIDA

GROUP	Mean	N	Std. Deviation	Minimum	Maximum	Median	Range
Normal	2.0476	21	.8047	1.00	3.00	2.0000	2.00
Macro -somia	3.2667	60	1.5055	1.00	8.00	3.0000	7.00
CPD	2.2667	60	1.5279	1.00	7.00	2.0000	6.00
OBPP	3.0208	48	1.8159	1.00	9.00	3.0000	8.00
Total	2.7513	189	1.6034	1.00	9.00	2.0000	8.00

FOR SAMPLE EXCL. PMMH

ANNEXURE 2

TABLE 3: MEANS FOR FIRST STAGE OF LABOUR(excl.PMMH)

FIRST STAGE OF LABOUR

GROUP	Mean	N	Std. Deviation	Minimum	Maximum	Median	Range
Normal	5.5710	20	3.7756	.00	12.50	5.2500	12.50
Macro-somia	4.2483	59	4.3967	.00	17.75	3.7500	17.75
CPD	.5885	59	1.8095	.00	8.50	.0000	8.50
OBPP	7.2971	41	3.4662	2.08	16.67	6.4200	14.59
Total	3.8881	179	4.2701	.00	17.75	3.0800	17.75

TABLE 4: MEANS FOR THE SECOND STAGE OF LABOUR (excl.PMMH)

SECOND STAGE OF LABOUR

GROUP	Mean	N	Std. Deviation	Minimum	Maximum	Median	Range
Normal	.1185	20	.1012	.00	.42	8.0E-02	.42
Macro-somia	.4278	59	1.9598	.00	15.00	8.0E-02	15.00
CPD	.0000	59	.0000	.00	.00	.0000	.00
OBPP	.3334	41	.3633	.08	2.33	.2500	2.25
Total	.2306	179	1.1474	.00	15.00	8.0E-02	15.00

ANNEXURE 3

TABLE 5: MEANS FOR SECOND STAGE OF LABOUR IN OBPP GROUP(excl.PMMH)

	GROUP			Statistic	Std. Error
SECOND STAGE OF LABOUR	OBPP	Mean		.3334	5.674E-02
		95% Confidence Interval for Mean	Lower Bound	.2187	
			Upper Bound	.4481	
		5% Trimmed Mean		.2793	
		Median		.2500	
		Variance		.132	
		Std. Deviation		.3633	
		Minimum		.08	
		Maximum		2.33	
		Range		2.25	
		Interquartile Range		.1600	
		Skewness		4.439	.369
		Kurtosis		23.497	.724

TABLE 6: MEAN BIRTHWEIGHT FOR SAMPLE GROUP AT PMMH

BIRTH WEIGHT

GROUP	Mean	N	Std. Deviation	Minimum	Maximum
Normal	3.1000	10	.4243	2.00	3.50
Macro-somia	4.2300	20	.3105	4.00	5.00
CPD	3.1250	20	.3827	2.50	3.95
OBPP	4.3100	5	.6309	3.60	5.05
Total	3.6300	55	.6838	2.00	5.05

ANNEXURE 4

TABLE 7 : MEANS FOR GRAVIDITY (PMMH)

GRAVIDA

GROUP	Mean	N	Std. Deviation	Minimum	Maximum	Range	Median
Normal	2.6000	10	.8433	1.00	4.00	3.00	3.0000
Macro-somia	2.6000	20	1.3534	1.00	5.00	4.00	2.0000
CPD	1.7000	20	1.0809	1.00	5.00	4.00	1.0000
OBPP	3.2000	5	2.1679	2.00	7.00	5.00	2.0000
Total	2.3273	55	1.3341	1.00	7.00	6.00	2.0000

TABLE 8: ESTIMATED BIRTHWEIGHT AND INFANT BIRTHWEIGHT FOR PMMH ONLY.

			infant birth weight categories			
			100- - 3499 g	3500 - 4500 g	4510 - 5500 g	Total
estimated birthweight categories	1000 - 3499 g	Count	2	4	2	8
		% within estimated birthweight cat2	25.0%	50.0%	25.0%	100.0%
		% within infant birth weight cat2	100.0%	44.4%	100.0%	61.5%
		% of Total	15.4%	30.8%	15.4%	61.5%
	3500 - 4500 g	Count		5		5
		% within estimated birthweight cat2		100.0%		100.0%
		% within infant birth weight cat2		55.6%		38.5%
		% of Total		38.5%		38.5%
Total		Count	2	9	2	13
		% within estimated birthweight cat2	15.4%	69.2%	15.4%	100.0%
		% within infant birth weight cat2	100.0%	100.0%	100.0%	100.0%
		% of Total	15.4%	69.2%	15.4%	100.0%

ANNEXURE 5

TABLE 9: BIRTHWEIGHT FOR SUSPECTED MACROSOMIC FETUS

			infant birth weight categories		
			3500 - 4500 g	4510 - 5500 g	Total
SUSPECTED BIG BABY	YES	Count	1		1
		% within SUSPECTED BIG BABY	100.0%		100.0%
		% within infant birth weight categories	33.3%		20.0%
		% of Total	20.0%		20.0%
	NO	Count	2	2	4
		% within SUSPECTED BIG BABY	50.0%	50.0%	100.0%
		% within infant birth weight categories	66.7%	100.0%	80.0%
		% of Total	40.0%	40.0%	80.0%
Total		Count	3	2	5
		% within SUSPECTED BIG BABY	60.0%	40.0%	100.0%
		% within infant birth weight categories	100.0%	100.0%	100.0%
		% of Total	60.0%	40.0%	100.0%

TABLE 10: METHOD OF DELIVERY FOR THE DIFFICULT DELIVERIES

			DIFFICULT DELIVERY		
			YES	NO	Total
METHOD OF DELIVERY	NVD	Count	3	21	24
		% within METHOD OF DELIVERY	12.5%	87.5%	100.0%
		% within DIFFICULT DELIVERY	75.0%	42.9%	45.3%
		% of Total	5.7%	39.6%	45.3%
	C-SECTION	Count	1	28	29
		% within METHOD OF DELIVERY	3.4%	96.6%	100.0%
		% within DIFFICULT DELIVERY	25.0%	57.1%	54.7%
		% of Total	1.9%	52.8%	54.7%
Total		Count	4	49	53
		% within METHOD OF DELIVERY	7.5%	92.5%	100.0%
		% within DIFFICULT DELIVERY	100.0%	100.0%	100.0%
		% of Total	7.5%	92.5%	100.0%

ANNEXURE 6

TABLE 11: ENGAGEMENT OF FETAL HEAD FOR OBPP CASES AT PMMH

Crosstab

			CONTROL & OBPP GROUPS	
			OBPP group	Total
ENGAGEMENT	5/5	Count	3	3
		% within ENGAGEMENT	100.0%	100.0%
		% within CONTROL & OBPP GRP	75.0%	75.0%
		% of Total	75.0%	75.0%
	4/5	Count	1	1
		% within ENGAGEMENT	100.0%	100.0%
		% within CONTROL & OBPP GRP	25.0%	25.0%
		% of Total	25.0%	25.0%
Total		Count	4	4
		% within ENGAGEMENT	100.0%	100.0%
		% within CONTROL & OBPP GRP	100.0%	100.0%
		% of Total	100.0%	100.0%

APPENDIX 1

CASE DATA SHEET

NUMBER: _____

HOSPITAL: _____

1. CASE NUMBER : _____
2. D.O.B: _____
3. FILE NUMBER (MAT.): _____
4. FILE NUMBER (CHILD): _____
5. NAME: _____
6. I.D. NO.:_____
7. ADDRESS: _____
8. MARITAL STATUS: S / M/ D / W:
9. EMPLOYED / UNEMPLOYED
10. IF EMPLOYED PROFESSION: _____
11. MATERNAL DETAILS: HEIGHT: _____
12. EARLIEST WEIGHT BEFORE PREGNANCY:: _____
13. WEIGHT BEFORE DELIVERY: _____
14. AGE: _____
15. RACE: _____
16. HISTORY: DIABETIC: Y / N
17. CARDIAC: Y / N
18. OTHER: _____
19. OBSTETRIC HISTORY: GRAVIDA: _____
20. PARA: _____
21. ALIVE: _____
22. FETAL DEATHS: Y /N : _____ CAUSE: _____
23. C/S: Y / N
24. PREVIOUS BIG BABY: Y / N
25. ANTE-NATAL HISTORY: NO. OF VISITS: _____

26. NAME OF ANC. CLINIC OR HOSPITAL: _____
27. WEIGHT GAINED: _____
28. COMPLAINTS: _____
29. COMPLICATIONS: _____
30. ULTRASOUND: a. BPD: _____
    b. FL: _____
    c. AC: _____
31. ESTIMATED BIRTHWEIGHT: _____
32. OTHER TESTS AND INVESTIGATIONS: _____
33. RISK FACTORS: _____
34. PELVIC ASSESSMENT: _____
35. PELVIMETRY: _____
36. SUSPICION OF BIG BABY: Y / N
37. EXPECTED MODE OF DELIVERY : _____
38. ESTIMATED BIRTHWEIGHT: CLINICAL: _____
39. SUSPICION OF CPD: Y / N
40. LABOUR: NO. OF WEEKS: ____
41. SPONTANEOUS / INDUCED :
42. REASON FOR ADMISSION: LAB / CONTRACT / MEM. RUPTURE/ SHOW /OTHER
43. DURATION: 1^{ST} STAGE: _____
44. 2^{ND} STAGE: _____
45. 3^{RD} STAGE: _____
46. TOTAL DURATION: _____
47. DELIVERY: CONDITION: _____
48. PRESENTATION: _____
49. POSITION: _____
50. ENGAGEMENT: _____
51. FETAL WELLBEING: _____
52. ESTIMATE OF PELVIC CAPACITY: ADEQ/ DOUB/ INADEQ/
53. MOULDING: _____

54. COMPOSITE LABOUR GRAPH USED: Y / N
55. ANY COMPLICATIONS ENVISAGED? Y / N
56. MODE OF DELIVERY: NVD / FORCEPS / VAC. EXTR / C- SEC
57. DELIVERED BY: DR / MIDWIFE / STUD. NURSE / A.H /MED.STUD
58. SUPERVISED BY: DR/ MIDWIFE/ NONE
59. INDICATION FOR TYPE OF DELIVERY: _____
60. IF FORCEPS : INSTRUMENT: _____
61. TRACTION : _____
62. APPLICATION: EASY/ DIFFICULT/ V. DIFFICULT
63. IF VACUUM: SIZE OF CUP: _____
64. APPLICATION: EASY / DIFFICULT / V. DIFFICULT
65. STRENGTH OF TRACTION? _____
66. EPISIOTOMY: Y / N
67. METHOD OF REPAIR: _____
68. OXYTOCICS: Y / N
69. ESTIMATED BLOOD LOSS: _____
70. WAS DELIVERY DIFFICULT? Y / N
71. INFANT DETAILS: WEIGHT: _____
72. LENGTH: _____
73. SEX: _____
74. APGAR AT 1MIN: _____ AT 5 MIN: _____
75. HEART RATE AT 1 MIN: _____
76. GEN. CONDITION: _____
77. ANY BIRTH INJURIES: Y / N
78. DESCRIBE: _____
79. OBSTETRIC BIRTH PALSY PRESENT? Y / N
80. AFFECTED ARM? L /R
81. TIME NOTICED POST DELIVERY? _____
82. PERSON WHO NOTICED PALSY? _____
83. FOLLOW UP: Y / N
84. PHYSIOTHERAPY REFERRAL : Y / N