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Erb's Palsy in Jenin District: Prevalence and Risk Factors

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Dedication

من أعماق روحي... وبكل الحب المتواجد في قلبي... وعلى كل الراحة المبثوثة في أركان بيتي... وعلى الدعم المتواصل لإتمام دراستي وانتاج هذه الرسالة المتواضعة التي أهديها بكل حب إلى رفيق دربي وملهمي... "زوجي الغالي"... حفظه الله لي.

مع كل ضحكة أمل تنبعث من شفاه أبنائي الأحباء... "أبي وتيم"... مع كل كلمة تخرج من أفواههم تزيد حبي وعشقي لهم... ولكل لحظة صبر طفولي توجوني بها أم حنون... إليهم وهم أغلى ما أملك أهدي هذا العمل المتواضع بكل حب العالم.

بكل الإخلاص والوفاء... وعلى كل المساندة التي لا تعتبر غريبة أبداً على "أبي الحبيب" و "أمي الغالية" أدامهم الله تاجاً فوق رؤوسنا ومناراً يضيئ دربنا وملاكاً حارساً يحمينا ويبعث الراحة والطمأنينة في نفوسنا... وعلى كل التعب الذي كان وما زال مرافقاً لهم في تربيتنا وإخراجنا للعالم بأفضل صورة.. أهدي رسالتي إلى والدي العزيزين وإخوتي الأحباء.

مع كل الامتنان والمحبة... وعلى كل الجهد والعمل الدؤوب لإخراج رسالتي بشكلها النهائي واحتوائها على قيمتها العلمية المتميزة... أبعث شكري وامتناني وخالص احترامي ووفائي لمشرفتي وباعثة الأمل في روحي... إلى الغالية... "الدكتورة أميرة شاهين" لوقوفها إلى جانبي ودعمي في مشواري العلمي... لها مني كل الاحترام والمودة والشكر.

إلى مشرفي الغالي الذي كان يحثني بكل كلمة يقولها على اتمام رسالتي والتعب عليها... إلى معلمي "الدكتور خليل عيسى"... الذي ساندني بنصائحه وحثني على الاستمرار.

ولن أنسى أبداً كل من ساعدني في البحث والاستقصاء... وكل من استقبلني ورفع من شأن بحثي في الميدان... ولن أنسى شعبنا البطل وقدسنا الطاهرة...

إليهم جميعاً أهدي هذه الرسالة المتواضعة

الاقرار

انا الموقع ادناه مقدم الرسالة التي تحمل العنوان:

Erb's Palsy in Jenin District:

Prevalence and Risk Factors

اقر بأن ما اشتملت عليه هذه الرسالة إنما هي نتاج جهدي الخاص، باستثناء ما تمت الإشارة إليه حيثما ورد، وان هذه الرسالة ككل، أو أي جزء منها لم يقدم من قبل لنيل أية درجة علمية أو بحث علمي أو بحثي لدى أية مؤسسة تعليمية أو بحثية أخرى.

Declaration

The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

Student Name: **اسم الطالب:**

Signature: **التوقيع :**

Date: **التاريخ :**

List of Contents

List of Tables

List of Abbreviations

	what is it Stand for?
BMI	Body Mass Index
BPI	Brachial Plexus Injuries
CBPP	Congenital Brachial Plexus Palsy
CBR	Community Based Rehabilitation
CS	Caesarean Section
CP	Cerebral Palsy
C1-C7	Cervical Vertebra (1-7)
CHD	Congenital Hip Dislocation
CT	Computed Tomography
DM	Diabetes Mellitus
GDM	Gestational Diabetes Mellitus
IRB	Institutional Review Board
Lt.	Left
MBR	Medical Birth Register
MOH	Ministry Of Health
OBPI	Obstetric Brachial Plexus Injury
OBPP	Obstetric Brachial Plexus Palsy
OR	Odd Ratio
PMRS	Palestine Medical Relief Society
PRCS	Palestine Red Crescent Society
PROM	Passive Range Of Motion
RR	Relative Risk
Rt.	Right
SCI	Spinal Cord Injury
SD	Shoulder Dystocia
SPSS	Statistical Package of Social Silences
UE	Upper Extremity
UK	United Kingdom
UL	Upper Limb
USA	United States of America
T1-T7	Thoracic Vertebra (1 - 7)
UNRWA	United Nations Relief and Works Agency

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Abstract

Background:

Erb's palsy is a physical condition which results from injury to the fifth and sixth cervical vertebra; it causes paralysis or paresis of upper limb (UL) resulting in waiter's tip deformity of that affected limb. Its risk factors vary among individuals. In some cases, Erb's palsy does not have any identifiable risk factor while in other cases it has one or more factors associated with mothers, infants, or obstetric procedures. The most identifiable risk factors of Erb's palsy are shoulder dystocia, macrosomia and breech vaginal delivery. This study aims at determining the prevalence and risk factors of the Erb's palsy in Jenin district over the period from 2007 to 2011.

Methodology:

This study is case-control study of all available infants having Erb's palsy condition who were born in Jenin district's hospitals from Jan 1, 2007 to Dec 31, 2011 as cases compared to infants without Erb's palsy having the same age, same sex, and same place of residency as controls. Hospitals (private and governmental), rehabilitation centers, orthopedic doctors,

syndicate disabled, key persons in each area, relatives and friends were visited to identify all Erb's palsied cases in the district. Parents of Erb's palsied infants interviewed by phone to fill in the questionnaire. They were asked to give a name of a child -from their area-who had the same age and sex as their child and his or her contact information. The parents of controls filled in the questionnaire by phone, too. Any missed or uncertain information was confirmed by reviewing the medical files of the delivery rooms of hospitals.

Results:

There was 1.04/1000 live births (38 Erb's palsy cases from 36701 deliveries) prevalence of Erb's palsy in Jenin district during the mentioned period. 36 infants of them were included in the study and were compared to 36 controls of the same age, sex, and place of residency. No significant differences observed between the two groups due to many variables as macrosomia, diabetes mellitus (DM), gestational diabetes mellitus (GDM), obesity, maternal age more than 35 years, parity, previous child with Erb's palsy in the family, mode of delivery, Apgar score at 1 and 5 minutes, delivery specialist, and delivery hospital. Shoulder dystocia (SD) (P-value = 0.008, OR = 5.9, 95% CI) was the most significant associated risk factor with Erb's palsy followed by labour induction (P-value = 0.012, OR = 0.045, 95% CI). Other risk factors identified to be related to Erb's palsy in this study were excessive weight gain during pregnancy (P-value = 0.014, OR = 0.286, 95% CI), short second stage of labour (P-value = 0.014, OR =

2.1, 95% CI), and assisted vaginal delivery (P-value = 0.011, OR = 1.6, 95% CI). The dominant affected UL in our study was the right (Rt.) UL that found to be present in 77.7% of the cases.

Conclusion:

The prevalence of Erb's palsy found to be within the ranges presented worldwide. SD and labour induction both were the most significant risk factors of Erb's palsy in Jenin and these can be avoided with practice, training and more delivery experiences from both mothers and delivery specialists.

Keywords: Erb's palsy, Waiter’s tip deformity, Macrosomia, SD, labour induction.

Chapter One
Introduction

This chapter presents scientific background about Erb's palsy including its definition, classical sign, recovery, prognosis, risk factors, diagnosis, treatment and rehabilitation. This knowledge is followed by problem statement, goal and objectives, and finally the theoretical framework of this study.

1.1 Scientific Background

Erb's palsy is a type of birth palsy where injury occurs to the upper portion of brachial plexus while paralysis or paresis caused to muscles innervated by the roots of fifth and sixth cervical nerves [1-3]. The lesion is caused to Erb's point where the roots of cervical nerves 5 and 6 are united to form the upper trunk of the brachial plexus [1]. The third and fourth cervical vertebrae (C3 and C4) affected in 5% of cases leading to dysfunction of phrenic nerve and paralysis of the hemidiaphragm [1;4].

In 1872; Duchenne was the first to describe Erb's palsy and proposed that arm traction at birth to be its cause [4]. In 1874, the foremost German neurologist of his time Wilhelm Heinrich Erb (annex 1.1) defined the findings of Duchenne which then referred to as Erb-Duchenne palsy or more commonly "Erb's palsy" [3;4].

1.1.1 Erb's palsy Knowledge

Brachial plexus anatomy is a very complex one as it includes many interconnecting nerves within it. It is responsible for nerve supply of arm and shoulder, and essential for hand functions (Figure 1.1) [5;6]. The brachial plexus consists of the last four cervical vertebrae (C5, C6, C7 and C8) and the first thoracic vertebra (T1) (Figure 1.1) [5-8].

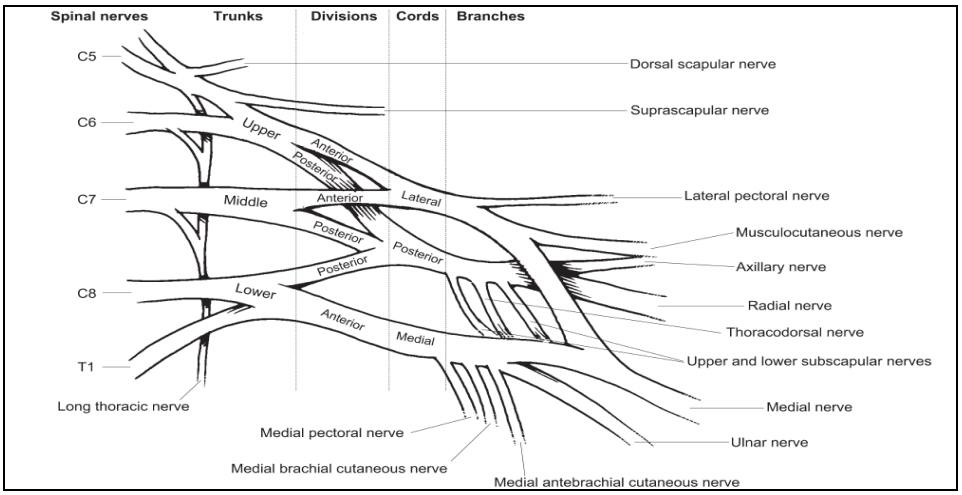

Figure 1.1: The brachial plexus [9].

OBPI classified according to anatomical nerves involvement and is divided into complete and incomplete injuries [6;7]. C5 through T1 are involved into complete injury that is also called total or Erb-Klumpke paralysis [4;6;9-11]. It is the second most common injury of OBPI where an infant suffered from total motor and sensory function loss results in a flail, paralyzed, numb, and areflexic arm[4;12-15].

Erb's palsy is the most common type of brachial plexus injury [7]. Its classical sign is “waiter’s tip hand, position, or deformity” [7;9]. This deformity caused by weaknesses or paralysis of shoulder muscles, elbow flexors, forearm supinator, and -in case of C7 involvement- fingers extensors [4]. In waiter's tip position; the arm is hanging limply from the shoulder that is internally rotated, the elbow is extended, the forearm is pronated, and the wrist and the fingers are flexed [1;4;9].

1.1.2 Erb's palsy risk factors

Risk factors of OBPI fall mainly into three categories: maternal, fetal, and obstetric risk factors. For Erb's palsy, the most associated risk factors are shoulder dystocia, macrosomia, and vaginal breech deliveries [1;9]. Other risk factors include; extremely short or prolonged second stage of labor, multiparous woman, use of vacuum or forceps in delivery, presence of previous Erb’s palsy child in the family, maternal diabetes, and too much lateral traction applied by inexperienced physician during delivery [1;9;16]. Caesarean section (CS) delivery cannot prevent occurrence of Erb’s palsy but it may reduce its opportunity to occur [1;17;18]. Erb's palsy occurrence in CS results from excessive lateral traction through the abdominal incision at the time of delivery, or from intrapartum forces on the brachial plexus before delivery [19].

1.2 Problem Statement

Worldwide; the incidence of OBPI ranges between 0.5 and 4.4 per 1,000 live births [9;17;19;19-25]. In England, the incidence of OBPI is less than 1/1,000 livebirths and rises to 5/1,000 live births in the developing countries [16]. OBPI accounts for 5% of birth injuries can occur in the presence or absence of shoulder dystocia (SD) regardless of delivery.

Incidence of Erb's palsy varies with time, healthcare services and geographic area [7;16;26]. Mackenzie et al study in 2007 shows an increase of Erb's palsy incidence over the last 20 years that accompanied with an increase in SD rates [7;16;26]. Other studies show the frequency of Erb's palsy to increase slightly or remain the same [18;25;27-30].

For the knowledge of the author, this study is the first study in Palestine where it will address the prevalence and risk factors of Erb's palsy. Also the study results will be compared to that present in the literature to verify similarity of our results to that presents worldwide. This study will be the basis for other related researches in the country.

During the researcher work as an occupational therapist, I have noticed that the cost of treating Erb’s Palsy is high and lifelong mainly if the infant requires surgical intervention. Most of Palestinian families have bad economic situation that will prevent them from seeking good rehabilitation services for their Erb's palsy infants. This study will highlight some of risk factors of Erb's palsy in Palestinian community that

will help to improve knowledge and practice of the health workers -mainly the midwives- in order to avoid its occurrence and consequences. On the other hand, it will help to improve public knowledge for early diagnose and rehabilitation of the affected infants to improve the outcomes of recovery process through spreading this study results mainly to the MOH.

1.3 Goal and Objectives of the Study

1.3.1 Goal

To determine the prevalence and risk factors of Erb's Palsy in Jenin district over the period from 2007 until 2011.

1.3.2 Objectives

- To determine the overall prevalence of Erb's palsy in Jenin district over the period from 2007-2001.
- To investigate the risk factors that are associated with having Erb's palsy in Jenin district.

1.3.3 Research Questions

»What is the prevalence of Erb's palsy in Jenin district throughout the period from 2007 - 2011?

»What are the risk factors that are associated with the occurrence of Erb's palsy in Jenin district during 2007 - 2011?

1.4 Theoretical framework of the study

Erb's Palsy presence in newborn infants occurred during his/her delivery in one of the hospitals or at homes of Jenin district during the period extended from 2007 until 2011 is the dependent variable of this study affected by many risk factors as described in the literature and presented in Figure (1.2).

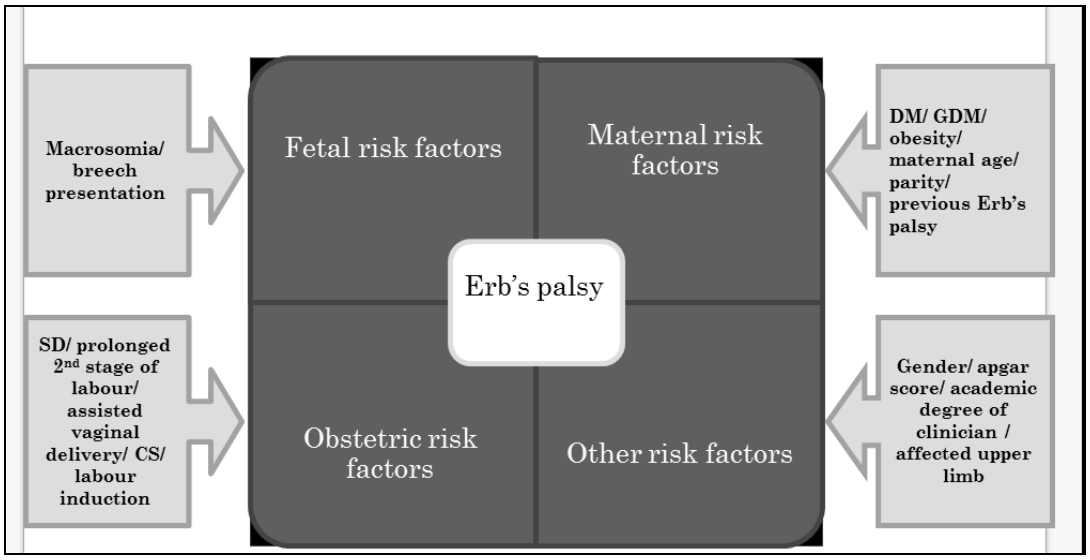

Figure 1.2: Erb's palsy and its risk factors

These risk factors are divided into four categories to ease data collection and data analysis. Definition and influence of each of these risk factors are presented in the following paragraphs:

1. Fetal risk factors: these risk factors are factors related to the fetus as:

Macrosomia: is large fetus weight that is 4000g or more for normal mothers or alternatively 4500g or more for diabetic mothers without concentration on gestational age [31]. Delivery of fetus with macrosomia is often preceded by labour dysfunctions mainly in the second stage of labour

[32-37]. It is often associated with a complication of SD that lead to the occurrence of Erb's palsy [38;39].

Breech presentation: is abnormal fetal position at delivery where the fetus delivered from his or her feet rather than his or her head that may cause some obstacles during delivery and need experienced and trained clinicians [40].

2. Maternal risk factors: these are risk factors that occur with the mother:

Diabetes mellitus or gestational diabetes: that occurs in pregnant women. The diabetic pregnant women tend to have larger fetus weight as it is one leading factor of macrosomia and refers to genetic factors mainly [18;41-46]. Mothers with GDM are often older, more obese, have more chronic hypertensive diseases, become more vulnerable to have multiparous pregnancy, and are more susceptible to have infants weighing more than 4,000 g [43;47;48].

Obesity: is defined as abnormal or excessive accumulation that has a risk to health (WHO). It is measured by the body mass index that divides the individual's weight into kilograms by the square of his or her height in meters. Individuals with BMI 30 or greater are considered obese. Those with BMI 25 or greater are considered being overweighed (WHO). The maternal obesity leads to deliveries complicated with SD that may cause Erb's palsy [49].

Excessive weight gain during pregnancy: gaining weight more than recommended for the pregnant women. These recommended weights are : 12.5-18 for underweight women at the beginning of pregnancy, 11.5-16 for women with normal weight, 7-11.5 kg for overweight women, and 6.8kg for obese women [50]. Excessive weight gain more than recommended during pregnancy increase the risk for having Erb's palsy during delivery process [43].

Primiparity: women who get pregnant for the first time [51]. The primiparous women have an increased incidence of Erb's palsy especially in the case of SD occurrence [52].

Multiparous mother who is pregnant for at least the second time [51]. Multiparity especially more than five deliveries have the safest pregnancy outcomes, having older maternal age, and more susceptible to get macrosomic and malpresented fetus [53]. Multiparous women are less susceptible to vacuum extraction than nulliparous women that will make them have less risk to have Erb's palsy [54;55].

Previous child with Erb's Palsy: the mother experienced previous Erb's palsy child whether recovered or still having Erb's palsy. The occurrence of previous Erb's palsy has a little contribution to the occurrence of another case within the family [11;56]. The delivery of previous macrosomic infants can lead to recurrent delivery of macrosomic infants that will lead to Erb's palsy [43].

3. Obstetric risk factors: these risk factors are risk factors occurring during delivery because of health staff mistakes and include:

Shoulder dystocia: an impaction of the infant's anterior shoulder behind the maternal symphysis pubis [(2)]. It is more likely to occur in fetuses have a birthweight more than 4,000 g that cause more forceful traction of the head to be applied by the clinician during delivery that widen the angle between neck and shoulder causing hyperextension of the ipsilateral brachial plexus [(57-61)]. In many studies, SD found to be the most significant risk factor of Erb's palsy [(62)]. There are many risk factors associated with SD and lead to Erb's palsy include: infant birthweight equal or more than 4,000 g, maternal diabetes, and prolonged second stage of labor [(38)].

Induction of labor: is the process of making the delivery occurs by some methods that stimulate uterine contractions and fastening delivery process [(63)]. Induction of labour considered to be a risk factor for Erb's palsy [(64)]. Labour induction for macrosomic fetuses will decrease the incidence of Erb's palsy [(62)].

Prolonged second stage of labor: the time period from which she's begun having the strongest birth contraction to the time of delivering the head of the fetus which is mostly more than 20 minutes to be considered as prolonged second stage of labour. The most cases of Erb's Palsy has a prolonged second stage of labour [(36;65)]. If the second stage of labour was shorter than 20 minutes this can prevent occurrence of Erb's palsy [(32)].

Mode of delivery: is the way of delivering the baby whether it was spontaneous vaginal delivery or by Caesarean Section. If it was vaginal delivery whether it was instrumented or non-instrumented. The instrumented vaginal delivery It includes the use of forceps, vacuum extractor, or episiotomy [16]. CS mode of delivery reduce the risk of Erb's palsy but not preventing its occurrence [62]. Elective CS is recommended to reduce the occurrence of Erb's palsy in women with GDM and fetus weight of or more than 4,250g [43].

Assisted vaginal delivery: it is an obstetric intervention including the use of some instruments to assist the vaginal delivery. These instruments includes forceps or vacuum cups [66]. The assisted vaginal deliveries mainly the episiotomy found to be higher in Erb's palsy cases [52].

4. Other risk factors: include:

Apgar score: system used to evaluate the physical condition of newborn at birth with scores from 0-10 at 1 and 5 minutes. This evaluation includes heart rate, respiratory effort, muscle tone, reflex irritability, and color. Each one has three scores from worst condition to good one (0, 1, and 2). If their summation is three and below then the baby condition is critically low, 4-6 fairly low, and 7-10 is normal. It was found that the cases of Erb's Palsy have apgar score less than 7 both at 1 and 5 minutes [65].

Chapter Two
Literature Review

This chapter presents epidemiological studies of Erb's palsy at global, regional and local levels. It also focuses on the studies that searching the risk factors of Erb's palsy. These risk factors include fetal risk factors, maternal risk factors, obstetric risk factors and some other risk factors that present in the literature.

2.1 Literature on Incidence/Prevalence of Erb's Palsy

2.1.1 At global level

In the United States of America (USA), Erb's palsy affects more than 4500 newborns annually with an incidence of 0.13-5.1%(8;8;36;67-70). Erb's palsy incidence has gradually declined from 1.7/1000 livebirths in 1997, to 1.6/1000 livebirths in 2000, and finally 1.3/1000 livebirths in 2003 with a mean incidence of 1.51 ± 0.02/1000 livebirths [(62)]. This decline was related to the increase of CS for expected macrosomic fetuses [(62)].

A retrospective study that was done in Los Angeles in 2010 by Ouzounian et al found a prevalence of Erb's palsy to be 0.7% of all the vaginal deliveries occurring between 1995 – 2004 [(38)]. In New York, Weizsaecker K et al made a case-control study revealed prevalence of Erb's palsy to be 4.1/1,000 live births and 5.5/1,000 of all the vaginal deliveries occurring between 2000 and 2004 [(65)].

In the United Kingdome (UK) and Republic of Ireland, an active surveillance of newborn infants was done in 2003 resulted in a mean incidence of 0.42/1000 livebirths for Erb's palsy [27]. Where the incidence in UK was 0.41/1000 livebirths and in Republic of Ireland was 0.45/1000 livebirths [27].

In UK ; in 2005 a retrospective study was done by Tandon, and Tandon found the incidence of Erb's palsy to be 0.96/1,000 livebirths [52]. In 1976 the study of Bennett and Harrold verified the incidence of Erb's palsy to be 0.61/1000 livebirths [27]. While in Ireland there is another study done by Donnelly et al in 2002 found the incidence of Erb's palsy to be 1.5/1000 livebirths [36].

Two population-based studies conducted in Sweden to determine Erb's palsy incidence [18;71]. The first study was between 1987 and 1996 that show the incidence of Erb's palsy to be 1.3/1000 livebirths [71]. The second study was between 1987 and 1997 that showed an incidence of 0.19% [18]. This study showed increase of incidence from 0.17% in 1987 to 0.27% in 1997 that explained by higher frequency of high birthweight more than 5,000 g that accounts for 4.3% of Erb's palsy cases [18]. In 1988; Sjoberg et al found the incidence of Erb's palsy to be 1.9/1000 livebirths [72].

In Netherland, Wolf et al in 2000 conducted a study that measured the incidence of Erb's palsy to be 0.46% [68].

2.1.2 At regional Level

For the knowledge of the author and after long searching literature looking for Erb's palsy studies searching on its prevalence, the following studies are the only ones that were found.

A retrospective study conducted in Tuzla in 2006 by Hudic et al indicated that the incidence of Erb's palsy was 1.89/1,000 livebirths [16].

Al-Rajeh et al conducted a study in Saudi Arabia that determine the incidence of Erb's palsy to be 1.19/1000 livebirths in 1990 [73].

In Israel, which is the nearest region to our country, the incidence of Erb's palsy found to be 1.48/1000 livebirths in 2001 according to the study made by Bar et al [23].

2.1.3 At local level

For the knowledge of the author; there was not found any study searching on Erb's palsy in Palestine.

2.2 Literature on Risk factors of Erb's Palsy

The Risk factor of OBPI in the early 1900s was considered to be the excessive traction applied on the upper limb of larger infants with SD during delivery [5]. While the most recent studies suggested the OBPI to be a multifactorial condition including interaction between the brachial plexus, maternal and infant risk factors, and the forces applied during delivery

process [5]. In case of Erb's palsy, there are two main risk factors, macrosomia and SD [18;57-60;71;74;75].

2.2.1 Literature on Fetal Risk Factors of Erb's palsy

Macrosomia is considered to be the most predisposing and identifiable risk factor of Erb's palsy [20;23;54;75-80]. It plays a major role in morbidity and mortality of fetuses and pregnant women [39;53;81]. Macrosomic fetus's delivery often preceded by labour dysfunctions mainly in the second stage of labour [32-37].

There is no exact measure of macrosomia; each study follows a particular standard. Some studies consider macrosomic fetuses to have birthweight more than 3,500 g [68]. This birthweight is considered to be one of the predisposing factors of birth injuries including Erb's palsy according to the study conducted by Borna et al in Iran in 2010 [64].

Most studies consider fetus with birthweight more than 4,000g to be a macrosomic fetus [23;27;65;68]. This birthweight is considered as one of the most predisposing risk factors of Erb's palsy [16;27]. In some studies they consider macrosomia to have a contribution to the occurrence of Erb's palsy as Weizsaecker et al in 2007 and Mollberg et al in 2005 [18;65]. Mollberg et al found the birthweight of 3,999g to increase the risk of Erb's palsy by 7 times more than lower birthweight mainly in the presence of SD and vacuum extraction [54].

The risk of Erb's palsy increases with birthweight equal to or more than 4,500g [11;18;23;32;54;62;82]. Mollberg et al in 2005 found the birthweight of 4,500g or more to be higher in nulliparous women than in multiparous women [54].

On the other hand, Tandon and Tandon found no significant association between macrosomia and Erb's palsy [52]. Ouzounian et al in 2012 supported the finding of increasing risk of Erb's palsy with birthweight equal to or more than 4,500g but they considered it not statistically significant to cause Erb's palsy [38].

Many studies suggested that the ***breech presentation*** deliveries cause much sever Erb's palsy cases because the nerves are torn resulting into root avulsion injury [83;84]. Nerve avulsion requires much more force to be produced than nerve rupture [85]. It occurs if the nerve group successfully resist the rupture force [85].

Breech deliveries was found to be the fourth significant risk factor of Erb's palsy in Foad et al study in 2008 [62]. Hudic et al in 2006 found the infants who had breech deliveries to be more likely to have Erb's palsy than those who had cephalic deliveries [16]. This finding was assured before by Mollberg et al and Wolf et al [18;68].

In a retrospective study of Al-Qattan et al based on Narakas classification 1987 (annex 2.1) done in Saudi Arabia; found that infants

born with breech presentation to be more likely to develop upper Erb's palsy and extended Erb's palsy than those born in cephalic presentation [86].

On the other hand, the study of Evans-Jones et al found no association between Erb's palsy and breech presentation [27].

2.2.2 Literature on Maternal Risk Factors

Some studies as Pondaag et al in 2011 and Mehta et al in 2006 found no association between ***DM*** and the occurrence of Erb's palsy [11;32;54].

Ouzounian et al in 2012 related Erb's palsy to maternal DM with an OR of 2.7 but with no statistical significance [38].

Many other studies assure the relationship between DM and Erb's palsy as Wolf et al in 2000, Bar et al in 2001 and Mollberg et al in 2005 with an OR of 2.4[16;18;23;65;68;87].

The diabetic pregnant women tend to have larger fetus weight [18;41-46]. These infants are more likely to have total palsies than others while non-diabetic mothers' infants most often likely to have Erb's palsy [88].

Gestational Diabetes Mellitus ***(GDM)*** is one of the factors increasing the occurrence of maternal and neonatal complications [47;89;90]. Mothers with GDM are often older, more obese, have more chronic hypertensive diseases, become more vulnerable to have multiparous pregnancy, and are more susceptible to have infants weighing more than 4,000g [43;47;48].

In literature, there was a significant relationship between GDM mothers and Erb's palsy occurrence [48]. Weizsaecker et al in their study noticed a large prevalence of GDM in mothers of Erb's palsied infants [65]. Suhonen et al in 2008 found the risk of Erb's palsy to increase when the pregnant women have GDM in association with infant birth weight more than 4,000g [43].

Obesity is one of the factors leading to the occurrence of Erb's Palsy [16;65]. Weizsaecker et al in 2007 found a significantly high maternal body mass index (BMI) in infants with Erb's Palsy [65]. Maternal obesity accompanied with SD lead to Erb's palsy in most of the cases [49]. Mehta et al study in 2006 found the maternal obesity to be the most associated risk factor of Erb's palsy with an OR of 7.04 [32]. In other studies, maternal obesity had no association to Erb's palsy [36;91].

Significant statistical association was found between ***excessive weight gain during pregnancy*** and Erb's palsy by some studies as the study of Suhonen et al in 2008 and Mollberg et al in 2005 [18;43]. While Donnelly et al study found no significant association between excessive weight gain during pregnancy and the occurrence of Erb's palsy [36].

Many studies found that mothers who are ***more than 35 years old*** at the time of delivery to be more susceptible to have an Erb's palsied infant [16;92]. In Bar et al study in 2001 maternal age of Erb's palsy infants was

older than maternal age of healthy infants with a mean of 32.1 ± 5.2 years old [23].

On the other hand, many other studies found no association between the maternal age and the occurrence of Erb's palsy as the study of Mollberg et al in 2005and the study of Mehta et al in 2006 [32;54].

The pregnant women are classified according to their ***parity*** into primipara and multipara woman. The primiparous woman is that one having her first child while the multiparous woman is that one having more than one child. Primiparity is another risk factor of Erb's palsy [52]. Tandon and Tandon in 2005 found the primiparous women to have an increased incidence of Erb's palsy especially in the case of SD occurrence [52]. While the studies conducted by Hudic et al and Mehta et al in 2006 found the opposite [16;32].

Fetus, mother, family and society consequences are associated with high parity [53]. High parity has an overall incidence of 10%-30% especially in the Muslim countries due to poor acceptance of family planning methods, spread of early marriage, and the norm of large-family [53]. Multiparity especially more than five deliveries have the safest pregnancy outcomes, older maternal age, less susceptible to vacuum extraction, and more susceptible to get macrosomic and malpresented fetus [11;53-55].

Hudic et al in 2006 found no significant association between Erb's palsy and multiparous women [16]. In USA 2008; Foad et al found that multiparity to reduce the risk of Erb's palsy [62]. In Sweden 2005, Mollberg et al found Erb's palsy cases to present in multiparous women more than in nulliparous women [54]. While Wolf et al study in 2000 showed a statistical significance between multiparous women and the occurrence of Erb's palsy [68].

The presence of **previous child with Erb's palsy** has no or little contribution to the occurrence of another Erb's palsy case within the family with a percentage of less than 1% in the study of Pondaag et al in Netherland and this percentage arises to 14% in the study of Al-Qattan and Al-Kharfy in Saudi Arabia [11;36;56]. Suhonen et al in 2008 suggested that the delivery of previous macrosomic infants could lead to recurrent delivery of macrosomic infants that will lead to Erb's palsy [43].

2.2.3 Literature on Obstetric Risk Factors

Shoulder dystocia is a significant risk factor for brachial plexus palsy resulting from disproportion between fetal passenger and pelvic passageway [11;93]. It is more likely to occur in fetuses who have a birthweight more than 4,000g causing more forceful traction of the head to be applied by the clinician during delivery [57-61]. This traction will widen the angle between neck and shoulder causing hyperextension of the ipsilateral brachial plexus [57-61].

SD is found to be the most significant associated factor that increases the risk of Erb's palsy [27;36;54;62]. SD is found to increase with birthweight equal to or more than 4,000g [18;27;54]. There are many factors associated with SD and lead to Erb's palsy too as GDM that was found by Fadl et al in 2010 [48]. Other factors include infant birthweight equal or more than 4,000 g, maternal diabetes, and prolonged second stage of labor [38].

Many other studies indicated poor or no association between Erb's palsy and SD [29;94-98]. In the study of Weizsaecker et al one-third of Erb's palsy cases were not associated with SD [65]. While a study of Gherman et al found that one-half of Erb's palsy cases weren't associated with the occurrence of SD [97;99].

Maternal and infant weights are found to be much lower when Erb's palsy presents without SD [29;30;49;94;96;97;99;100]. Rapid second stages of labour and posterior arm injuries are found to be more common in cases without SD too [30;97].

Prolonged second stage of labour is found to be present in most cases of Erb's Palsy with statistically significant association [36;65;68]. Mehta et al in 2006 indicated that if the second stage of labour was shorter than 20 minutes it can prevent the occurrence of Erb's palsy [32]. Rapid, strong or precipitous second stage of labour also causes Erb's palsy to occur [16;87;97;100]. On the other hand, Pondaag et al in 2011 and Ouzounian et al in

2012 found no significant association between Erb's palsy and second stage of labour [11;38].

Second stage of labour is found to be associated with SD and parity [49;52]. Sandmire and DeMott found that second stage of labour in case of SD to be shorter than that presented without SD [49;79;87;101]. In the study of Tandon and Tandon in 2005 the second stage of labour was longer in the primiparous women than the multiparous women [52].

Assisted vaginal delivery is considered one of the significant risk factors of Erb's palsy [27;64]. In the literature, there was a significant association between assisted vaginal delivery and Erb's palsy [16;18;27;68]. Foad et al in 2008 found that assisted vaginal delivery to be the third significant risk factor of Erb's palsy [62]. While Mehta et al in 2006 found no association between Erb's palsy and assisted vaginal delivery [32].

Assisted vaginal delivery includes the use of forceps, vacuum extractor, or episiotomy [16]. Episiotomy is found to be higher in Erb's palsy cases but not enough to be statistically significant [23;52]. Vacuum and forceps use is found to cause Erb's palsy but not enough too to be statistically significant [38]. Forceps use is noted to be higher in infants with Erb's palsy but did not reach the statistical significant [27;52;62].

In vacuum extraction, the extraction time should not exceed 20 minutes and it should interrupt if there is not any noticeable progress after three consecutive pulls [54;102]. Mollberg et al indicated the risk of Erb's

palsy to increase if the extraction time was equal to or more than 10 minutes [54]. The study of Foad et al in 2008 confirmed the association of Erb's palsy and vacuum extraction [62].

Caesarian section mode of delivery reduces the risk of Erb's palsy but does not prevent its occurrence [27;62;78;80;94]. Suhonen et al in 2008 suggested an elective CS to reduce the occurrence of Erb's palsy in women with GDM and fetus weight of or more than 4,250g [43]. Donnelly et al in 2002 found no significant association between mode of delivery and Erb's palsy [36].

Erb's palsy was significantly associated with ***induction of labour***[18;64;99;103]. Other studies documented no significant association between Erb's palsy and labour induction [16;32;54;104]. Labour induction for macrosomic fetuses was shown to decrease the incidence of Erb's palsy [62].

2.2.4 Literature Review on Other risk Factors

No significant association is found between ***sexes*** and Erb's palsy [11;16;52;105]. Evans-Jones et al in 2003 found a slight male sex preference over female sex in Erb's palsy [27]. While Wolf et al in 2000 found Erb's palsy to be more common in females than males [68].

Cases of Erb's Palsy found to have ***Apgar score less than 7*** both at 1 and 5 minutes [16;18;65;105]. Tandon and Tandon in 2005 found the Apgar score of Erb's palsied infants to be less than 5 [52].

No significant associationis found between Erb's palsy occurrence and ***clinicians or midwifes education and experience*** [54;68;78].

The most cases in the study of Tandon and Tandonin 2005 were ***Lt. sided Erb's palsy*** due to more commonness of the Lt. occipito-anterior position at the start of labour [52]. Evans-Jones study indicates ***Rt.-sided Erb's palsy*** to be more frequently presented in their sample in 2003[27].

Chapter Three

Methodology

Chapter three describes the methodology of the study. Study design, settings, population, inclusion and exclusion criteria, sample size and sampling techniques, data collection process and tool, data analysis procedure and ethical issues are explained in this chapter. It also includes the limitation and obstacles that faced the researcher throughout data collection process.

3.1 Study design

This is a case-control study was chosen based on ratio of 1:1. Similar study design was used by other studies that were found to investigate this health problem[23;52;104;105]. This study is conducted to determine the prevalence of Erb's palsy and to investigate its risk factors in Jenin district. All the available Erb's palsied infants were born over the period 2007 until 2011 in one of Jenin's hospitals, and they meet the inclusion criteriawhich is involved in the study. Controls matched for age, sex and place of residency.

3.2 Study Settings

The study conducted in Jenin's city, camp, and its 76 villages. Erb's palsy cases of this study are children born in one of the three hospitals in Jenin; "Jenin Governmental Hospital" as the only governmental hospital,

"Al-Razi Hospital" and "Al-Amal Hospital" as the two private hospitals. UNRWA population usually undergoes delivery in one of these three hospitals. It’s worth mentioning that home deliveries are always registered in Jenin Governmental hospital.

Erb's palsy cases were recruited through visiting rehabilitation centers in the district. These centers included the physiotherapy clinic in Palestine Red Crescent Society (PRCS), rehabilitation workers in Community Based Rehabilitation (CBR), program of the Palestine Medical Relief Society (PMRS), Al-Galil society, physiotherapy UNRWA clinic, Al-Shifaa center for physiotherapy, Shawki Amer Physiotherapy Center, Qabatia Rehabilitation Society, Al-Rahma center, Al-Ri'yah center, Al-Basheer Center.

3.3 Study population

The population of this study includes all the available newborn babies who were delivered in Jenin district from the beginning of January 2007 until the end of December 2011 in one of the district’s three hospitals, delivery centers, or at homes.

3.4 Inclusion criteria

Cases: Infants having an Erb's palsy condition from Jenin district born in one of Jenin's hospitals or at home during the period included in the study (2007 until 2011).

Controls: Infants from Jenin district who do not have Erb's palsy and were born in one of Jenin's hospitals or at home during the period included in the study (2007 until 2011) from the same sex, place of residency, and year of birth of the corresponding case.

3.5 Exclusion criteria

Cases: infants who are not residents of Jenin district, were born before or after the study period (2007-2011), and normal or have other medical conditions.

Controls: infants who are not residents of Jenin district, were born before or after the study period (2007-2011), have other medical conditions, and normal infants from another sex, place of residency or year of birth of the corresponding case.

3.6 Sample size

The study sample is convenient including all the available Erb's palsied infants who were born in one of the three hospitals of Jenin city from 2007 until 2011 as cases. Same number of controls was recruited to match for the same birth year, sexes, and residency place. This has yielded a sample size of 72 infants from which 36 infants are cases and 36 infants are controls.

3.7 Data collection process

Data collection process had three stages; the first stage was the stage of cases identification by visiting all the rehabilitation centers working in

the district, the orthopaedic doctors, Disabled Persons' Federation, and personal contact - relatives, Friends, specialists working in the field of rehabilitation and friends and relatives of all these- . From this stage, the researcher had a list of 109 cases that were identified as having Erb's palsy.

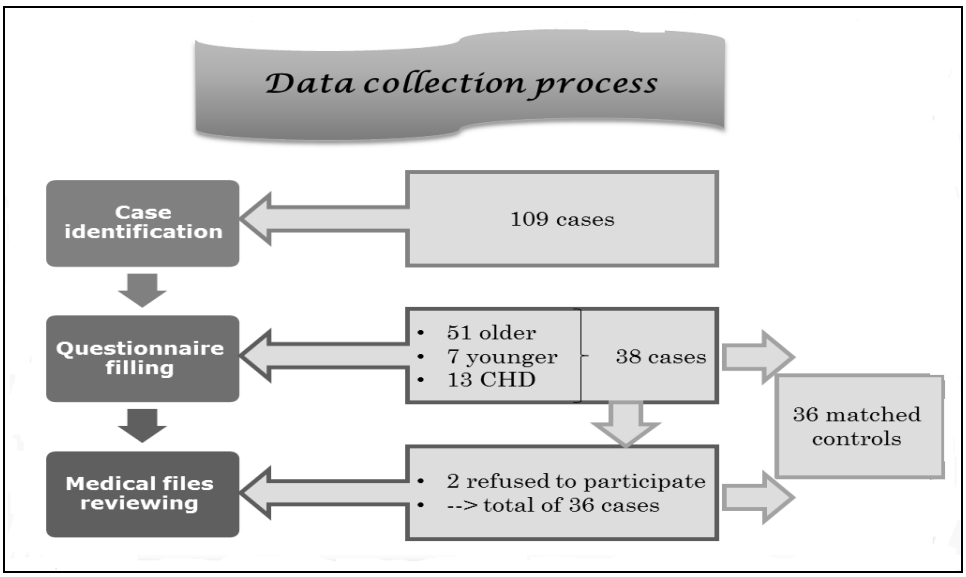

Figure 3.1: data collection process and sample size.

The second stage started by filling the questionnaire of Erb's palsy (annex 3.1). In this stage, the researcher had a list of names with some telephone numbers and places of residency. The researcher had to contact some officials such as the ministry of Interior and the Palestinian national authority in order to have contact information of each person in the cases list. Relatives, friends, important people in the villages, and the relatives and friends of the researcher's relations were also contacted for the same reason.

At the end of the second stage, there were51 persons older than the search age, 7 persons younger, and 13 persons had Congenital Hip

Dislocation (CHD). The persons who had Erb's palsy and were included in the sample were 38 cases from which the parents of one case denied the presence of Erb's palsy in their child and the parents of another case refused to cooperate with the researcher.

The selection of controls took place during filling out the questionnaires, through asking the parents to give the researcher a name and contact information of another child who had the same sex, from the same place of residency and was born in the same year. These controls' parents were also asked to fill out the same questionnaire as the Erb's palsied infants' parents' except for questions related to Erb's palsy occurrence and treatment.

In the third and last stage of data collection, the researcher reviewed the medical files of the delivery rooms and in the archive of Jenin's hospitals. These files were reviewed to confirm the data presented in the questionnaire and the data that could not be taken from the parents.

3.8 Data collection tool

The researcher constructed a questionnaire based on Literature to achieve the study goal. The questionnaire of Erb's palsy was performed by the researcher through telephone calling with the parents of the Erb's palsied infants particularly the mother as she knows more about the pregnancy and delivery conditions. It took about 15 minutes in minimum from the mother's time after they verbally agree to do a phone interview.

The questionnaire consists of three sections: the demographic data, risk factors, and information from hospital sections (annexes 3.1 and 3.2). These sections were constructed in order to judge the effect of each risk factor on the occurrence of Erb's palsy.

The first section consists of demographic data. These including:

- Contact number and address.
- Mother's name in order to ease searching for infant's medical file in hospitals.
- Date of birth to make sure that this infant is from the sample.
- Place of birth “the name of the hospital”.
- sex
- Affected upper extremity whether Rt. or Lt. (The affected upper extremity is not filled for the normal controls).
- Place of residency: in the city, the camp, or in one of the 76 villages of Jenin district.
- Infant's arrangement in the family.

The second section contains the possible risk factors of Erb's palsy answered by the mother by two options yes or no according to its occurrence during pregnancy or at time of delivery. These are:

- *Fetal risk factors* include macrosomia and breech presentation.

- *Maternal risk factors* are diabetes mellitus, gestational diabetes mellitus, obesity, excessive weight gain during pregnancy, maternal age greater than 35 years old, parity, previous child with Erb's palsy.
- *Obstetric risk factors* contain shoulder dystocia, induction of labour, prolonged second stage of labour, and assisted vaginal delivery.

The third section is treatment and rehabilitation of Erb's palsy. It includes five questions related to recovery.

- *First question*: emphasis on the time of Erb's palsy discovery weather was at the time of delivery, within the first week, within the first month, within the second month, or within the first year.
- *Second question*: focuses on the treatment if the infant treated immediately at the time of discovery.
- *Third question*: investigates which type of treatment did the case received or still has. These include the consultation of pediatrics, orthopedics, and/or neurologists and receiving rehabilitation from physiotherapists or occupational therapists.
- *Fourth question:* investigates whether the case made surgery or not that reflects mainly the severity of case's condition.
- *Fifth question*: was about recovery and its percentage from the first discovery until the time of making the interview according to the opinion of the parents themselves.

The fourth section is the section of some information that should be filled from the medical files of the hospitals. This information was taken for two reasons: the first is to make sure of some data that mothers may forget, and the second is to take data that the mothers may not know at all. This information includes:

- *Fetal risk factors:* birthweight, Apgar score at one and five minutes, and fetus presentation.
- *Maternal risk factors*: include only the maternal age.
- *Obstetric risk factors:* include specialists who made the delivery (a doctor, a midwife or both), mode of delivery (vaginal or CS), vaginal delivery (natural or assisted), assisted vaginal delivery (vacuum, forceps, oxytocin, episiotomy, or epidural anesthesia), and the period of second stage of labour (prolonged if it was more than 30 minutes, normal between 20 and 30 minutes, and short if it was less than 20 minutes).

3.9 Ethical and administrative issues:

The ethical and administrative issues that were obtained during the thesis period include:

✓ Institutional Review Board (IRB) Approval through university (annex 3.3)

✓ Ethical approval from the Ministry of Health (MOH) to use Jenin Governmental hospital's archive.

✓ Agreement with private hospitals (Al-Razi and Al-Amal) to use the medical records in the archive.

✓ Permission and agreement of the rehabilitation centers, orthopaedic doctors and Disabled Persons' Federation to view their files.

✓ Verbal consent of the parents of Erb's palsied infants to make the telephone calling in order to fill out the questionnaire.

3.10 Data analysis procedure

The statistical analysis made using the Statistical Package for Social Sciences (SPSS) version 17 with 95% confidence interval. The P-value was determined to be ≤0.05 as a criterion of statistical significance.

» The descriptive characteristics of the sample done using the descriptive analysis Includes rates, distributions, and means.

» Chi square test and Fisher's Exact test were used to test the statistical significance of all the categorical variables and their relationships to Erb's palsy one by one.

» Binary logistic regression was used to measure the statistical significance of each one of the independent variables and its relationship to the Erb's palsy.

» The risk factors that were found to be significantly associated with Erb's palsy through univariate analysis were entered into a multivariate logistic regression model to rule out the most associated risk factors with Erb's palsy.

» If P-value of the tests was greater than 0.05 then the tests are not statistically significant. While if it was equal or less than 0.05 then the tests are statistically significant.

3.11 Methodology Limitations

The researcher faced critical problems during the data collection that explained in the following points:

- Bad conditions found in private rehabilitation centers. These conditions include:

→ Most of them have no or not informative registration system.

→ Misdiagnosis of the Erb's palsy cases with other conditions such as congenital anomalies or CHD.

→ Do not have files for their clients.

→ Some centers do not admit Erb's palsy patients due to long rehabilitation period and excessive cost.

→ Some centers were not cooperative and postponed their meetings many times especially if they were busy or hadany other meetings.

- In UNRWA, physiotherapy clinic, where they were very cooperative, the medical registration book of 2007 was lost! They destroy the medical files of clients every month, and some of their data was missed or wrong as the year of birth, place of residency, or even names.
- After finishing the first stage, there was a list of names with some missing or wrong contact information as telephone number, place of

residency, or exact year of birth. Therefore, the researcher asked help from the ministry of interior, Palestinian National Authority, Paltel, friends, relatives, and persons with whom the interview was made.

- Strikes in governmental hospital and unwilling of some employee in private and governmental hospitals to give the researcher the medical files of the patients because it is a complex process and takes a long time, and they were busy as they answered!

Chapter Four

Results

This chapter presents results and data analysis of the study. It determines the prevalence of Erb's palsy in Jenin district and the significance of Erb's palsy. Multivariate logistic regression shows which of these risk factors strongly associated with Erb's palsy occurrence.

4.1 The prevalence of Erb's palsy in Jenin district

From the Ministry of Health the researcher could have the birth census for the period included in the study (from 2007 - 2011) and these are summarized in Table 4.1.

Table 4.1: Statistics of birth census from 2007-2011 based on MOH records

Year			2007	2008	2009	2010	2011	All
Birth number	Overall		8388 (5)*	7209 (9)	6949 (7)	7034 (8)	7121 (7)	36701 (36)
	Males		4272 (2)	3767 (2)	3540 (5)	3595 (3)	3648 (6)	18822 (18)
	Females		4116 (3)	3442 (7)	3409 (2)	3439 (5)	3473 (1)	17879 (18)
Place of residency	City	Overall	1267 (1)	1267 (2)	1214 (2)	1304 (3)	1278 (2)	6330 (10)
		Males	663 (0)	637 (1)	598 (1)	651 (1)	644 (1)	3193 (4)
		females	604 (1)	630 (1)	616 (1)	653 (2)	634 (1)	3137 (6)
	Village	Overall	7121 (4)	5942 (7)	5735 (5)	5730 (5)	5843 (5)	30371 (26)
		Males	3609 (2)	3130 (1)	2942 (4)	2944 (2)	3004 (5)	15629 (14)
		females	3512 (2)	2812 (6)	2793 (1)	2786 (3)	3839 (0)	15742 (12)
Place of delivery	Hospital	Overall	7654 (5)	6752 (9)	6634 (7)	6659 (8)	6742 (7)	34441 (36)
		Governmental	3477 (2)	3690 (6)	3915 (5)	4129 (6)	4383 (4)	19594 (23)
		Private	4177 (3)	3062 (3)	2719 (2)	2530 (2)	2359 (3)	14847 (13)
	Home		734 (0)	457 (0)	315 (0)	375 (0)	379 (0)	2260 (0)
*: Erb's palsy cases present between brackets								

From January 1, 2007 to December 31, 2011, there were 36701 deliveries in Jenin district. Of these 38 infants born with unilateral Erb's palsy yielding a prevalence of 1.04/1,000 livebirths (Table 4.2).

The cases of Erb's palsy in Jenin district were 38 cases. One of them refused to fill out the questionnaire and one denied the presence of Erb's palsy that forced the researcher to compute them only in the overall prevalence and exclude them from the statistical analysis or any other analysis.

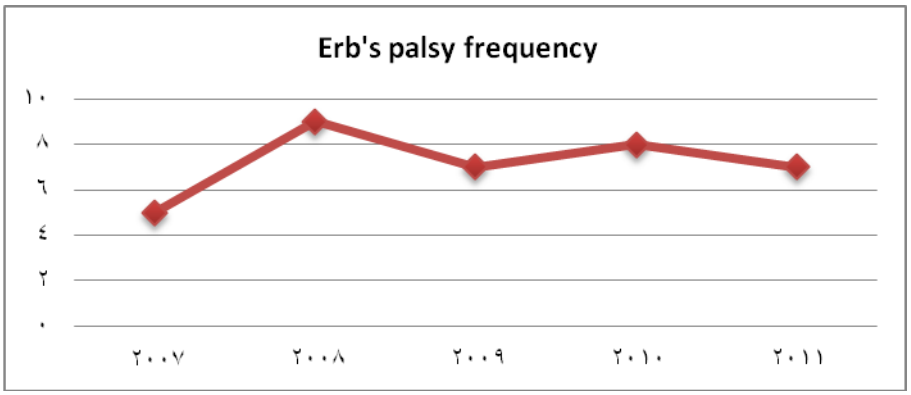

Figure 4.1: Secular trend of Erb's palsy through 2007 until 2011 in Jenin.

The prevalence of Erb's palsy in 2007 was 0.59/1,000 livebirths, 1.25/1,000 livebirths in 2008, 1.01/1,000 livebirths in 2009, 1.14/1,000 livebirths in 2010, and 0.98/1,000 livebirths in 2011 (Figure 4.1). As we note in 2008 was the highest prevalence and the lowest prevalence was in 2007 (Table 4.2).

Table 4.2: Prevalence of Erb's palsy along the search period (2007-2011) in Jenin

Year	Frequency	Percentage	Prevalence (per 1.000 livebirths)
2007	5	13.9	0.596
2008	9	25	1.25
2009	7	19.4	1.01
2010	8	22.2	1.14
2011	7	19.4	0.98
All	36	100	1.04

4.2 Risk factors of Erb's palsy

The sample contains 72 infants from which 36 are cases having Erb's palsy and 36 controls without Erb's palsy resulting from a case control study based on a ratio of 1:1. Their parents agreed to participate in the study. Mothers of cases and controls had to fill out the questionnaire on phone, as the mother knows more about her pregnancy and delivery than the father does. Infants in cases and controls groups matched for age, sex, and place of residency.

Demographic risk factors

The sample contains 36 males and 36 females from which 18 infants of each category having Erb's palsy. Most infants were villagers that constitute 75% of the sample because Jenin city has large number of villages reaches to 76 villages. Table 4.3 shows the demographic characteristics of the sample.

Table 4.3: Chi square tests for demographic characteristics

Risk factor		Erb's palsy			P-value	Odd ratio (CI)
		Yes n (%)	No n (%)	Total n (%)		
Sex	**Male**	18 (50)	18 (50)	36 (50)	1.000*	1.000 (0.4-2.5)
	Female	18 (50)	18 (50)	36 (50)		
Place of residency	**City**	8 (50)	8 (50)	14 (19.4)	1.000*	1.000 (0.3-2.6)
	Camp	2 (50)	2 (50)	4 (5.6)		
	Village	26 (50)	26 (50)	54 (75)		
Total		36	36	72	**Significant level ≤ 0.05 / CI = 95%**	
***: using chi square test**						

Fetal risk factors

Fetuses' birth weight in the sample was 4015g ± 719g in average with a minimum birth weight of 1900g and a maximum birth weight of 6000g. Birth weight of infants with Erb's palsy varied from 1900g to 5600g with an average of 4067g ± 671g. Average birth weight for controls was 3964g ± 769g varied from 2500g to 6000g.

In this thesis, we considered infants with birth weight at delivery 4000g and more in non-diabetic women and of 4500g and more for diabetic women to be a macrosomic infant. In the sample, 37 (51.4%) infants were macrosomic of which 18 (48.6%) were cases and 19 (51.4%) were controls (Table 4.4). By using chi square test for judging the statistical significance

relationship between Erb's palsy and macrosomia, we found no significant relationship presented between them in this study.

There is not even one case or control in the study sample having breech presentation! All of them had cephalic presentation. This made it difficult to make tests of statistical significance for the fetal presentation.

Table 4.4: Univariate analysis for fetal risk factors of Erb's palsy

Risk factor		Erb's palsy			P-value	Odd ratio
		Yes n (%)	No n (%)	Total n (%)		
Macrosomia	**Yes**	18 (48.6)	19 (51.4)	37 (51.4)	0.814*	0.895 (0.4-2.3)
	No	18 (51.4)	17 (48.6)	35 (48.6)		
Infant's birthweight	**<4000g**	18 (51.4)	17 (48.6)	35 (48.6)	0.814*	1.118 (0.4-2.8)
	≥4000g	18 (48.6)	19 (51.4)	37 (51.4)		
Total		36	36	72	**Significance level ≤ 0.05 / CI = 95%**	
***: using chi square test**						

Maternal risk factors

Table 4.5 shows the maternal risk factors of Erb's palsy in the study sample. These include DM, GDM, obesity, excessive weight gain during pregnancy, maternal age more than 35 years old, parity, and having previous child with Erb's palsy.

In DM, there were one mother with DM from the controls and indicated no statistical significance with Erb's palsy. While GDM was present in 23 (31.9%) mothers. 12 (52.2%) mothers of them were from cases group, and 11 (47.8%) mothers of them were from controls group and with no statistical significance with Erb's palsy too (Table 4.5).

By looking at obesity, there were34 (47.2%) of the mothers in the sample obese with 13 (38.2%) of them only in the cases group and 21 (61.8%) of them in the controls group (Table 4.5). 38 (52.8%) mothers had normal weight from which 23 (60.5%) mothers were from the cases group and 15 (39.5%) mothers were from the controls group. P-value of obesity is 0.059 that borderlines to the significant level of 0.05. This led us to think about an assumption that if the sample were larger, it mightpresent with a statistical significance to the occurrence of Erb's palsy.

Table 4.5: Univariate analysis for maternal risk factors of Erb's palsy

Risk factor		Erb's palsy			P-value	Odd ratio
		Yes n (%)	No n (%)	Total n (%)		
DM	**Yes**	0 (0)	1 (100)	1 (1.4)	1.000^	2.029
	No	36 (50.7)	35 (49.3)	71 (98.6)		(1.6-2.6)
GDM	**Yes**	12(52.2)	11 (47.8)	23 (31.9)	0.800*	1.136
	No	24 (49)	25 (51)	49 (68.1)		(0.4-3.1)
Obesity	**Yes**	13 (38.2)	21 (61.8)	34 (47.2)	0.059*	0.404
	No	23 (60.5)	15 (39.5)	38 (52.8)		(0.2-1.0)
Excessive weight gain	**Yes**	18 (39.1)	28(60.9)	46 (63.9)	**0.014***	0.286
	No	18 (69.2)	8 (30.8)	26(36.1)		(0.1-0.8)
Maternal age ≥ 35	**<35**	23 (50)	23 (50)	46 (63.9)	1.000*	1.000
	≥35	13 (50)	13 (50)	26 (36.1)		(0.4-2.6)
Parity	**Primiparous**	5 (45.5)	6 (54.5)	11 (15.3)	0.743*	0.806
	Multiparous	31 (50.8)	30 (49.2)	61 (84.7)		(0.2-2.9)
Previous child with Erb's palsy	**Yes**	3 (60)	2 (40)	5 (6.9)	1.000^	1.545
	No	33 (49.3)	34 (50.7)	67 (93.1)		(0.2-9.9)
Total		36	36	72	**Significance level ≤ 0.05 / CI = 95%**	

*: using chi square test

^: using Fisher's Exact test

There were 46 (63.9%) mothers who had an excessive weight gain during pregnancy. Only 18 (39.1%) mothers of them were in the cases group and the remaining 28 (60.9%) mothers were in the controls group

(Table 4.5). It is the only risk factor that is significantly associated to Erb's palsy from the maternal risk factors with P-value = 0.014.

The mean maternal age for both cases and controls in the study sample was 32 years old.26 (36.1%) mothers had an age of 35 years old or more that were equally distributed between cases and controls. 46 (63.9%) mothers had an age of less than 35 years old that were also equally distributed between cases and controls (Table 4.5). There was no statistically significant difference between the cases and controls groups in the presence of Erb's palsy among mothers with the age of 35 years old and more.

The distribution of parity is present in table 8. Only 11 (15.3%) mothers were nulliparous having5 (45.5%) mothers in cases group and 6 (54.5%) in controls group. The remaining 61 (84.7%) were multiparous women from whom31 (50.8%) mothers were in the cases group and 30 (49.2%) in the controls group. The mean of infant's arrangement in the sample was the third that is the same as it was in the cases, while in controls it was the fourth. This risk factor also is not significantly related to Erb's palsy in the study.

The last risk factor in the maternal risk factors was the presence of a previous child with Erb's palsy for the mother of Erb's palsied infant. Only 5 (6.9%) mothers in the sample had a previous child with Erb's palsy. 3 (60%) mothers of them were from the cases group and 2 (40%) mothers

were from the controls group (Table 4.5). The majority of the study sample did not have a previous child with Erb's palsy. These constitute 67 (93.1%) mothers, 33 (49.3%) mothers from the cases group and 34 (50.7%) mothers from the controls group.

Obstetric risk factors

41 (56.9%) mothers in the sample recorded a child with SD, the majority of them were in the cases group (27 (65.9%) mothers) while 14 (34.1%) mothers of them were in the controls group (Table 4.6). 31 (43.1%) mothers did not record a child with SD during delivery process (9 (29%) mothers in cases group and 22 (71%) mothers in controls group).

Table 4.6: Univariate analysis for obstetric risk factors of Erb's palsy

Risk factor		Erb's palsy			Chi square test	Odd ratio (CI)
		Yes n (%)	No n (%)	Total n (%)		
SD	**Yes**	27 (65.9)	14 (34.1)	41 (56.9)	**0.002***	4.714
	No	9 (29)	22 (71)	31 (43.1)		(1.7-12.9)
2nd stage of labour	**Short**	13 (81.3)	3 (18.7)	16 (22.2)	**0.014***	2.130
	Normal	9 (36)	16 (64)	25 (34.7)		(0.6-8.0)
	Prolong	14(45.2)	17 (54.8)	31 (43.1)		
Mode of delivery	**Vaginal**	36 (52.9)	32 (47.1)	68 (94.4)	0.115^	0.471
	CS	0 (0)	4 (100)	4 (5.6)		(0.4-0.6)
Vaginal delivery	**Natural**	5 (100)	0 (0)	5 (6.9)	**0.011***	1.622
	Assisted	31 (49.2)	32 (50.8)	63 (87.5)		
	CS	0 (0)	4 (100)	4 (5.6)		
Assisted vaginal delivery	**None**	5 (55.6)	4 (44.4)	9 (12.5)	0.946*	1.043
	Vacuum	6 (54.5)	5 (45.5)	11 (15.3)		(0.8-1.4)
	Forceps	1 (33.3)	2 (66.7)	3 (4.2)		
	Episiotomy	11 (45.8)	13 (54.2)	24 (33.3)		
	Oxytocin	13 (52)	12 (48)	25 (34.7)		
Induction of labour	**Yes**	21 (38.2)	34 (61.8)	55 (76.4)	**0.001^**	0.082
	No	15 (88.2)	2 (11.8)	17 (23.6)		(0.01-0.4)
Total		36	36	72	**P-value = 0.05 / CI = 95%**	

*: using chi square test

^: using Fisher's Exact test

The average of the second stage of labour was 31 minutes for the sample, 28 minutes for cases, and 34 minutes for controls. The majority of mothers had prolonged second stage of labour including 31 (43.1%)

mothers from whom14 (45.2%) mothers were in the cases group and 17 (54.8%) mothers were in the controls group. This was followed by a normal second stage of labour including 25 (34.7%) mothers from whom9 (36%) mothers were in the cases group and 16 (64%) mothers were in the controls group. Finally, 16 (22.2%) mothers (13 (81.3%) mothers from cases group and 3 (18.7%) mothers from controls group) belonged to the short second stage of labour that has the least number of mothers (Table 4.6).

The vaginal mode of delivery was the most frequent mode in 68 (94.4%) mothers of the study sample from which 36 (52.9%) mothers belonged to the cases group and 32 (47.1%) mothers belonged to the controls group. Only 4 (5.6%) mothers had CS delivery and all of them from the controls group (Table 4.6). It occurred naturally in 5 (6.9%) mothers in the sample, all from cases group and assisted in 63 (87.5%) mothers. 31 (49.2%) mothers of them belonged to the cases group and 32 (50.8%) mothers were from the controls group.

The most assisted vaginal delivery methods used in this study was oxytocin for 25 (34.7%) mothers (13 (52%) mothers from the cases group and 12 (48%) mothers from the controls group) and episiotomy for 24 (33.3%) mothers (11 (45.8%) from the cases group and 13 (54.2%) from the controls group). Forceps use was the least used method of assisted vaginal delivery. 3 (4.2%) mothers only underwent forceps use from whomonly1 (33.3%) mother belonged to the cases group and 2 (66.7%)

mothers belonged to the controls group. 11 (15.3%) mothers delivered by using vacuum extraction method.6(54.5%) mothers of whombelonged to the cases group and 5 (45.5%) mothers belonged to the controls group.

55 (76.4%) labours were induced from which only 21 (38.2%) mothers presented in cases group and 34 (61.8%) mothers were in controls group. While 17 (23.6%) labours started spontaneously` from which 15 (88.2%) mothers were in cases group and only 2 (11.8%) mothers were in the controls group (Table 4.6).

Obstetric risk factors of Erb's palsy had the largest number of variables that were statistically associated to Erb's palsy. These included SD (P-value = 0.002), second stage of labour (P-value = 0.014), vaginal delivery (P-value = 0.011), and induction of labour (P-value = 0.001) as explained in table 4.6. While mode of delivery and assisted vaginal delivery were not significantly related to Erb's palsy.

Other risk factors

None of the other risk factors was found to be statistically associated with Erb's palsy. This is described in Table 4.7.

Table 4.7: Univariate analysis for some other risk factors of Erb's palsy

Risk factor		Erb's palsy			P-value	Odd ratio
		Yes n (%)	**No n (%)**	**Total n (%)**		
Apgar score at 1 minute	**< 7**	9 (75)	3 (25)	12 (16.7)	0.111^	3.667 (0.9-14.9)
	≥7	27 (45)	33 (55)	60 (83.3)		
Apgar score at 5 minutes	**< 7**	3(100)	0 (0)	3 (4.2)	0.239^	2.091 (1.6-2.7)
	≥7	33 (47.8)	36 (52.2)	69 (95.8)		
Delivery specialist	**Doctor**	3 (42.9)	4 (57.1)	7 (9.7)	0.633*	0.485 (0.1-2.5)
	Midwife	15 (45.5)	18 (54.5)	33 (45.8)		
	Both	18 (56.3)	14 (43.7)	32 (44.4)		
Delivery hospital	**Governmental**	23 (46)	27 (54)	50 (69.4)	0.306*	0.590 (0.2-1.6)
	Private	13 (59.1)	9 (40.9)	22 (30.6)		
Total		36	36	72	**P-value = 0.05 / CI = 95%**	

*: using chi square test

^: using Fisher's Exact test

Apgar score at 1 minute had a mean of 8, 7, and 8 for sample, cases, and controls respectively that is raised to 9, 9, and 10 for them respectively at 5 minutes. In the first minute after birth, 12 (16.7%) infants had an Apgar score less than 7, from whom9 (75%) infants were in the cases group and 3 (25%) infants were in the controls group. This number reduced to 3 (4.2%) infants at 5 minutes all from the cases group (Table 4.7). Apgar score of 7 or more was determined in 60 (83.3%) infants from whom27 (45%) infants from the cases group and 33 (55%) infants from the

controls group that raised at 5 minutes to 69 (95.8%) infants 33 (47.8%) of them from the cases group and 36 (52.2%) of them from the controls group.

Only 7 (9.7%) mothers of the sample delivered by a doctor, 3 (42.9%) mothers of them belonged to the cases group and 4 (57.1%) mothers to the controls group (Table 4.7). 33 (45.8%) mothers delivered by midwife (15 (45.5%) mothers in the cases group and 18 (54.5%) in thecontrols group). 32 (44.4%) mothers delivered by both doctors and midwives (18 (56.3%) mothers from the cases group and 14 (43.7%) mothers from the controls group).

The majority of mothers –50 (69.4%) mothers- in the sample delivered in the governmental hospital from whom23 (46%) mothers from the cases group and 27 (54%) mothers from the controls group (Table 4.7). 22 (30.6%) mothers delivered in private hospitals.13 (59.1%) mothers of them were from the cases group and 9 (40.9%) mothers from the controls group.

4.3 Multivariate logistic regression of significant risk factors of Erb's palsy

Table 4.8 shows the multivariate logistic regression of the risk factors found to have significant relationship with Erb's palsy in the study from univariate logistic regression analysis. These are excessive weight gain during pregnancy, SD, second stage of labour, vaginal delivery, and labour induction. This model shows that SD (P-value =0.008) is the most

associated risk factor of Erb's palsy followed by labour induction (P-value = 0.012).

Table 4.8: Multivariate logistic regression model of Erb's palsy

Risk factor	P-value	Odd ratio	CI
Excessive weight gain	0.102	0.335	0.1 – 1.2
SD	**0.008**	5.939	1.6 – 22.0
Second stage of labour	0.072	2.314	0.9 – 5.8
Vaginal delivery	0.998	1.500	--------
Labour induction	**0.012**	0.045	0.01 – 0.5
Significant level ≤ 0.05 / CI = 95%			

4.4 Rt. sided or Lt. sided Erb's palsy

28 infants have Rt. Affected Upper limb that represents about 77.78% of the cases, and only 8 infants have Lt. affected Upper limb that represents 22.22%. Figure 4.2 shows the distribution of affected Upper limb where the Rt. Upper limb is the dominant affected limb.

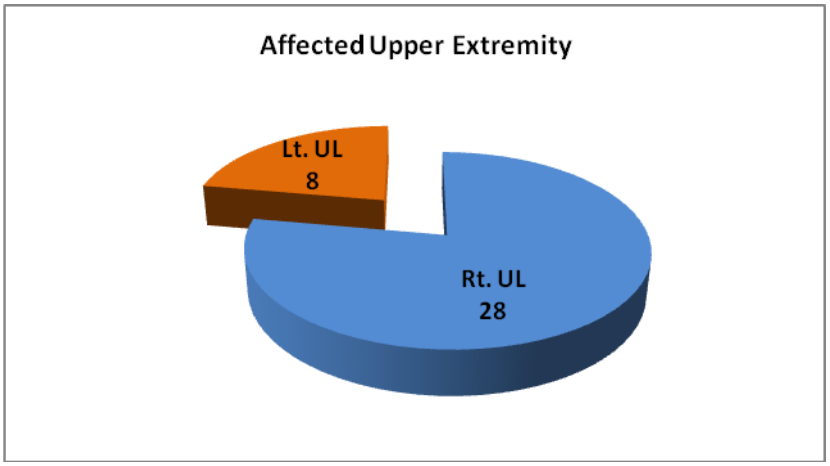

Figure 4.2: Affected upper limb distribution.

4.5 Improvements of Erb's palsy cases

As the Erb's palsy is a condition that can be easily detected at the time of delivery, there were 27 (75%) of the cases in the study sample discovered at the time of delivery. While others were discovered most often during the first month by making an X-Ray to distinguish it from other conditions as clavicular fracture mainly (Figure 4.3). There was one case only representing 2.8% discovered after two months because the infant existed in the incubator for 45 days then went to many doctors for diagnosis where parents were asked to make an X-Ray and physical examination to judge the condition. 8 (22.5%) cases were discovered during the first month of life.

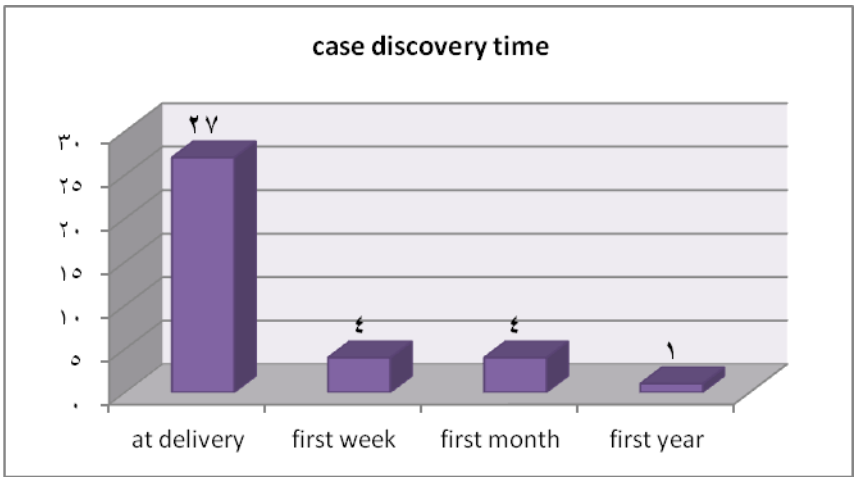

Figure 4.3: Distribution of time of case discovery.

Of these, 33(91.7%) cases were treated at the time of delivery by visiting doctors (mainly orthopedic, pediatric, and neurologist) where they converted to physiotherapy as well to have accurate rehabilitation. 3 (8.3%) cases were not treated at the time of discovery for two reasons. The

first was the delay of doing the right diagnosis, and the second was the parents' lack of knowledge about the condition.

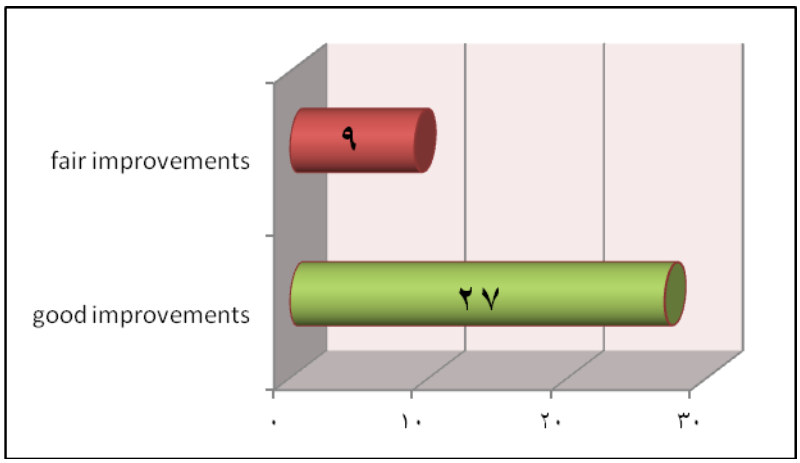

Figure 4.4: Cases improvements distribution.

Of the cases, 27 (75%) had good improvements from Erb's palsy after rehabilitation for at least 4 months from delivery. 9 (25%) cases only had fair improvements of affected upper limb even after making rehabilitation until the date of making the interview with the mother (Figure 4.4).

6 (16.7%) cases underwent surgery to getting better or recurred from Erb's palsy. 30 (83.3%) cases did not make any surgery either for good improvements or for getting afraid of having this experience as they heard that it might worsen their child's condition.

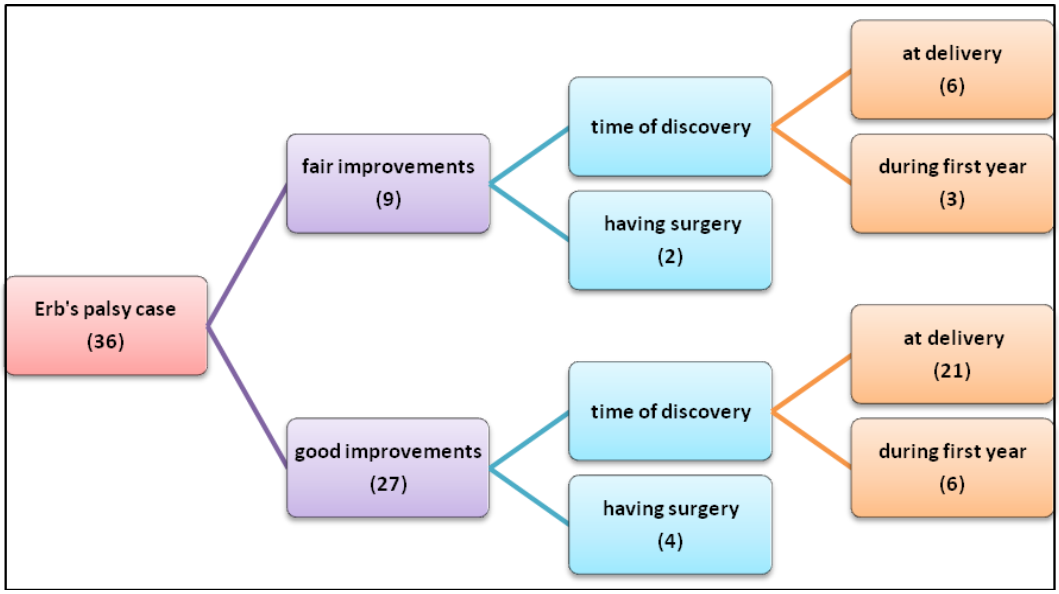

Figure 4.5: case's discovery time and surgery relations to Erb's palsy improvements.

Chapter Five

Discussion

Erb's palsy is one of the serious problems that presents in each community and has various predicted risk factors. These risk factors can be avoided by appropriate awareness and good knowledge of the community and professional experience of the health services providers. It affects seriously the individual himself, his family, relatives and surrounding people. It limits many activities of the affected individual specially that needs the use of both hands. Erb's palsy reduces self-image due to disability and its consequences and causes social problems mainly if the affected individual is a female due to our Palestinian culture and traditions.

This study aimed at determining the prevalence of Erb's palsy and highlighting its risk factors in Jenin district.

5.1 Prevalence of Erb's palsy

Several studies were carried out in the world to determine the prevalence and risk factors of Erb's palsy but none done in Palestine. This case-control study conducted to highlight Erb's palsy prevalence in the light of many persisted difficulties in the area. It took place in Jenin's city, camp and villages that lie in the north of the West Bank in Palestine. 38 infants were having Erb's palsy in the district through 2007 until 2011, while 36701 infants were born in that period which resulted in a prevalence of

1.04 per 1000 livebirths. This prevalence is for somewhat similar to that reported worldwide that is summarized in Table 5.1.

Table 5.1: Prevalence of Erb's palsy in the world

Area	Study year	Author	Prevalence (per 1000 livebirths)
USA	1997	Foad et al	1.7
	2000	Foad et al	1.6
	2003	Foad et al	1.3
	2004	Weizsaecker et al	4.1
UK	1976	Bennett and Harrold	0.61
	2003	Evans-Jones et al	0.42
	2005	Tendon and Tandon	0.96
Republic of Ireland	2002	Donnelly et al	1.5
	2003	Evans-Jones et al	0.45
Sweden	1988	Sjoberg et al	1.9
	1996	Christoffersson and Rydhstroem	1.3
Turkey – Tuzla-	2006	Hudic et al	1.89
Saudi Arabia	1990	Al-Rajeh	1.19
Israel	2001	Bar et al	1.48
Palestine – current study-	**2013**	**-------**	**1.04**

From Table 5.1 we noticed that Israel -which is the nearest region to our country-, has a prevalence higher than that reported in our study. This is because it has much better diagnosis procedures, registration systems and has a holistic survey system that survey each individual in Israel. Perhaps if

Palestine has all these elements and if we have a much larger sample size in our study may be we will have a prevalence that will be much correct and nearer to that recorded in Israel and other areas of the world. The prevalence in our study is more close to that found in Saudi Arabia by Al-Rajeh in 1990 [73].

In Palestine, the highest prevalence of Erb's palsy was present in 2008 (Table 4.2). This may be due to the birth census of Jenin district that also registered Tubas governorate's infants too until the half of 2008. The decline in the next years may be normal situation as the birth statistics just included Jenin district. On the other hand, the prevalence in 2007 may be the smallest one as the whole population was larger and containing also the population of Tubas governorate which hadn't been searched in the study for the cases of Erb's palsy. Then we can consider the prevalence to be actually declining or remaining constant throughout the study period as shown in Figure 4.1. This prevalence decreased from 2008 until 2011 that is for somewhat a good thing and can reflect new strategies used to overcome the problem.

5.2 Risk factors of Erb's palsy

Not significant risk factors of Erb's palsy in the study

Cases and controls in the sample matched for their demographic data including sex, age, and place of residency. There was no statistically significant difference between them and as it is noted in the literature

review there was no study search for the effect of the demographic data on the occurrence of Erb's palsy.

If we have to consider the both infants whose mothers refused to fill out the questionnaire and they were females, the frequency of females will be higher than males by these two infants and this preference will be the same as presented in wolf et al study in 2000 [68].

Infants having Erb's palsy were in average 103g ± 98g larger than those without Erb's palsy were. Despite the presence of many measures of macrosomia, most studies in the literature considered it 4000g for non-diabetic mothers and 4500g for diabetic mothers. This was the measure adopted in our study. Half the cases in the study were macrosomic and half were non-macrosomic. This meant that there's no significant association between macrosomia and Erb's palsy in this study that came into agreement with the study of Tandon and Tandon in 2005 and the study of Ouzounian et al in 2012 [38;52].

Many procedures used by midwives and doctors to overcome the difficulties of macrosomia and the disabilities that would result from it including Erb's palsy. One of these procedures is CS delivery that cannot prevent but reduces this risk. The occurrence of SD as a complication of macrosomia in our study was significantly associated (P-value of 0.005, OR of 4.1, 95% CI). 15 (41.7%) infants in the study had macrosomia, SD, and Erb's palsy (Figure 5.1), and this percentage is high and for somewhat

agrees with Al-Sammani and Ahmed study in 2012 [42]. As macrosomic infants were more likely to have SD in our study (P-value = 0.005, OR = 2.041, 95% CI) they were also more likely to be delivered for an obese mother (P-value = 0.002, OR = 2.063, 95% CI).

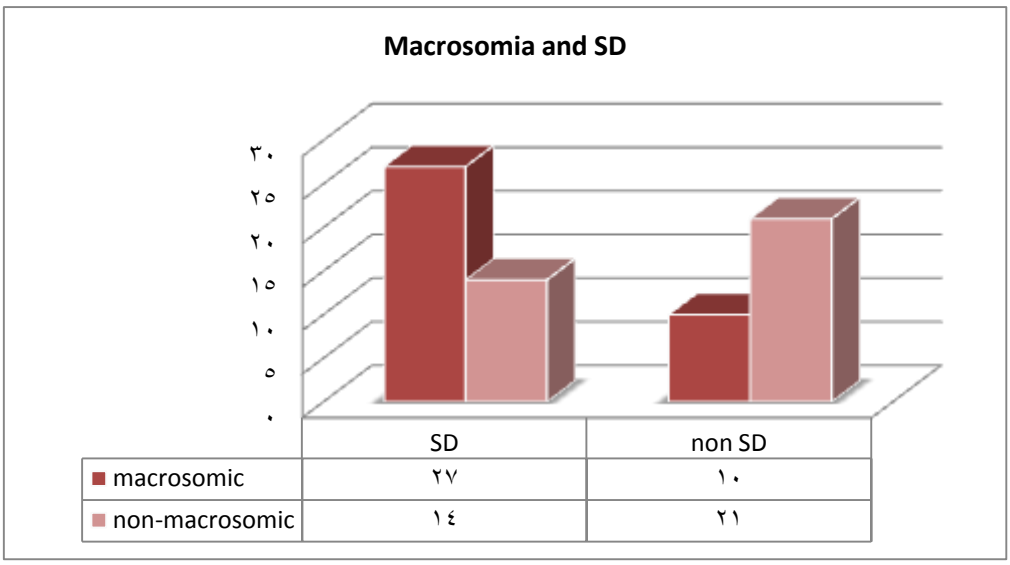

Figure 5.1: Macrosomia and shoulder dystocia

Not even one case in our study had a breech presentation at the time of delivery. This might give an indication about the precaution used for breech deliveries. These precautions included having CS delivery to prevent any possible complications, which reflected the advanced training and prolonged experience of midwives and doctors in the last years mainly.

DM was one of the risk factors of Erb's palsy as noted in the literature. The only study -as far to the author knowledge- that found no association between maternal DM and Erb's palsy was the Pondaag et al study in 2012 which was confirmed by this study for somewhat. This

related to the only one mother with DM in this study that belonged to the controls group. This is may also be associated with the late appearance of DM in old ages mostly, while this study had an average age of 32 years old and the majority of the cases were young mothers (46 mothers representing 63.9% of the sample). On the other hand; Ouzounian et al related DM to Erb's palsy but without statistical significance with an OR of 2.7 and 95% CI which is very near to this study that found an OR of 2.03 and 95% CI for DM [38]. DM mainly affected the mode of vaginal delivery in our study to be assisted vaginal delivery (P-value = 0.002, OR = 1.414, 95% CI).

GDM is one of the conditions that appear during pregnancy mainly in the last trimester. It has many complications on both mother and fetus. All the reviewed studies in the literature indicated a significant relationship between Erb's palsy and GDM mothers [43;48;65]. On the contrary, this study found the opposite where there was no significant effect of GDM on Erb's palsy (P-value = 0.800, OR = 1.14, 95% CI).

Obesity of mother before getting pregnant in many studies is considered to play an important role in Erb's palsy occurrence. In our study, it is considered to have no significant relationship to the occurrence of Erb's palsy [16;32;65;85]. Our results were similar to that found by Robinson et al and Donnelly et al both in 2002 [36;91]. In our study the obese mother tended to have older age (P-value = 0.020, OR = 0.310, 95% CI), gain more weight during pregnancy (P-value = 0.002, OR = 5.185, 95% CI), and deliver a macrosomic infant (P-value = 0.002, OR = 4.615, 95% CI).

In the study, 32 years old was the mean age for mothers of Erb's palsy infants and this what was found also by Bar et al study in Israel 2001 [23]. Most studies in the literature found that the age of 35 years and more to be more associated with Erb's palsy occurrence [16]. In our study, the majority of mothers had an age of less than 35 years (46 mothers that represent 63.9% of the study sample). Our results were in line with other results obtained by Mollberg et al in 2005 and Mehta et al in 2006 where no significant association was indicated between maternal age and Erb's palsy [32;54]. In this study, Mothers of 35 years old and more were susceptible to be multiparous women (P-value = 0.048, OR = 5.652, 95% CI) and to be more obese (P-value = 0.020, OR = 0.565, 95% CI).

Out of 36 mothers of Erb's palsy infants, 5 only were primiparous mothers and 31 were multiparous mothers. Statistically significant difference between these two groups was not found (P-value = 0.743, OR = 0.806, 95% CI). This was similar to the results of Hudic et al and Mehta et al both in 2006 [16]. Multiparous women in our study were more susceptible to experience SD during delivery than primiparous women (P-value =0.031, OR = 1.25, 95% CI). Primiparous women were more likely to have a younger age, which was less than 35 years, than multiparous women (P-value = 0.043, OR = 6.9, 95% CI). This younger age prevalence was due to early marriage, which is frequent in the Palestinian society; this resulted in having multiparous women in early age. Early marriage occurs due to poor economic situations for some families that mainly prevents

females from continuing their education and leads them to get married early. In addition, there's wrong cultural beliefs and traditions in some areas that suppose girls to get married early or, they will be considered as spinsters if they reach the age of 20 without getting married.

The presence of a child with a previous Erb's palsy in the family had little contribution to Erb's palsy as was cleared by some studies [11;56]. Donnelly et al in 2002 found no association between the presence of previous child with Erb's palsy in the family with Erb's palsy and this what was found in our study (P-value = 1.000, OR = 1.545, 95% CI) [36].

Mode of delivery either it was vaginal or by CS had no effect on the occurrence of Erb's palsy in our study (P-value = 0.115, OR = 0.471, 95% CI) and this what was found by Donnelly et al in 2002 [36]. Only four mothers delivered by CS and they were all from the controls group and none was in the cases group. On the other hand, some authors of different studies recorded the presence of Erb's palsy infants after a CS delivery [78;80].

Apgar score at 1 minute and at 5 minutes to be less than 7 were not associated with Erb's palsy occurrence (P-value = 0.111 and 0.239 respectively, OR = 3.667 and 2.091 respectively, with 95% CI). This was a contrast to the findings of others that assure the association between Apgar score less than 7 at 1 and 5 minutes and others that found an association with Apgar score less than 5 at 1 and 5 minutes [16;18;52;65;105]. It can be due

to subjective judgment of the midwife who made the test, which will leave some space for bias and personal decision.

Neither giving birth at the hospital (P-value = 0.306, OR = 0.59, 95% CI) nor by specialist (P-value = 0.633, OR = 0.458, 95% CI) had an effect on Erb's palsy occurrence in our study. The majority of the cases and controls were delivered in the governmental hospital due to free services covered from the national or Al-Aqsa assurance. The majority of the mothers in the sample (33 mothers (45.8%)) delivered by midwives and this was due to personal confidentiality as many mothers get ashamed from being delivered by a male doctor. Midwives in hospitals should have a bachelor degree and be well trained in order to work in the delivery rooms. And during their work; they should get many workshops to help them develop their practice and experience.

Rt. Upper extremity was the dominant affected extremity in our study (Figure 4.2). This what was found in the study of Evans-Jones in 2003 [27]. The opposite was found by Tandon and Tandon study in 2005 [52].

Significant risk factors of Erb's palsy in the study

The first significant risk factor of Erb's palsy in our study was Excessive weight gain during pregnancy (P-value = 0.014, OR = 0.286, 95% CI). These results were similar to those found by Suhonen et al in 2008 and Mollberg et al in 2005 [18;43]. In our study mothers who were obese before pregnancy were more susceptible to have excessive weight

gain during pregnancy (P-value = 0.002, OR = 5.185, 95% CI). Excessive weight gain will affect the delivery process by the overload of the extra weight.

SD was another significant risk factor in our study (P-value = 0.002, OR = 4.714, 95% CI). It was the risk factor that took a large space of searching studies in the literature. There was a lot of arguments about its contribution in the occurrence of Erb's palsy during delivery. Some studies found no statistical significant relationship between Erb's palsy and SD such as the study of DeMott and Sandmire in 2002 [(49)]. In our study; SD (P-value = 0.008, OR = 5.939, 95% CI) is considered to be the most important risk factor in the occurrence of Erb's palsy and this what was found by the study of Foad et al in 2008 and the study of Evans-Jones in 2003 [(27;62)].

Mollberg et al in 2005 found SD to be associated with 30% of Erb's palsy cases. Donnelly et al in 2005 found it to be associated with 51% of Erb's palsy cases. In our study, SD was associated with 75% of Erb's palsy cases, which was the highest percentage. This can be a result of useless maneuvers used to relief SD during delivery and, for some extent, due to the intervention of a trainee in the delivery process without sufficient experience to overcome the delivery complications [(54)]. Other studies found strong association between SD and Macrosomia as the study of Mollberg et al in 2005 [(18)]. Ouzounian et al in 2012 indicated macrosomia to be associated with Erb's palsy; our study also indicated this association (P-

value = 0.005, OR = 4.050, 95% CI) [38]. Apgar score less than 7 at 1 minute (P-value = 0.008, OR = 11, 95% CI) and primiparous women (P-value = 0.046, OR = 4.406, 95% CI) are two other risk factors that were associated with the presence of SD in our study.

In our study, the assisted vaginal delivery had an effect on the occurrence of Erb's palsy (P-value = 0.011, OR = 1.622, 95% CI), but which method of assisted vaginal delivery was used did not matter (P-value = 0.946, OR = 1.043, 95% CI). Borna et al in 2010, Hudic et al in 2006, Mollberg et al in 2005 and Evans-Jones et al in 2003 assured the relationship between assisted vaginal delivery and Erb's palsy that is close to our results [16;18;27;64].

Short second stage of labour (P-value = 0.014, OR = 2.230, 95% CI) in our study is also considered to have statistically significant association with Erb's palsy. This what was found by Gherman et al, Acker et al, Hudic et al all in 2006 and Gonen et al in 2000 [16;87;97;106]. This could happen due to labour induction mainly in the governmental hospitals where midwives tended to shorten the delivery intervals by giving oxytocin so that they can help all the mothers admitted to the hospital that day deliver. This was one reason; another reason was that when the shift was coming to its end, the midwife tended to fasten the mother’s delivery in order not to be late in her shift. These reasons have helped shorten the period of the second stage of labour.

The last significant risk factor of Erb's palsy in our study was the labour induction (P-value = 0.001, OR = 0.082, 95% CI). This finding has come into agreement with Borna et al in 2010, Chauhan et al in 2005, Ouzounian et al in 2005, and Mollberg et al in 2005 [18;64;99;107]. Induction of labour is mainly associated with short second stage of labour (P-value = 0.019, OR = 5.2, 95% CI). It is considered to be the second most associated risk factor with Erb's palsy occurrence in our study (P-value = 0.012, OR = 0.045, 95% CI).

5.3 Conclusions

"Erb's palsy in Jenin district: Prevalence and risk factors" is a case-control study conducted to determine the prevalence and highlight the risk factors of Erb's palsy in Jenin district. Erb's palsy has a prevalence of 1.04/1000 livebirths. Shoulder dystocia and labour induction are the most significant risk factors in the Palestinian society. Excessive weight gain, vaginal delivery, and prolonged second stage of labour are other risk factors of this condition in Jenin.

5.4 Recommendations

► To design programs, media messages, and spreading brochures targeting pregnant women and focusing on disabilities resulting from delivery including Erb's palsy.

► To improve midwives' knowledge and practice through training. Training should focus on procedures to be applied during delivery, which

will set mothers and infants health on the safe side and prevent the occurrence of disabilities including Erb's palsy or avoid them.

► To conduct a prospective study of Erb's palsy

The following recommendations are some strategies to ease researches in Jenin district.

► To make rules on the level of MoH regarding full and accurate registration system in the private centers following by continuous supervision to assure commitment.

► To unify medical terminology in all health sectors in Palestine.

► To encourage disabled persons to register in syndicate disabled to ease researches of disabilities as a whole.

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ANNEXES

Annexes of chapter one

Annex 1.1:

Wilhelm Heinrich Erb (1840-1921)

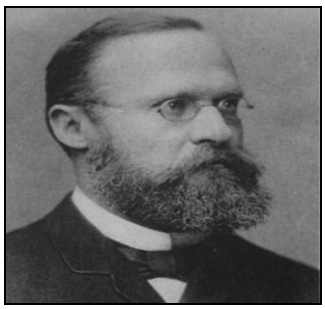


Figure 1.4: Whilhelm Heinrich Erb [108].

Wilhelm Heinrich Erb was the foremost German neurologist of his time, born on November 30, 1840 in town of Winnweiler in the pastureland of western Germany's Palatinate [3;108]. His father was a forester [108]. In 1857, he entered University of Heidelberg to study medicine which he was finished in 1862 to have a residency in internal medicine in the same university [108].

Erb's doctoral work was in hematology as "Picrinic Acid and Its Physiologic and Therapeutic Actions" in 1864 [109]. He got teaching professor status due to his work "The Development of Red Blood Corpuscles" in 1865 [109]. After this he left hematology and focused on neurology where he presented electrodiagnostic testing by using direct and asymmetric alternating currents [109]. In this content he established three of his most famous contributions to understand physiology of peripheral nerve

and anatomy of brachial plexus [109]. These included *tetany investigations* where he was the first to illustrate the electrophysiologic nature of tetany, *Erb's palsy*, and *deep tendon reflex* where his publications were considered as a first description of deep tendon reflex mainly the patellar one [109].

In Erb's palsy which bears his name despite the fact that he wasn't the first one to describe this injury but he was the first to localize this injury at the Erb's point in 1874 [109]. This point is a point where the cutaneous branches of the cervical plexus emerge that directly overlies 5^{th} and 6^{th} cervical nerve when they join to the superior root of the brachial plexus, lies along the posterior border of the sternocleidomastoid midway between its sternoclavicular origin and insertion on the mastoid process [109].

Erb's palsy occurs due to lesion at or proximal to the Erb's point then it affects axillary, suprascapular, musculocutaneous, and upper and lower subscapular nerves [109].

Erb's attributed the pathophysiologic mechanism of Erb's palsy to a tension placed over the brachial plexus when an angle between the head and shoulder of the affected arm is increased [109].

Before him, Duchenne had published a description of the clinical manifestation of the upper root lesion in 1872; this is why Erb's palsy sometimes is referred to as "Erb's-Duchenne palsy" [109].

When Erb was the age of 40 in 1879 he became the chair and director of the Department of Internal Medicine in the University of Leipzig [109]. In this university he worked to make neurology a separate discipline within internal medicine [109].

In 1883; Erb's mentor Nikolaus Friedreik died, and that gave Erb an opportunity to work again in University of Heidelberg to make a clinical neurology course as requisite component of medicine study [109].

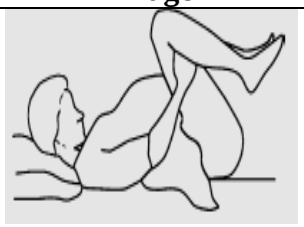
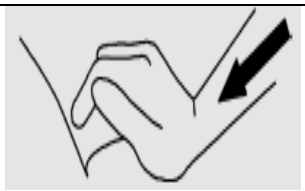
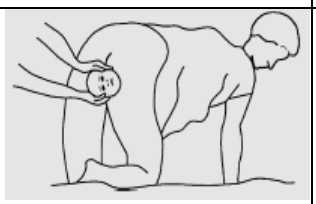
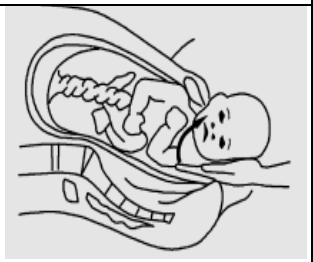
Describing "muscular dystrophy", "Erb's dystrophy", and "reaction of degeneration of muscles" was another accomplishment of Erb[109;110].

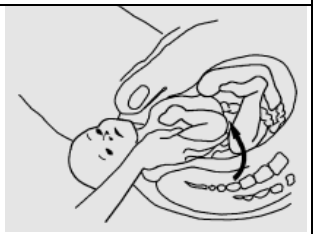
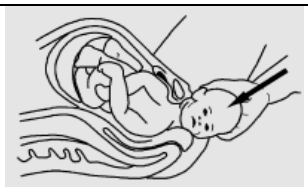
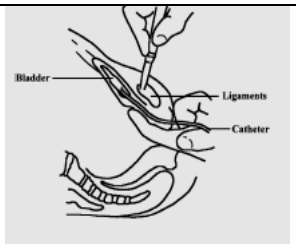
Erb's publications include 273 papers [109]. Then in 1910, the Society of German Neurologists established "Wilhelm Erb Medal" to be given every three years to the most dedicated researcher in neurology [109].

Annex 1.2:

Shoulder dystocia relief maneuvers

Table 1.1: Shoulder dystocia relief maneuvers[7]

Maneuver	Image	Procedure	Mechanism
McRoberts' maneuver		Maternal hips are flexed and abducted so that the maternal thighs are positioned on the abdomen	Straighten the lumbo-sacral angle, rotate the maternal pelvis cephalad, and decrease angle of pelvic inclination so that the impacted anterior shoulder is released
Suprapubic pressure		Pressure is applied in a downward and lateral direction to push the posterior aspect of the anterior shoulder towards the fetal chest	Reduce the bisacromial diameter and rotate the anterior shoulder into the oblique pelvic diameter so that the shoulder is free to slip underneath the symphysis pubis
All-fours position		The mother is rolled over so that the maternal back is up and the body is supported by her hands and knees, so that the upturn posterior shoulder is delivered first by downward traction	The posterior shoulder is disimpacted from the sacrum by gravity
Internal rotation of shoulders		In the Woods' corkscrew maneuver, the posterior shoulder is abducted by exerting pressure onto the anterior surface of the posterior shoulder In the Rubin's (reverse Woods') maneuver, pressure is applied to the posterior surface of the most accessible part of the fetal shoulders (either the anterior or posterior shoulder) to effect shoulder	Reduce the bisacromial diameter and rotate the shoulders into an oblique diameter or by a full 180-degree rotation of the fetal trunk in a corkscrew fashion

		adduction	
Posterior arm extraction		The posterior fetal arm is traced down to the antecubital fossa where gentle pressure is then applied in order to flex the fetal forearm. The arm is subsequently swept out over the infant's chest and delivered over the perineum	After delivery of the posterior arm, the shoulder diameter is reduced by 20% as bisacromial diameter is replaced by axilloacromial diameter
Zavanelli maneuver		Cephalic replacement of the head into the vagina, through the reversal of cardinal movements of labour: derestitution and flexion, under tocolytics, and finally followed by caesarean delivery	Bypass birth canal to deliver the baby abdominally
Symphysiotomy		Cutting the ligaments of the symphysis under local anaesthesia. The urethra must be protected by inserting a firm catheter, and laterally displaced with a finger in the vagina	Increase in pelvic diameter (up to 2 cm)
Cleidotomy	None	Bending the clavicle with a finger or surgical division	Reduce the shoulder diameter

Annexes of chapter two

Annex 2.1:

Narakas classification of OBPI

In 1987, Narakas classified the obstetric brachial plexus babies into four categories as present in Table 2.1 [111]. This classification is recommended to be applied about two weeks after delivery as the simple blocks are recovered as Birch recommended [45]. Al-Qattn et al has conducted a retrospective study over 15 years period and found it worth to split group four into two categories based on the early recovery of wrist extension [7;111].

Table 2.1: Narakas classification of OBPI[111]

Group	Name	Roots injured	Site of weakness/paralysis	Likely outcome
I	Upper Erb's palsy	C5, C6	Shoulder abduction/external rotation Elbow flexion	Good spontaneous recovery in over 80% of cases
II	Extended Erb's palsy	C5, C6, C7	As above with drop wrist	Good spontaneous recovery in about 60% of cases
III	Total palsy with no Horner's syndrome	C5, C6, C7, C8, T1	Complete flaccid paralysis	Good spontaneous recovery of the shoulder and elbow in 30-50% of cases. A functional hand may be seen in many patients
IV	Total palsy with Horner's syndrome	C5, C6, C7, C8, T1	Complete flaccid paralysis with Horner's syndrome	The worst outcome. Without surgery, sever defects throughout the limb are expected.

Annexes of chapter three

Annex 3.1

Questionnaire of Erb's palsy

The first section: the demographic data		
Parents' contact telephone: address:		
Mother's name:		
Date of birth: - -		
Place of birth:		
Sex: ☐ male ☐ female		
Affected upper extremity: ☐ Rt. ☐ Lt.		
Place of residency: ☐ city ☐ camp ☐ village		
infant's arrangement in the family:		
The second section: risk factors		
The risk factor	Yes	No
Fetal risk factors, if the following happened to the patient:		
1- Macrosomia		
2- Breech presentation		
Maternal risk factors, if the following happened to the patient mother:		
1- Diabetes mellitus		
2- Gestational diabetes		
3- Obesity		
4- Excessive weight gain during pregnancy		
5- Maternal age >35 years old		
6- Primiparity		

7- Multiparous		
8- Previous Erb's palsy		
Obstetric risk factors, if one of the following occurs during delivery:		
1- Shoulder dystocia		
2- Induction of labor		
3- Prolonged second stage of labor		
4- Assisted vaginal delivery		

The third section: treatment
1. When the case was discovered: ☐ at delivery ☐ after a week ☐ during the 1st month ☐ during the 2nd month ☐ during the 1st year
2. Is the case was treated at the time of discovery? ☐ yes ☐ no
3. Which type of treatment did the child receive? ☐ Orthopedics☐ neurologist ☐ physiotherapist☐ occupational therapist ☐peadiatrics
4. Undergo surgery: ☐ Yes ☐ no
5. Does the case totally recovered? ☐ Yes ☐ no ☐ partially (specify percentage? _____)
The fourth section: information from hospital
1. Fetal risk factors
Birthweight:
Apgar score : ☐ at 1 minute ( ) ☐ at 5 minute ( )
Presentation: ☐ cephalic ☐ breech
2. Maternal risk factors

Maternal age:
3. Obstetric risk factors
Specialist made the delivery: ☐ doctor ☐ midwife☐ both
Mode of delivery: ☐ vaginally ☐ CS
If vaginally: ☐ natural ☐ operative/assisted
If operative: ☐by vacuum ☐ with forceps ☐episiotomy ☐epidural anesthesia ☐ oxytocin
2nd stage of labour: ( )

Annex 3.2

Translation of Questionnaire of Erb's palsy in Arabic

القسم الآول: المعلومات الديموغرافية		
تلفون الأهل: العنوان:		
تاريخ الميلاد: - -		
مكان الولادة:		
الجنس: ☐ ذكر ☐ أنثى		
اليد المصابة: ☐يمين☐يسار		
مكان السكن: ☐ مدينة ☐ مخيم ☐ قرية		
ترتيب الطفل في العائلة:		
القسم الثاني: عوامل الخطر		
عامل الخطر	موجود	غير موجود
عوامل الخطر المرتبطة بالجنين. هل كانت العوامل التالية موجودة أثناء الولادة؟:		
1 - حجم الجنين كان كبير؟		
2 - كان الجنين مستعرض؟		
عوامل الخطر المرتبطة بالأم. هل كانت الأم تعاني من العوامل التالية؟:		
1 - السكري		
2 - سكري الحمل		
3 - السمنة		
4 - زيادة وزن كبيرة خلال الحمل		
5 - عمر الأم أكثر من 35 سنة		
6 - بكرية		
7 - متعددة الولادات		
8 - حالة خلع ولادة سابقة		
عوامل حدوث مرتبطة بالولادة. هل حدثت العوامل التالية خلال الولادة؟:		
1 - عسر الولادة من الكتف		
2 - التحريض على الولادة		
3 - الفترة الثانية من الولادة كانت طويلة		
4 - الولادة تمت باستخدام أدوات		
القسم الثالث: العلاج		
1. متى تم اكتشاف الحالة؟☐ عند الولادة ☐ بعد أسبوع ☐خلال الشهر الاول ☐ خلال أول شهرين☐خلال السنة الأولى من الولادة		
2. هل تم علاج الحالة فور اكتشافها؟ ☐ نعم ☐ لا		
3. ما هو نوع العلاج الذي تلقاه الطفل؟ ☐ دكتور عظام ☐ دكتور أعصاب ☐ علاج طبيعي☐ علاج وظيفي ☐ دكتور		

أطفال
4. هل تم شفاء الحالة تماماً؟ ☐ نعم ☐ لا ☐ جزئياً
5. هل أجرت الحالة عملية: ☐ نعم ☐ لا
القسم الرابع: معلومات من المستشفى
1. عوامل خطر متعلقة بالجنين
وزن الجنين عند الولادة: ( )
مقياس أبغار: □ في الدقيقة الأولى ( ) □ في الدقيقة الخامسة ( )
وضعية الجنين: □ طبيعي □ مستعرض
2. عوامل خطر متعلقة بالأم
عمر الأم عند الولادة:
عدد مرات الحمل: □ بكرية □متعددة الولادات
السكري: □ نعم □ لا
سكري الحمل: □ نعم □لا
3. عوامل متعلقة بالولادة
الأخصائي الذي أتم الولادة: □طبيب ولادة □قابلة□الاثنين معاً
طريقة الولادة: □ طبيعية □ عملية قيصرية
الولادة الطبيعية: □ بدون استخدام أدوات □باستخدام أدوات
اذا كانت باستخدام أدوات هل هي باستخدام: □ الشفاط □الملقط □ الجرح □التخدير □الطلق الصناعي
مدة المرحلة الثانية من الولادة: ( )

Annex 3.3:

The Institutional Review Board (IRB)

An-Najah
National University
Faculty of Medicine

بسم الله الرحمن الرحيم

جامعة
النجاح الوطنية
كلية الطب

IRB Approval letter

Study title:
Erb's Palsy in Jenin district: prevalence and risk factors

Submitted by:
Laiali Aiosh

Date Reviewed:
May 7, 2012

Date approved:
May 27, 2012

Your study titled " Erb's Palsy in Jenin district: prevalence and risk factors." Was reviewed by An-Najah National University IRB committee & approved on May 27, 2012

IRB

Samar Musmar,MD, FAAFP
IRB Committee Chairman,
An-Najah National University

نابلس - ص.ب ٧٠٧,٧ هاتف: ٠٩/٢٣٤٢٩٠٢/٤/٧/٨/١٤)(٠٩)(٩٧٢)، فاكسميل٠٩/٢٣٤٩٧٣٩)(٠٩)(٩٧٢)
Nablus - P.O.Box 7,707 - Tel. (972)(09)2342902/4/7/8/14 - Facximile (972)(09)2349739

جامعة النجاح الوطنية
كلية الدراسات العليا

خلع الولادة في محافظة جنين: نسبة الانتشار وعوامل الحدوث

إعداد
ليالي عمر عيوش

إشراف
د. أميرة شاهين
د. خليل عيسى

قدمت هذه الأطروحة استكمالا لمتطلبات الحصول على درجة الماجستير في الصحة العامة من كلية الدراسات العليا، جامعة النجاح الوطنية، نابلس- فلسطين.
2014

خلع الولادة في محافظة جنين: نسبة الانتشار وعوامل الحدوث

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إشراف

د. أميرة شاهين

د. خليل عيسى

الملخص

المقدمة: خلع الولادة هو عبارة عن حالة فيزيائية تحدث نتيجة إصابة الأعصاب الطرفية الخامس والسادس مما يؤدي إلى ضعف أو شلل الطرف العلوي. عوامل حدوث خلع الولادة تختلف من شخص لآخر وترتبط بالأم أو الجنين أو عملية الولادة. نسبة انتشاره وعوامل حدوثه في المحافظة غير معروفة ولم تتم دراستها من قبل. تهدف هذه الدراسة إلى تحديد نسبة انتشار خلع الولادة في محافظة جنين وعوامل حدوثه في الفترة الواقعة بين 2007 – 2011.

الطريقة: هذه الدراسة هي عبارة عن مقارنة محددات وعوامل الخطورة بين 72 طفل ولدوا في الفترة الزمنية 2007 – 2011 من ضمنهم 36 طفل مصاب بخلع الولادة و 36 طفل سليم من خلع الولادة. حيث تمت زيارة المراكز والمؤسسات وجميع الجهات المعنية بحالات الإعاقة المختلفة لتحديد العينة. من ثم تم تعبئة الاستبانة مع الأم عن طريق الهاتف. في النهاية تمت مراجعة ملفات المستشفيات الثلاثة التي تتم فيها عمليات الولادة في المحافظة وهي مستشفى جنين الحكومي، ومستشفى الرازي، ومستشفى الأمل.

النتائج: أظهرت هذه الدراسة أن نسبة انتشار خلع الولادة في محافظة جنين تقدر ب 1.04 حالة خلع ولادة لكل 1000 مولود حي. كما أظهرت الدراسة ارتباط عدة عوامل بحدوث خلع الولادة لدى الأطفال. هذه العوامل تشمل تعسر الولادة من الكتف، التحريض على الولادة، زيادة كبيرة في الوزن

خلال الحمل، كون المرحلة الثانية من الولادة قصيرة، وإجراء الولادة باستخدام أدوات مساعدة. تعسر الولادة من الكتف هو أكثر هذه العوامل ارتباطاً مع خلع الولادة. كما أن إصابة اليد اليمنى بالخلع كانت هي اليد المصابة السائدة في العينة.

الاستنتاج: نسبة انتشار خلع الولادة في منطقة جنين يقدر بنسبة انتشاره في الدول الأخرى. أكثر العوامل التي كان لها ارتباط بخلع الولادة كانت عوامل متعلقة بإجراءات عملية الولادة لذلك لا بد من زيادة توعية وتدريب القابلات اللواتي يقمن بإجراء عملية الولادة.