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Risk Factors for Macrosomia among Newborns Attending Health Services at UNRWA Health Centers in Gaza Governorates

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Thesis Approval

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Dedication

To the loving memory of my father, God bless his soul

To my precious mother

To my brothers; Mr. Abdellwahid, Mr. Jaber, Dr. Atef, Mr. Anwer and Mr. Khalil

To my sisters

To my wife

To my sons; Faisal, A'ed, Ahmed and Abdullah

To my relatives and friends

Declaration

I certify that this thesis submitted for the degree of master, is the result of my own research, except where otherwise acknowledged, and that this study (or any part of the same) has not been submitted for a higher degree to any other university or institution.

Signed

Mustafa Mohammed Shaath

Date: 8/5/2018

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I hope this study could be helpful for the practice and for knowledge seekers.

Mustafa Mohammed Shaath

Abstract

Macrosomia of the newborn is considered as an adverse pregnancy outcome and over the last few decades it has been increasing in many regions of the world especially in the developed countries. Several studies have reported that the prevalence of macrosomia was ranged from 5 to 20%. The aim of this study is to determine the risk factors for macrosomia among newborns attending health care services at UNRWA health centers in Gaza governorates in order to improve maternal &child health care and contribute to reducing mortalities and morbidities.

Case control study was carried out to determine the risk factors for macrosomia. Six health centers were selected randomly with total sample size of 262 (131 cases and 131 controls) newborns who attended their first neonatal visit at the selected health centers. The calculated sample was 186 with power 80% and confidence level 95%.The cases were all eligible infants born with macrosomia (≥ 4kg) during study period and controls were infants born with normal birth weight. The matching was done in base of location and age. The study instrument was a validated constructed questionnaire and record based review of e-medical files. The questionnaire consisted of four domains; maternal, pregnancy related, newborn related and paternal factors. Pilot study was carried out and resulted with no any modification inthe instrument. P-value ≤ 0.05 and/or confidence interval of 95% are considered statistically significant.

In this study bivariate analysis shows that there are statistically significant association ($p < 0.05$) between macrosomiaand the under mentioned risk factors; from maternal characteristics "maternal age at delivery, parity, gravidity, previous history of macrosomic birth, family history of DM, maternal weight during first trimester, maternal BMI during first trimester, eating organ(like liver) once weekly andeating fruits", and from pregnancy related factors "DM during the pregnancy, excessive maternal weight gain during pregnancy, gestational age at delivery and FBG at 24 weeks of gestation", from newborn related factors "male sex and birth order", and from paternal characteristics only "paternal weight".

A prediction model was employed using multivariate logistic regression analysis, showed that the main predictor risk factors for macrosomia were; previous history of macrosomic birth (adjusted OR: 4.662, CI: 1.829–11.88), first trimester BMI (adjusted OR: 2.74, CI: 1.229–6.106 and adjusted OR: 2.739, CI: 1.086–6.907 respectively for overweight and obese mothers), eating fruits (adjusted OR for the groups of mothers who eat fruits 3-5 times weekly and ≥6 times weekly were 7.481, CI: 1.311–42.67 and 10.686, CI: 2.056–55.52 respectively), male sex of newborn (adjusted OR: 2.075, CI: 1.001–4.301), gestational age at delivery (adjusted OR: 1.058, CI: 1.020–1.098), and FBG at 24 weeks of gestation (adjusted OR:1.047, CI: 1.010–1.086).

The study concluded that previous history of macrosomic birth, first trimester BMI, gender of newborn, eating fruits, gestational age at delivery and FBG at 24 weeks were main predictor risk factors for macrosomia. In addition, the study concluded that all these significant risk factors should be taken into consideration during health care delivery and health education program should be adopted to work on modifiable risk factors. Also UNRWA and MoH should refine its criteria for diagnosing GDM. Moreover macrosomic infants should be targeted to maintain their body weight within normal ranges according to z-score. There is a need to conduct research studies to explore the effects of macrosomia on later life among macrosomic newborns.

عوامل الخطورة للمواليد كبيري الحجم بين الأطفال حديثي الولادة الذين يتلقون خدماتهم الصحية في المراكز التابعة لوكالة الغوث الدولية بمحافظات غزة

ملخص الدراسة

يعتبرإنجاب مواليد كبيري الحجم (أي إنجاب طفل بوزن 4 كجم أو أكثر) نتيجة سلبية من نتائج الحمل وعلى مدى العقود الماضية ارتفعت نسبة انتشاره في العديد من مناطق العالم و خاصة في الدول المتقدمة. وقد ذكرت الدراسات أن نسبة انتشار إنجاب مواليد كبيري الحجم تراوحت بين 5 إلي 20%. إن الهدف من هذه الدراسة هو تحديد عوامل الخطورة التي تؤدي إلى إنجاب مواليد كبيري الحجم بين الأطفال حديثي الولادة الذين يتلقون خدمات الرعاية الصحية في المراكز الصحية التابعة لوكالة الغوث الدولية في محافظات غزة من أجل تحسين الرعاية الصحية للأم والطفل والمساهمة في الحد من الوفيات والأمراض.

وقد استخدم الباحث دراسة مقارنة (الحالات والشواهد) بين حالات مرضية وحالات سليمة من أجل تحديد عوامل الخطورة. وبلغ عدد عينة الدراسة 262 منهم 131 حالة مواليد كبيري الحجم و 131 حالة سليمة من بين الذين حضروا لتلقي رعاية الزيارة الأولى لحديثي الولادة في ستة مراكز صحية تابعة لوكالة الغوث الدولية. وتم اختيار المراكز الصحية بطريقة عشوائية, ولقد تم أخذ كافة الحالات المرضيةالتي حضرت إلي العيادات المختارة خلال فترة الدراسة . وكانت الحالات المرضية هي مواليد كبيري الحجم (4 كجم أو أكثر) والحالات السليمة هي مواليد ذي حجم طبيعي أي بوزن ولادة من 2.5 كجم حتى وزن ولادة أقل من 4 كجم.وكانت حالات المواليد ذي وزن ولادة كبير الحجم متطابقة مع الحالات السليمة في العمر و مكان تلقي الخدمة الصحية . وكانت أداة الدراسة هي عبارة عن استبانه محكمة و مراجعة للملفات الصحية الالكترونية. وقد احتوت الاستبانه علي أربع مجموعات رئيسية وهي: خصائص الأم, عوامل لها علاقة بالحمل, خصائص المولود, و خصائص الأب. ولقد أجريت العينة التجريبية قبل تطبيق الدراسة ميدانياولم تحدث أي تغيرات في أداة الدراسة. استخدمت في هذه الدراسة الدلالة الإحصائية ($p \leq 0.05$).

في هذه الدراسة من خلال تحليل ثنائي المتغيرات كانت عوامل الخطورة ذات الدلالة الإحصائية ($p< 0.05$) هي: من خصائص الأم "عمر الأم عند الولادة, عدد الولادات, عدد الحمولات, ولادة سابقة لمولود ذي حجم ولادة كبير , وجود مرض سكري عند الأقارب, وزن الأم في الأشهر الثلاثة الأولي منالحمل, مؤشر كتلة جسم الأم في الأشهر الثلاثة الأولى من الحمل, تناول الكبدوتناول الفاكهة", من العوامل المرتبطة بالحمل "إصابة الأم بمرض السكري, زيادة وزن فوق المعدل الطبيعي خلال فترة الحمل, فترة الحمل عند الولادة, و نسبة السكر في الدم علي 24 أسبوع من الحمل", من العوامل المرتبطة بالمولود "جنس المولود, وترتيب المولود بين أشقائه", ومن خصائص الأب "وزن الأب".

كما و تم استخدام نموذج التنبؤ باستخدام تحليل الانحدار اللوجستي متعدد المتغيرات, وأظهرت النتائج بأن عوامل الخطورة الرئيسية للتنبؤ لإنجاب مواليد كبيري الحجم هي "ولادة سابقة لمولود ذي حجم كبير, مؤشر كتلة جسم الأم في الأشهر الثلاثة الأولى من الحمل, تناول الفواكه, جنس المولود, فترة الحمل عند الولادة, ونسبة تحليل السكر بالدم ع لى 24 أسبوع من الحمل".

وتلخصت الدراسة إلى أن ولادة سابقة ل مولود ذي حجم كبير , مؤشر كتلة جسم الأم في الأشهر الثلاثة الأولى من الحمل, تناول الفواكه, جنس المولود, فترة الحمل عند الولادة, ونسبة تحليل السكر بالدم عند 24 أسبوع من الحمل كانت عوامل الخطر الرئيسية للتنبؤ لإنجاب مواليد كبيري الحجم.

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List of abbreviations

aOR	Adjusted Odds Ratio
BCG	Bacillus of Calmette and Guérin
BMI	Body Mass Index
CDC	Centers for Disease and Prevention
CI	Confidence Interval
CM	Centimeter
DM	Diabetes Mellitus
E-Health	Electronic Health System
FBG	Fasting Blood Glucose
FHT	Family Health Team Approach
GA	Gestational Age
GDM	Gestational Diabetes Mellitus
Hb	Haemoglobin
IOM	Institute of Medicine
Kg	Kilogram
M	Meter
MCH	Maternal & Child Health Care
MoH	Ministry of Health
NCDs	Non-communicable Diseases
OR	Odds Ratio
PIH	Pregnancy Induced Hypertension
PCBS	Palestinian Central Bureau of Statistics
UK	United Kingdom

UNRWA	United Nation Relief and Working Agency for Palestine Refugees in The Near East
USA	United State of America
WHO	World Health Organization

Chapter 1

INTRODUCTION

1.1 Background

Macrosomia of newborn is considered as an adverse pregnancy outcome and over the last few decades it has been increasing in many regions of the world especially in the developed countries with prevalence ranged from 5 to 20% of births in different populations (Henriksen, 2008).

Macrosomia is potentially dangerous to mother and neonate that it might cause significant complications (Ali & Ishtiaque, 2014). For mother macrosomia increases the risk for cesarean delivery, postpartum hemorrhage, vaginal and perineal tear, and for neonate it increases the risk of shoulder dystocia, clavicle fractures, brachial plexus injury and increases the rate of admissions to the neonatal intensive care unit and hospitalization (Kamana , Shakya, & Zhang, 2015).

However, long-term consequences of macrosomia are overweight and obesity in later life. Data from the Center of Disease Control and Prevention's (CDC) demonstratedthat children who were macrosomic at birth have a high prevalence of overweight during childhood; one-third of macrosomic infants were overweight at age 3 to 4 years(Mei, Grummer-Strawn, & Scanlon, 2003).Domestic and international longitudinal studies have demonstrated that higher birth weight also increases the risk for adulthood obesity by a factor of 1.5 to 2(Wojcicki et al., 2008).Overweight in childhood and obesity in adulthood are important because of associations with the metabolic syndrome and cardiovascular disease (Wojcicki, et al., 2008). Accordingly obesity is a serious pediatric public health problem associated with risk of complications in childhood and increased morbidity and mortality throughout adult life (Kliegman et al., 2016).

Macrosomia is the most well-known complication in newborns of women with diabetes, whether gestational or pregestational (Cruz, et al., 2015; Kamana, Shakya, Zhang, 2015). However, macrosomia might affect newborn of non-diabetic women due different risk factors like high maternal age, multiparity, maternal obesity, prolonged gestational age, male sex of newborn (Bektas, Demircioglu, et al., 2013; Wojcicki, et al., 2008), pre-

pregnancy overweight, previous history of macrosomic birth (Wojcicki, et al., 2008) and excessive gestational weight gain (Rokhil, 2014).

1.2 Research Problem

Worldwide the prevalence of macrosomia in developed countries is ranged from 5% to 20% with increasing trend in the last few decades (Henriksen, 2008). However there are no studies conducted about macrosomia in Gaza strip except one cohort study conducted among obese pregnant women showed that the incidence of macrosomia was 16.2% among obese pregnant women(Baloushah, Elhissi, & Abu Mohsen, 2013). Since macrosomia is associated with an increased risk of adverse maternal, neonatal health outcome (Hong, et al., 2009), and long term health problems such as an increased risk for obesity and diabetes of macrosomic babies in their later life (Bektas, et al., 2013). In Gaza strip where there are scarcity of resources it is crucial to identify the leading risk factors for macrosomia in order to take preventive measures. However, in Gaza Strip no information available about the risk factors of macrosomia and this study is considered the first study to handle the topic of macrosomia's risk factors and it will serve as a baseline study that generates an important information which will help the researchers and knowledge seekers in this issue. In other word, this study will fill important information gap regarding macrosomia.

1.3 Justification of the study

Since macrosomia is considered as an adverse pregnancy outcome and it is associated with short term and long term adverse health events. The short term complications include maternal complications like; cesarean deliveries, prolonged labour, postpartum hemorrhage, vaginal and perineal tear, and neonatal complications like; shoulder dystocia, brachial plexus injuries, clavicle fracture, asphyxia and hospitalization. Macrosomi also is associated with long term morbidities like childhood overweight/obesity, adulthood overweight/obesity, metabolic syndrome, diabetes and cardiovascular events. So identifying the risk factors for macrosomia are very important to adopt effective preventive measures in order to alleviate the maternal and neonatal morbidities. It will be helpful for decision makers in policy formulation regarding maternal & child health care. Moreover, by conducting this study the practitioners will be able to predict and control of coming offspring's birth weight which in turn will prevent some lifelong morbidities such as obesity and diabetes mellitus. And this will contribute to reduction of life threatening adverse events in later life like metabolic syndrome and cardiovascular events.

1.4 Aim of study

To determine the risk factors for macrosomia among newborns attending health care services at UNRWA health centers in Gaza governorates in order to improve maternal &child health care and contribute to reducing mortalities andmorbidities.

1.5Specific objectives

1. To determine the relationship between maternal characteristics and macrosomia.
2. To identify the relationship between pregnancy related factors and macrosomia.
3. To examine the relationship between newborn related factors and macrosomia.
4. To study the relationship between paternal characteristics and macrosomia.
5. To set recommendations to reduce the macrosomia and improve maternal and child health.

1.6 Research Questions

1. Is there an association between mother's anthropometric measurements and macrosomia?
2. Is mother's previous delivery of macrosomic infant associated with current macrosomia?
3. Is advanced maternal age associated with macrosomia?
4. Is multiparity associated with macrosomia?
5. Is maternal nutritional status associated withmacrosomia?
6. Is there a relation between diabetes during pregnancy and macrosomia?
7. Is there an association between gestational age and macrosomia?
8. Is there a relationship between excessive maternal weight gain during antenatal care (period) and macrosomia among newborns?
9. Are gender and birth order of newborn associated with development of macrosomia?
10. Arepaternal anthropometric measurements associated with development of macrosomia among newborns?

1.7 Context of the study

1.7.1 Socio-demographic Context

Gaza strip is a narrow zone of land, bounded on the south by Egypt, on the west by the Mediterranean Sea, and on the east and north by the occupied territories in 1948.It is 365 squared km with 46 km long, 5-12 km wide, and 40 km coast line.Gaza strip administratively is divided into five governorates: North Gaza, Gaza, Deir Albalah, Khanyounis, and Rafah. It consists of four cities, fourteen villages, and eight refugees camps. Gaza strip is considered one of the most populated area of the world with population density 5,239persons per squared km and with total population of 1,912,267. The population of Gaza strip is characterized by younger population, that42.7% of Gaza population is under the age of 15 and 2.4% is above 64, high growth rate 3.3%(Palestinian Central Bureau of statistics, 2017) and high total fertility rate 4.5(MoH, 2017). Refugees account 81.9% of Gaza population (UNRWA-Department of Health, 2017).

The complex political instability affects all aspects of the life in Gaza strip and the situation has been worsening due to tight blockade and recurrent wars on Gaza that prevent the transition from relief to development in the whole context of development. The unemployment rate in Gaza is 41.7% and poverty rate is 38.8%which clearly explain the economical constrains of Gaza population (Palestinian Central Bureau of statistics, 2017). However 47% of households in Gaza suffer from moderate to severe food insecurity(OCHA, 2016).

1.7.2 Health Care System

The health care system in Gaza strip is composed of primary, secondary and tertiary care and the health services provided by five main health care providers include the Ministry of Health, UNRWA, NGO's, Palestinian Military Medical Services, and the private sector.The health infrastructure in Gaza strip consists of 30 hospitals with 637 people per bed, and primary health care facilities of variousservice providers; 48 by MoH, 22 by UNRWA, 80 by NGO's, and 5 by Palestinian Military Medical Services that cover the need of the population(MoH, 2017).

The health sector in Gaza strip suffers from different obstacles due to continuous siege which leads to many consequences like recurrent power cuts, inadequate maintenance capacity,shortage of essential drug and medical disposable items, inadequate tertiary care, the treatment abroad is heavily restricted, fragmented health service (WHO, 2014), and growing burden of NCDs(UNRWA-Department of Health, 2017).

1.7.3UNRWA

UNRWA is a United Nations Relief and Working Agency for Palestine Refugees in Near East established by the General Assembly in 1949 following the first 1948 Arab-Israeli War, and became operational in 1950. Its mandate is to provide assistance and protection to a population of over 5 million registered Palestine refugees. Its mission is to help Palestine refugees in Jordan, Lebanon, Syria, West Bank and Gaza Strip to achieve their full potential in human development, pending a just solution to their plight. UNRWA's

services encompass education, health care, relief and social services, camp infrastructure and improvement, microfinance and emergency assistance. UNRWA is funded almost entirely by voluntary contributions(UNRWA-Department of Health, 2017).

UNRWA provides service delivery through 143 Health Centers, 22 of them are located in Gaza strip. The Department of Health employees over 3,000 staff, 500 of whom are doctors. 3.5 million Palestine refugees utilize UNRWA health services, free of charge. UNRWA operates only one hospital in West Bank, moreover, it has a reimbursement scheme for its beneficiaries(UNRWA-Department of Health, 2017).

However, with an increased people life expectancy, the challenge of dealing with an aging population whose main cause of morbidity and mortality is now non-communicable diseases (NCDs) like diabetes mellitus, cardiovascular diseases and other NCDs whichnow are responsible for 70.0% of deaths among UNRWA's served population. These chronic diseases are costly to treat, and often lifestyle and behavioral related(UNRWA-Department of Health, 2017).

In late 2011, UNRWA has adopted a health reform package as a part of the Agency-wide Organizational Development plan. Family Health Team is a primary care package focused on providing comprehensive and holistic primary health care for the entire family, emphasizing long-term provider-patient/family relationships. This person-centered approach has been successfully adopted in many developed and developing countries to address the growing burden of NCDs and the increasing costs associated with their care. The FHT was designed to improve quality, efficiency and effectiveness of health services, particularly targeting NCDs. The FHT approach is supported by introducing the electronic medical records (e-Health) which has positive impact on health care delivery to Palestinian refugees(UNRWA-Department of Health, 2017). UNRWA working hand in hand with Palestine refugee community, host countries and other stakeholders applying multidimensional strategy that focuses on three dimensions: disease surveillance on NCDs and their determinants; health promotion and prevention interventions to combat major risk factors and their environmental, economic, social and behavioural determinants; and the provision of cost-effective interventions (UNRWA-Department of Health, 2017).

1.8 Operational Definitions

1.8.1 Macrosomia

Macrosomia is defined as birth weight of 4,000 gram or more irrespective of gestational age(UNRWA, 2009).

1.8.2 Risk factor

Risk factor is an independent variable associated with an increased risk for macrosomia occurrence.

1.8.3 Socio-demographic factors

In this study socio-demographic characteristics such as educational level of the parents and employment of the parents, age of mother, smoking status of parents, gender of newborn, family income and type of residency are included.

1.8.4 Maternal characteristics

In this study maternal characteristics are referred to the factors related to the mother which increase the risk of macrosomic births such as; first trimester BMI, height, previous delivery of macrosomic infant, maternal age, multiparty, nutritional status, physical activity and pre-existing DM.

Multiparity; is defined as a condition of 2 or more deliveries (Wondie, Jara, & Ayana, 2014),Nutritional status; in this study food frequency table used as an indicator for mother's nutritional status, physical activity; in this study physical activity was measured based on the second Global physical activity Questionnaire that established by World Health Organization which consists of three domains: activity at work; travel to and from places; and recreational activities, pre-existing diabetes mellitus; in this study it refers to

diabetes mellitus which already exist before pregnancy or diagnosed in the first trimester of pregnancy.

1.8.5 Pregnancy related risk factors

Pregnancy related risk factors refer to risk factors which might increase the risk of macrosomic birth such as; gestational diabetes mellitus, gestational age and excessive weight gain during antenatal period are included:

Gestational diabetes mellitus; it refers to diabetes mellitus which is firstly diagnosed during the second or third trimesters of pregnancy, gestation age which means the period of gestation from the beginning of last menstrual period till the delivery with average of 40 weeks or 280 days, and excessive weight gain during antenatal period; The excessive weight gain during the antenatal period is the weight gain above the recommended weight gain during the pregnancy based on pre-pregnancy or first trimester body mass index and summarized according to the Institute of Medicine (2009) and are; for the underweight pregnant women 12.5 – 18 kg, for normal weight pregnant women 11.5 – 16 kg, for overweight pregnant women 7 – 11.5 kg, and for obese pregnant women 5 – 9 kg. However the increase of body weight during the first trimester can be ignored because this increase is minimal and it ranges from 0.5-2.0 kg (Annex 2)(Institute of Medicine, 2009). Calculating the weight gain by subtracting the first body weight reading in the first trimester from the last body weight during the last antenatal care visit. Hypertensive disorders during pregnancy refers to any type of hypertension during pregnancy whether it was chronic, pregnancy induced hypertension (PIH), pre-eclempsia, or even eclampsia.

1.8.6Newborn related risk factors

The risk factors related to the newborn his/herself are risk factors that assumed to increase the risk of being macrosomic such as; gender and birth order of newborn.

1.8.7 Paternal Characteristics

Paternal characteristics are referred to the factors related to the father which might increase the risk of macrosomic births such as; height, weight and BMI of the newborn's father.

Chapter Two

Conceptual framework and literature review

2.1.Conceptual framework

The researcher developed the conceptual framework based on literature and personal experience, the framework shows what the researcher is going to study, it consists of four domains; the core structure of the frame is the influence of the four domain on the macrosomia occurrence as shown below in the figure 2.1

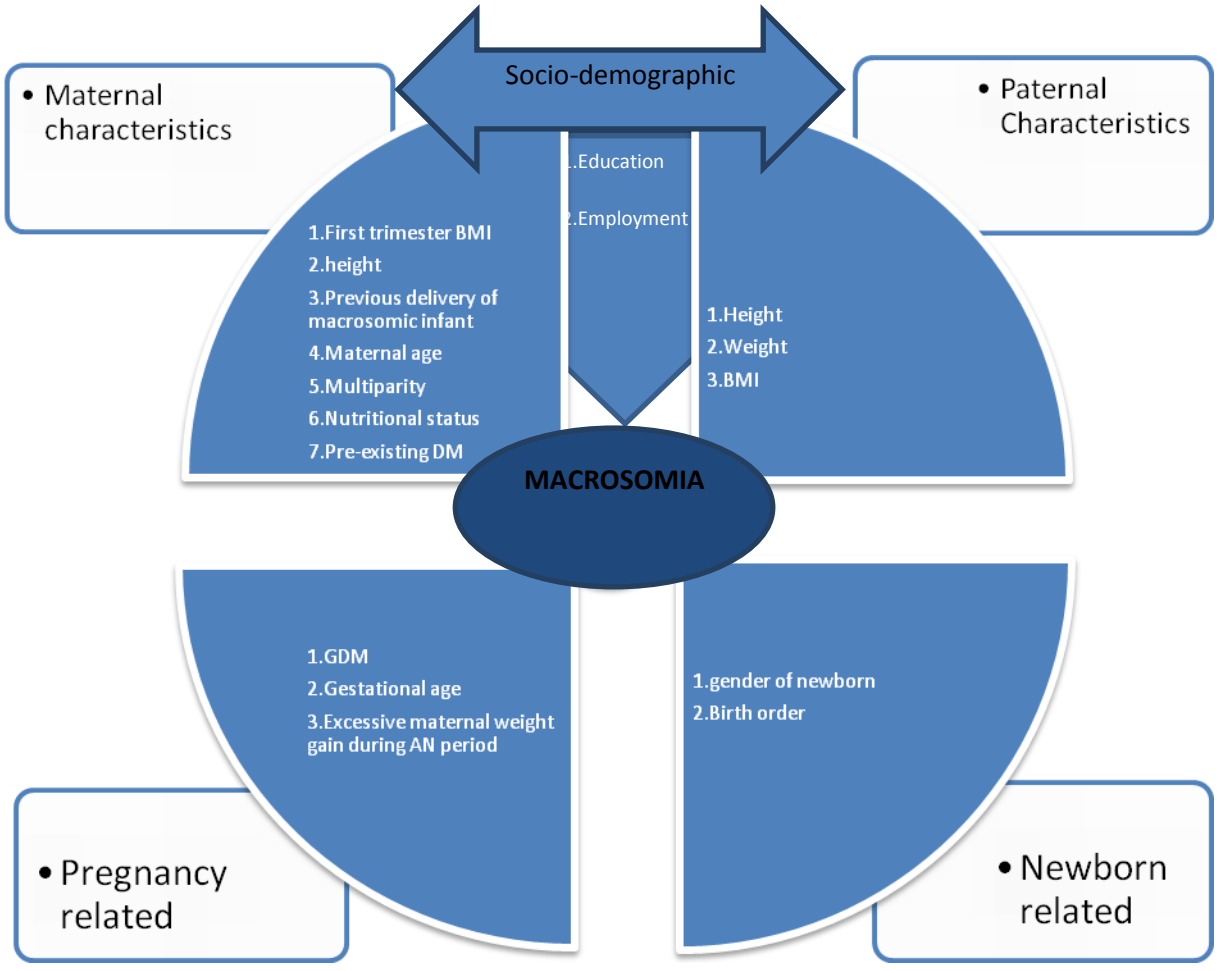

Figure 2.1 conceptual framework self-developed.

2.1.1 Domain of maternal characteristics

maternal characteristics are the factors related to the mother which assumed to increase the risk of macrosomic births that include; first trimester BMI, height, previous delivery of macrosomic infant, maternal age, multiparty, nutritional status and pre-existing DM. Nutritional status in this study was measured based on foot frequency table which reflected food habits during pregnancy period.

2.1.2 Domain of pregnancy related factors

In this domain supposed pregnancy related risk factors for development of macrosomia among newborns which include; gestational diabetes mellitus, gestational age and excessive weight gain during antenatal period are included.

2.1.3 Domain of newborn related factors

These factors might influence the development of macrosomia and includes; the gender and birth order of newborn.

2.1.4 Domain of paternal characteristics

Paternal characteristics are the factors related to the father which assumed to increase the risk of macrosomic births and include; height, weight and BMI of the newborn's father.

2.1.5 Domain of Socio-demographic factors

This domain interacts with the maternal and paternal characteristics in overlapping relationship on their effects on macrosomia development and it includes variables such as educational status and employment of the parents, and other factors as age of mother, smoking status of parents.

All these domains supposed to interact with each other in determining the risk for development of macrosomia among newborns.

2.2 Literature review

Macrosomia of the newborn is considered one of adverse pregnancy outcomes and over the last few decades it has been increasing in many regions of the world especially in the developed countries. Henriksen T.(2008)in his review study showed that globally the prevalence of macrosomia was ranged from 5 to 20% in different populations (Henriksen, 2008).

2.2.1Macrosomia definition

The term of macrosomia is used to describe a newborn with an excessive birth weight, and it literally means large body. In literature macrosomia is differently defined either by an absolute birthweight of or greater than 4000gram, 4500gram, or as a birthweight centile of greater than the90th, 95^{th} or 97^{th} percentile for the infant's gestational age. A birth weight of 4 kg at 40 weeks corresponds to the 90^{th} centile, and this is consistent with a definition of large for gestational age (LGA) (Ritcher, 2013; Walsh & McAuliffe, 2012; Ye, et al., 2015). For the United State a weight of 4.057 kg and 4.232 kg are corresponds to 90^{th} and 95^{th} percentilerespectively at gestational age of 40 weeks (The American College of Obstetricians and Gynecologists, 2016).

Berard et al. from France, they used the definition of macrosomia as birth weight greater than 4500g(Berard, et al., 1998).However the most used definition in literature is birth weight of 4,000 gram or moreirrespective of gestational age (Martinez & immons, 2005; UNRWA, 2009; Wondie, Jara, & Ayana, 2014; Kamana , Shakya, & Zhang, 2015). The same definition is used in different countries like; Iran(Najafian & Cheraghi, 2012), USA (Wojcicki, Hessol, Hyeman, & Fuentes-Afflick, 2008) and Kingdom of Saudi Arabia(Shahnaz, Jamil, & Hamld, 2015). However macrosomia is classified into three grades according to newborn birth weight that 4000 - 4499 gram is considered grade one, 4500 – 4999 gram is considered grade two and ≥ 5000 gram is considered grade three(Medin, 2007).

2.2.2Magnitude of macrosomia

Macrosomia shows an increased trend especially in the last few decades and it's prevalence in developed countries is ranged from 5% to 20% (Henriksen, 2008). A secondary analysis of the WHO Global Survey (2004-2008) in low and middle income countries in Africa, Asia and Latin America shows a variation in prevalence of macrosomia; in Africa 7.3% with highest prevalence in Algeria(15.2%), in Asia it was 2.5% with highest prevalence in China (7.2%), and in Latin America it was 5.5% with highest prevalence in Paraguay (10.2) (Ye, et al., 2015). In USA, a prospective study conducted showed that the percentage of macrosomia among deliveries was 11% (Wojcicki, Hessol, Hyeman, & Fuentes-Afflick, 2008). In neighbor countries to us, a study conducted in Turkey by Bekdash M, et al. in 2007-2010 showedthat the prevalence of macrosomia was 4.7% (Bektas, et al., 2013), a cohort study conducted in Iran between 2007 and 2011 showed that the prevalence of macrosomia was 9%(Najafian & Cheraghi, 2012), In Pakistan, the prevalence of macrosomia was 5.2% (Ali & Ishtiaque, 2014)and a newly published study in Saudi Arabia showed that prevalence of macrosomia was 8.21%(Nadir, Jamil, & Hamid, 2015).However, in Palestine there was no study conducted to study the prevalence or even the subject of macrosomia except one study conducted to identify the effect of maternal obesity on pregnancy outcome, the study was carried out among obese pregnant women in Gaza strip the researchers found that the percent of macrosomia was 16.2% among obese pregnant women(Baloushah, Elhissi, & Abu Mohsen, 2013).

2.2.3 Placental pathologic features of macrosomia

A large prospective cohort study conducted among 29248 women who delivered a singleton infant in United State with complete data on placental pathology revealed that women with macrosomia had a large, thick and heavy placenta, long cord, more central insertion of the cord into the placenta, more thrombosis in cut surface, fetal neutrophilic infiltration, pigment of macrophage cell, abnormal color of the cord and membrane, abnormal fetal surface related meconium stain, true cysts in cut surface and postmaturity of the whole placenta(Fang, et al., 2017).These findings emphasize that macrosomia is related to many placental pathologic lesions and this may be related to the long-term impact of macrosomia an health and disease risk in later life(Fang, et al., 2017).

2.2.4 Complications of macrosoma

Macrosomia is potentially dangerous to mother and neonate that it might cause significant complications (Ali & Ishtiaque, 2014). For mother macrosomia increases the risk for cesarean delivery, postpartum hemorrhage, vaginal and perineal tear, and for neonate it increases the risk of shoulder dystocia, clavicle fractures, brachial plexus injury and increases the rate of admissions to the neonatal intensive care unit and hospitalization (Kamana , Shakya, & Zhang, 2015). A cohort study conducted in Iran also showed that the statistically significant neonatal complications associated with macrosomia were humerus-clavicle fractures and arm-brachial plexus injury in comparison to control group with p-value < 0.001 where significant maternal complications were uterine atony, vaginal-cervix lacerations and uterine rupture with p-value < 0.001(Najafian & Cheraghi, 2012). In Pakistan, a prospective case control study showed that caesarean section, postpartum hemorrhage and perineal tear were statistically associated with macrosomia and also the investigators found that women who delivered macrosomic infants were 3 times (CI: 2.9 – 62.64) more likely to deliver by caesarean section and also macrosomic infants were more likely to be hypoglycemic than controls (Ali & Ishtiaque, 2014). A case control study conducted in UK to identify risk factors for major obstetric haemorrhage found that a birth weight with 4 kg or more significantly increased the risk of maternal blood loss (estimated blood loss more than 1 liter) by 1.9 times (CI: 1.38 – 2.6) compared with birth weight less than 4 kg(Stones, Paterson, & Saunders, 1993).The severity of macrosomia and the maternal health condition have a strong impact on the frequency and on the severity of adverse neonatal outcomes(Mitanchez, Yzydorczyk, & Simeoni, 2015).

Data from the Center of Disease Control and Prevention's (CDC) Pediatric Nutrition Surveillance longitudinal study demonstrates that children who were macrosomic at birth have a high prevalence of overweight during childhood that's one-third of macrosomic infants are overweight/obese at age of 3 to 4 years (Mei, Grummer-Strawn, & Scanlon, 2003). Gu et al. also found that macrosomic infant had a 1.52 fold and 1.50 fold risk respectively of developing overweight or obesity at the age of 7 years (p: 0.001 and p: 0.000) (Gu, et al., 2012). Moreover, a prospective study conducted Wojcicki et al. demonstrated that higher birth weight also increases the risk for adulthood obesity by a factor of 1.5 to 2 (Wojcicki, et al., 2008). Overweight in childhood and obesity in adulthood are important because of associations with the metabolic syndrome and cardiovascular disease (Wojcicki, et al., 2008). Also Kliegman et al. concluded that obesity

is a serious pediatric public health problem associated with risk of complications in childhood and increased morbidity and mortality throughout adult life (Kliegman, et al., 2016).

2.2.5 Socio-demographic risk factors for macrosomia

In a recent study conducted by Abubakari et al. showed that the rural residency location is associated with decreased risk for macrosomia (Abubakari, Kynast-Wolf, & Jahn, 2015). However, in China, a study showed that urban residency was not significantly associated with macrosomia (p: 0.5313)(Bao, et al., 2011). A cross-sectional study conducted in Northern Ethiopia, showed that there was no significant association between family income, type of residency (in term of urban and rural) and macrosomia with p-value > 0.05(Mengesh Hayelom, 2017). On the other hand,in Turkey, a case-control study conducted among non-diabetic mothers to identify the risk factors for macrosomia showed that family income is significantly associated with macrosomia (p: 0.043)(Kaymaz, et al., 2016)

In Turkey, a study showed that there was no significant association between paternal smoking and the occurrence of macrosomia with p-value > 0.05(Kaymaz, et al., 2016). In China, a study conducted by Fan et al. showed that paternal smoking and paternal education were not significantly associated with high birth weight (p > 0.05)(Fan, Huang, Cui, Gao, Song, & Wang, 2015).

A study showed that less than 6 years education of mother carries higher risk for macrosomia but it was statistically not significant (Wojcicki, et al., 2008). Another study conducted in China, showed that nor mother's educational status nor the father's exerted any influence on macrosomia occurrence (Fan, et al., 2015). Mardani M. et al. in their study, they found that no relation existed between mother's occupation and macrosomia (Mardani, et al., 2014). Gu S et al. found that there were no statistical significant association between smoking during pregnancy, maternal education and macrosomia (Gu, et al., 2012). Mengesh Hayelom (2017) in his study, didn't found a significant relationship between maternal education status and macrosomia (p > 0.05) (Mengesh Hayelom, 2017).

2.2.6Maternal risk factors for macrosomia

A case-control study conducted at Debre Markos Referral Hospital, Northwest Ethiopia, (2014) showed that multiparity was statistically significant maternal risk factor for macrosomia(Wondie, Jara, & Ayana, 2014), in Pakistan, also a study concluded that increasing parity was associated with increased risk for macrosomia with dose-response relationship(Ali & Ishtiaque, 2014). Another study conducted in Turkey in 2013 among non-diabetic macrosomic infants showed that in addition to multiparity, maternal age more than 35 years was significantly associated with macrosomia (Bektas,et al., 2013).Kamana et al. in their literature review study, highlighted that the newborns of obese women had more than double the risk of macrosomia compared to those of women with normal weight(Kamana , Shakya, & Zhang, 2015), Rockhill also found that pre-pregnancy obesity significantly influence the development of macrosomia with adjusted OR 1.63(Rokhil, 2014). In addition to the previous studies Cruz, et al. found that the initial pregnancy overweight or obesity was statistically associated with macrosomia(Cruz, et al., 2015). A study conducted at the Obstetric Unit of the University of Benin Teaching Hospital in Nigeria showed that the mother's height was also a risk factor for macrosomia(Oloko, Onakewhor, & Aderoba, 2015). Another conducted in Algeria supported the finding as taller mother had a risk for macrosomic births(AH & Abbassia, 2014).

A study conducted at San Francisco General Hospital, in unadjusted analysis the investigators found that the significant risk factors for macrosomia were older maternal age, increasing gravidity, previous history of macrosomic birth and pre-pregnancy overweight but after adjusting for confounders using multivariate analyses, oldermothers had an elevated risk of macrosomia with odds ratio 2.59 (CI: 1.28 - 5.24) (Wojcicki, et al., 2008).

In a review study done by Jennifer M.Walsh and FionnualaM.McAuliffe, they found in one study that the women with a history of one macrosomic infant were at significantly increased risk of delivering another macrosomic infant in a subsequent pregnancy with an OR of 15.8, and for women with two or more macrosomic infants the risk is even greater with an OR of47.4(Walsh & McAuliffe, 2012).

T. Henriksen in his review study concluded that pre-gestational diabetes play an important role as well as gestational diabetes in development of macrosomia, also he concluded that maternal nutritional status is a risk factor for macrosomia(Henriksen, 2008). However a study carried among Latina women showed that iron and vitamins supplementation during pregnancy carry a lower risk for macrosomia but the associations were not statistically significant (Wojcicki, et al., 2008).

2.2.7Physical activity and sedentary behavior

A study conducted in Northern Ireland, showed that there were statistically significant association between maternal reduced physical activities, increased sedentary behavior and macrosomia with p-value: 0.021 and 0.020 respectively(Reid, McNeil, Alderdice, Tully, & Valerie, 2014). However Thangaratinam S. et al. in their systematic review and meta-analysis study which included 44 relevant randomized controlled trials with total 7278 women enrolled in the study, they concluded that there was no statistically significant association between physical activities and macrosomia (Relative Risk: 0.85, CI: 0.66 – 1.09)(Thangaratinam, et al., 2012). In Iran, the researchers also found that there was no relation between physical activities and the occurrence of macrosomia (p-value: 0.60) (Mohammadbeigi, et al., 2013). A multicenter randomized clinical trial was carried out in United Kingdom, concluded that a behavioral intervention addressing physical activity in women with obesity during pregnancy was not adequate to reduce the incidence of large-for-gestational-age infants(Poston, et al., 2015).

2.2.8 Maternal dietary pattern

Regarding dietary habits Medin A (2007), conducted a study about nutrition during pregnancy and how maternal lifestyle factors affect the risk of macrosomia, found that protein intake in term of energy consumption was significantly associated with macrosomia as a protective factor with OR: 0.5 (CI: 0.2 – 0.9) for upper quartile women compared by women in the lower quartiles (p: 0.03) (Medin, 2007). On the other hand, she used a definition of obesogenic diet which was constructed by the researcher herself based on her own reflection and literature, to gather the nutritional factors at levels were thought to contribute to a higher risk of macrosomia or have a positive effect on birth weight and

she found that the women who gave birth to a macrosomic infant and consumed an obesogenic diet during the week 14-16 or week 30-32 were not significantly different from the proportion of pregnant women who gave a birth to a macrosomic infant and eating a non-obesogenic diet during week 14-16 or week 30-32 (Medin, 2007).In a longitudinal study conducted by Coelho et al. in Brazil, to examine the relationship between dietary pattern in pregnancy and birth weight, the investigators categorized dietary pattern into four patterns of consumption as follows: (1) prudent pattern (milk, yogurt, cheese, fruit and fresh-fruit juice, cracker, and chicken/beef/fish/liver); (2) traditional pattern (beans, rice, vegetables, breads, butter/margarine and sugar); western pattern (potato/cassaca/yams, macaroni, flour, pizza/hamburger/deep fried pastries, soft drinks and pork/sausage/egg); snack pattern (sandwich cookie, salty snacks, chocolate and chocolate drink mix), of these dietary patterns they only found a positive association between snacks dietary pattern and birth weight in adolescent (<20 years) pregnant women (β: 56.64, p: 0.04)(Coelho, Cunha, Esteves, Lacerda, & Filha, 2015). Another prospective study conducted among Danish women showed that fruit consumption was significantly associated with birth weight and birth weight showed an increased pattern by 10.7 gram per quintile increase in fruit intake during pregnancy period, but the investigators didn't find a significant association between vegetable consumption and birth weight (Mikkelsen, Osler, Orozova-Bekkevold, Knudsen, & Olsen, 2006).

A study conducted in Iran, showed that there were statistically significant association between protein, fruits/vegetables and macrosomia (p-value: 0.014, 0.002 and 0.035 respectively) but the researchers didn't find significant association between diary, fast food, rice/bread and macrosomia (p-value: 0.552, 0.879 and 0.206 respectively)(Akbari, Mansourian, & Kelishadi, 2015).

Medin in her thesis mentioned that, avoidance or decrease in consumption of soft drinks during pregnancy could be beneficial but she hypothized the claim on the ground of excessive consumption of sweetened soft drinks might lead to overweight or obesity and thus leads to higher birth weight or even to macrosomic birth (Medin, 2007). Regarding water consumption for drink, a cohort study conducted in United State to examine the relationship between water intake and fetal growth and preterm delivery, the researchers concluded that high water intake may be associated with higher mean birth weight (adjustment for confounders was done) and they found some evidence of an exposure - response relationship with mean differences in birth weight between groups ranging from

27 – 50 grams with increasing total water intake compared to the lowest quartile after adjustment(Wright, Hoffman, & Savitz, 2010).

2.2.9Micronutrients and vitamin supplementation during pregnancy

In literature, there was no agreement on the effects of micronutrient and vitamins supplementation during pregnancy period on the infant's birth weight. Several studies were done, showed different findings. One of them, a prospective longitudinal study conducted among 226 pregnant women throughout the whole period of pregnancy in Algeria, showed that iron, zinc, calcium, vitamin B1, vitamin C and vitamin E intake during pregnancy period (1., 2., 3. Trimesters) were not correlated to birth weight ($p > 0.05$), but magnesium intake during first trimester and vitamin B9 intake during the third trimester were significantly correlated to birth weight(Tebbani, Oulamara, & Agli, 2017). Another study conducted in Turkey, by Kalem et al. with total 1838 pregnant women divided into four groups: iron group, multivitamins group, multivitamin+iron group and control (without supplements) group, and the researchers found that the birth weight was significantly higher in the multivitamin group and the multivitamin+iron group than in the iron group and the control group, and also they found vitamin supplementation increased the risk of macrosomia by 3.9 times, while multivitamin+iron supplementation increased the risk by 4.8 times(Kalem, Kamalak, Kosus, Kosus, & Kalem, 2017).However in Spain, a studyconducted to explore the relationship between iron, folic acid supplementation and low birth weight, found that iron supplementation associated with lower risk of LBW in pregnant women (OR: 0.56, CI: 0.33 – 0.96)(Palma, Perez-Iglesias, Prieto, Pardo, Liorca, & Delgado-Rodriguez, 2008). In Ireland, Horan et al. in their randomized clinical trial, they studied a variety of vitamins and minerals (riboflavin, thiamine, niacin, folate, vitamin B6,B12,Cand D, zinc, selenium, and iron) in relation to birth weight and only they found a significant negative association between birth weight and second trimester vitamin D intake (p: 0.003), and positive association with third trimester vitamin B12 intake (p: 0.002)(Horan, McGown, Gibney, Donnelly, & McAuliffe, 2015).

Regarding Omega-3 supplementation during pregnancy, a study conducted in USA showed that no statistically significant association between Omega-3 supplementation during pregnancy and birth weight, but they found that Omega-3 significantly associated with gestational length(Harris, et al., 2015).

2.2.10 Pregnancy related risk factors for macrosomia

A literature review study conducted by Kamana et al shows that the frequency of macrosomia in women with GDM was increased by 50% compared to non-GDM women in both the non-obese and obese groups (Kamana , Shakya, & Zhang, 2015). Different studies considered GDM as a major risk factor for macrosomia (Ali & Ishtiaque, 2014; Najafian & Cheraghi, 2012). A study conducted at the America Arias University Maternity Hospital in Cuba during 2002–2012, showed that inadequate glycemic control among gestational diabetic pregnant mothers and excess pregnancy weight gain were significant predictor risk factors of macrosomia (Cruz, et al., 2015).

Erika Ritcher in his study, demonstrated the importance of excessive gestational weight gain as a significant risk factor for development of macrosomia (Ritcher, 2013) and Rockhill also found the same result (Rokhil, 2014). Furthermore Walsh and McAuliffe (2012) in their review, they found in 8 studies that the maternal weight gain during pregnancy had an important influence on infant birth weight (Walsh & McAuliffe, 2012). Consistent with these findings, a study conducted in Cuba showed that excess weight gain during pregnancy was a significantly associated with macrosomia occurrence with OR: 3.1 and CI: 2.34 – 9.84 (Cruz, et al., 2015). A similar finding was observed in Canada cohort study with OR: 2.86 and CI: 2.09 – 3.92 for the group of mothers with excessive weight gain during pregnancy compared by the group who didn't have excessive weight gain (Ferraro, et al., 2012).

A case-control study by Wondie et al., showed that postmaturity was a significant risk factor for macrosomia development (Wondie, Jara, & Ayana, 2014). Furthermore a study conducted in South East Nigeria, showed that postdate births were more likely to be macrosomic with adjusted OR 2.1 (95% C.I;1.4-4.1) (Iyoke, Lawani, et al., 2014). Similar findings were observed in China, which showed that the gestational age was significantly associated with macrosomia with t: 3.91 and p-value: 0.001(Li Yi, 2015). In Northern Ethiopia, the same findings also was observed with relative risk for developing macrosomia among pot-term pregnant women was 2.22 (CI: 1.1 – 4.56)(Mengesh Hayelom, 2017).

Regarding FBG level during pregnancy, a population based study conducted in Hungary revealed the presence of a significant association between maternal FBG and birth weight with p-value: 0.004 and the researchers also found that the risk of having LGA, increased significantly when FBG > 90mg/dl compared with the group of mothers with 72 – 81mg/dl, and the odds of having macrosomia for the groups of mothers 90 – 99 and >99 were 1.53 (CI: 1.15 – 2.05) and 2.45 (CI: 1.50 – 4.03) respectively(Kereayi, et al., 2009). Mohammadbeigi et al. also found similar finding in Iran that there was a statistically significant difference between mothers of case and control groups in their FBG level with p-value 0.01, the high FBG level was observed in mothers of case group(Mohammadbeigi, Farhadifar, Soufi Zadeh, Mohammadsalehi, Rezaiee, & Aghaei, 2013). while in China, a study showed that there was no statistical significant association between FBG and macrosomia with t: 0.09 (p: 0.927)(Li Yi, 2015).

Mohaamadbeigi et al. also found that there were no statistical significant association between the systolic BP, diastolic BP and the occurrence of macrosomia with p-value 0.28 and 0.09 respectively(Mohammadbeigi, Farhadifar, Soufi Zadeh, Mohammadsalehi, Rezaiee, & Aghaei, 2013). Regarding Hb level, a prospective study conducted in Switzerland showed that there was no significant association between Hb < 11 with low ferritin level or Hb < 11 with normal ferritin level and the occurrence of macrosomia with p-value 0.25 and 0.82 respectively when they compared with mothers with normal Hb and ferritin level(Bencaiova & Breymann, 2014), while in Turkey, a case-control study was carried out among non-diabetic mothers showed that there was a significant association between Hb and macrosomia and the mean Hb for case and for control group were 11.1 and 11.8 with p-value: 0.005(Kaymaz, et al., 2016). In India, a study showed that Hb level was significantly associated with birth weight with p-value 0.005 (Bora & Das, 2015).

1.2.11 Excessive weight gain during pregnancy

The most commonly used definition criteria for recommended weight gain during pregnancy is the criteria of Institue of Medicine (2009) which is determined by recommended weight gain based on pre-pregnancy or early pregnancy (first trimester) BMI and it is mentioned that the weight increase during first trimester is minimal and range 0.5 – 2 kg and can be ignored (Institute of Medicine, 2009). The recommended weight gain for the underweight pregnant women 12.5 – 18 kg, for normal weight pregnant

women 11.5 – 16 kg, for overweight pregnant women 7 – 11.5 kg, and for obese pregnant women 5 – 9 kg. However the increase of body weight during the first trimester can be ignored because this increase is minimal and it ranges from 0.5-2.0 kg (Institute of Medicine, 2009). However, the excessive weight gain during pregnancy is the weight gain which exceeds the recommended weight gain during pregnancy as determined by Institute of Medicine criteria and as follows; for the underweight pregnant women > 18 kg, for normal weight pregnant women > 16 kg, for the overweight pregnant women > 11.5, and for the obese women > 9 kg (Annex 2) (Institute of Medicine, 2009). This definition was applied in this study with the same criteria.

In Canada, Ferraro et al. used the same criteria in their cohort study and found that the odds of macrosomia occurrence was 2.86 (CI: 2.09 – 3.92) for the group who exceed the recommended weight gain by IOM (Institute of Medicine) compared with the group who didn't exceed the recommended weight gain (Ferraro, et al., 2012).

2.2.12 Newborn related risk factors for macrosomia

In a cross-sectional study conducted in Turkey by Bektas et al. (2013) showed that the male/female ratio among 509 macrosomic infants were 2.2 with p-value < 0.05 (Bektas, et al., 2013). Habiba Sharaf Ali and Shahina Ishtiaque (2014) in their study, they found that the male infants were more likely to be macrosomic compared with female infants with OR 1.20 (Ali & Ishtiaque, 2014). Another study conducted by Iyoke et al. found the same association with adjusted OR 1.64 (Iyoke, et al., 2014). In China, also Li et al. found that the odds of male fetuses to be delivered with macrosomia was 2.48 in comparison to female fetuses(Li Yi, 2015). A similar findings were also observed in Northern Ethiopia that the relative risk for female fetuses to be born with macrosomia was 0.58 (CI: 0.35 – 0.9) compared with male fetuses(Mengesh Hayelom, 2017). However, in Iran, the researcher didn't find a significant association between the gender of newborn and macrosomia with p-value 0.34(Mohammadbeigi, Farhadifar, Soufi Zadeh, Mohammadsalehi, Rezaiee, & Aghaei, 2013)

In Iran, the investigators found that birth order was associated significantly with the occurrence of macrosomia(Maroufizadeh, Omani, Amini, & Sepidarkish, 2016), and a similar finding also was observed in Korea(Kang, et al., 2012).

2.2.13Paternal risk factors for macrosomia

Regarding macrosomia, the majority ofstudies focused on maternal and newborn factors and the researches, which studied the relationship between father's characteristics and macrosmia occurrence, were rare and this area need more in-depth studies. However, despite the rare studies in this issue, there was a cross sectional analytical study conducted in Cameroon, showed that women whose husband BMI ≥30 gave birth to macrosomic babies more than women whose husband BMI < 25 and the OR for macrosomia was 3.7 (CI: 1.7 – 6.9) when father's BMI ≥ 30 in comparison to father's with BMI < 25 (Nkwabong & Nazli Tangho, 2015). Another study conducted by Yang et al. concluded that thefathers who are overweight or obese influence the risk for macrosomia development among their offspring (Yang, et al., 2015). In Sydney, a study showed that there were significant association between paternal weight, paternal height and large-for-gestational age (p: 0.002)(Donnelley, Raynes-Greenow, Turner, Carberry, & Jeffery, 2014).

On the other hand, in Northern Ireland, the researchers didn't find significant association between paternal weight, paternal height and the occurrence of macrosomia with difference in means between the groups were for the fathers' weight 0.239 kg (p: 0.62) and for fathers' height 0.3 cm (p: 903) respectively(Reid, McNeil, Alderdice, Tully, & Valerie, 2014). Another study conducted in Turkey, showed that there was no significant association between paternal BMI and the occurrence of macrosomia with p-value > 0.05(Kaymaz, et al., 2016). Lepereq et al. concluded that paternal characteristics had no significant effect on offspring birth weight(Lepereq, Timsit, & Hauguel-de, 2000).

2.2.14 Main predictor risk factors for macrosomia

In China, a study conducted by Li et al. showed that the main predictors of macrosomia were pre-pregnancy BMI, gravidity, parity, gestational age, maternal age and weight gain in pregnancy(Li Yi, 2015). In Canada, Ferraro et al. found that the main predictors of macrosomia were maternal BMI, parity, maternal age, maternal height, excessive maternal

weight gain (according to IOM criteria) and maternal smoking (as protective factor) (Ferraro, et al., 2012). In Turkey, Akin et al. in their study, which was conducted among 4246 non-diabetic pregnant women, found that the main predictor risk factors for macrosomia were maternal age, parity, pre-pregnancy BMI and gestational weight gain(Usta, et al., 2017). However,Kaymaz et al.,from turkey, conducted a study among non-diabetic mothers showed that the main predictors risks for macrosomia were male infant, gestational age at delivery and mother age ≥ 35(Kaymaz, et al., 2016). In Iran, Mohammadbeigi et al. found that gestational diabetes, previous history of macrosomic birth and preeclampsia in pregnancy period as the main predictors of macrosomia occurrence(Mohammadbeigi, Farhadifar, Soufi Zadeh, Mohammadsalehi, Rezaiee, & Aghaei, 2013).

2.2.15Management of macrosomia

As there are various adverse outcome related to fetal macrosomia, efforts should be made to identify macrosomic fetuses during antenatal period and before delivey(Ali & Ishtiaque, 2014). Diagnosing fetal macrosomia by clinical estimation of fundal level is inaccurate and subject to considerable variations like maternal size, amount of amniotic fluid, status of bladder, pelvic masses, fetal position and many other factors(Aye, Miller, Saxena, & Farhan, 2010). However ultrasound biometry used to detect fetal weight 4000 gram and above is characterized by low sensitivity, low positive predictive value and high negative predictive value(Aye, Miller, Saxena, & Farhan, 2010).

Optimization of blood glucose in diabetic pregnant women, maternal weight and limitation of weight gain during pregnancy would be useful for preventing macrosomia occurrence(Zamorski & Biggs, 2001). Furthermore pregnancy counseling and public health initiatives should stress the importance of attaining a healthy weight prior to pregnancy and avoidance of excessive weight gain after conception in addition to maintaining good glycemic control in diabetic pregnant women(Walsh & McAuliffe, 2012).

Management of pregnancies with suspected fetal macrosomia is challenging for clinicians(Aye, Miller, Saxena, & Farhan, 2010). Elective caesarean section is intended to

prevent several complications associated with fetal macrosomia, especially brachial plexus injuries and perineal lacerations(Aye, Miller, Saxena, & Farhan, 2010).

In United State, care provider concerns about a suspected big baby were the fourth most common reason for an induction delivery with percent of 16% of all inductions, and the fifth most common reason for cesarean section with percent 9% of all cesarean sections(Dekker, 2013). Furthermore, of the women who told that their baby was getting big, two out three said that their care provider discussed inducing labour because of the suspected fetal macrosomia, and one out of three said that their care provider talked about planning a cesarean section because of the suspected fetal macrosomia(Dekker, 2013).

However, in conjunction with cost-effectiveness analyses elective caesarean section is only beneficial for non-diabetic women whose fetus is suspected to be 5000 gram and more(Aye, Miller, Saxena, & Farhan, 2010). The management of suspected fetal macrosomia should not only determined by birth weight alone, but by a complex and poorly understood relationship between fetal and maternal anatomy and different factors like the weight estimate of the suspected macrosomic fetus, the pregnant mother's obstetric history, her progress during labour, the adequacy of her pelvis and other evidence suggestive of fetopelvic disproportion should be used in determining the intervention, such as caesarean section(Zamorski & Biggs, 2001).

Chapter Three

Methodology

3.1 Study design

The design of this study is a case control study aiming to achieve the objectives of the study in identifying and determining risk factors for macrosomic births. Case control study is best to fit this situation with known outcome (macrosomia) in which we trying to identify risk factors (exposure). It gives us opportunity to explore a group of risk factors supposed to have an effect on the outcomes. It is easy, practical, less expensive, needs less logistics, and preserved the time.

3.2 Study setting

This study was carried out at six UNRWA health centers at different governorates in Gaza strip. The health centers were selected randomly; 2 health centers from each area (North, middle and South area). They are Rimal, Beach, Nusairat, Deir-Balah, Japanese and Maen health centers.

3.3 Study population

The study population consisted of two groups (cases and controls) ; the cases were newborns with macrosomia who are seeking their first neonatal health care visit (for BCG administration) to the health center, and the control were newborns with normal birth weight (2500 to less than 4000gram) who visited UNRWA health centers seeking their first neonatal health care visit. Matching between case group and control group was applied in term of catchment area (location) and infant's age .

3.4 Sample and sampling

Gaza strip traditionally are divided into three area (zone) and the same is used by UNRWA-Health Department, so to be more representative the researcher excluded one health center (Jabalia) due to non-integrated e-health system in that health center at study time and then the researcher randomlyselected two health centers from each area with totalsix health centers distributed among the three zones; two in the south area, two in the middle area, and two in the north area. The six health centers were selected by random sampling method after exclusion of Jabalia health center. Within the six health centers all eligible subjects after obtaining consent form, were selected during the period of study till obtaining the needed proportion of sample size from each health center. And for every case, a control was selected by matching age of the newborn and the location in term of the same catchment area.

3.5 Sample size

The sample size based on literature review and consultation with experts in the field of the study and it was calculated by using Epi info version 7 (Annex 3) with parameters of $\alpha = 0.05$ and the power = 0.80.

The calculated sample size was 93 cases and 93 controls. however, to be more representative it decided to involve 131 cases and 131 controls with total sample size of 262participants divided among the six health centers in proportionate manner based on number of births of the year 2015.

3.6 Eligibility criteria

3.6.1 Inclusion criteria

Cases: All newborns, with birth weight of 4.000gram and more, who came to the first neonatal visit at the selected health centers and whose family was willing to participate in the study.

Controls: All newborns, with normal birth weight, who came to the first neonatal visit at the selected health centers and who match the criteria of location and infant's age.

3.6.2 Exclusion criteria

- Anyone who didn't meet the inclusion criteria.
- Newborns with low birth weight.
- Newborns with congenital anomalies such as hydrocephaly.

- Families who refused to participate.

3.7 Period of the study

The study was carried out in the field during the period of August 2016 to April 2017.

3.8 Instrument of the study

The researcher used structured questionnaire for the selected newborn's parents. The questionnaire included newborn's personal data, parents' demographic data, mothers past and current medical, lifestyle and nutritional history, mother's past and the recent reproductive history, newborn's birth history. Physical activities were measured based on the Second Global Physical Activity Questionnaire that established by WHO. The physical activity scale divided into three domains: activity at work; travel to and from places; and recreational activities. The scale was calculated as adopted by WHO and physical activities were classified accordingly into three groups: high; moderate; and low. In addition nutritional status was measured by using food frequencies table.

The second step was record based review of the e-medical records of newborns' and their parents' noting that all medical data was available in UNRWA electronic medical records.The third step is to record anthropometric measurements for newborns and their fathers.

3.9 Validity and reliability

3.9.1 Validity

The questionnaire was submitted to ten experts in the field to evaluate its components, relevance and the context of the questionnaire, and their comments were taken into consideration in order to improve the instrument's validity. Also, a pilot study was conducted before implementing the research in the field to examine participants' response and understanding. The pilot study didn't lead to any changes in the questionnaire.The face validity was ensured by proper construction of questionnaire into parts with logical consequences and arrangement.

3.9.2 Reliability

Many measures were taken to ensure the reliability of the instruments including;

- Training of data collectors on the questionnaire's techniques.
- By using standardized anthropometric measurements.
- The data entry was filled in the same day of data collection to allow possible interventions to check the data completeness and quality or to re-fill the questionnaire when required.
- Re-entry of 5% of the data after finishing data entry was done to assure correct entry procedure and decrease entry errors.

3.10 Pilot study

Pilot study was conducted on 20 subjects; 10 cases and 10 controls before implementing the study on the field in order to ensure the validity and reliability of the questionnaire. The pilotstudy didn't lead any changes in the questionnaire.

3.11 Data collection

The researcher assisted by two data collectors who conducted the structured questionnaire in the selected UNRWA health centers for the participants. Administration of questionnaire took place of nine months. The researcher trained the assistant data collector about the aim of the study, its objectives, tools that would be used. Every questionnaire took about 15 minutes. At the same period record based review took place and anthropometric measurement especially for the father and newborn were carried out. Noting that all anthropometric measurements of mothers and newborns were already available in their e-medical records.

3.12 Data entry and analysis

The researcher used Statistical Package of Social Science (SPSS) program for data entry and analysis. Data analysis was done by the researcher himself with support by the supervisor. Descriptive statistics such as frequency tables were done to study variables and

cross tabulation between macrosomia as dependent variable and the studied risk factors as independent variables.

Advanced statistical and epidemiological analysis was done such as;

- Cross tabulation, Chi square and Fisher's exact test for categorical variables.
- Odds ratio.
- Independent sample t-test for continuous variables
- Simple logistic regression.
- Multiple logistic regression and constructing a predictor model

P-value equal or less than 0.05 will be considered as statistically significant, with confidence interval (CI) of 95%.

3.13Administrative and ethical consideration

The researcher was committed to all ethical considerations required to conduct the research, ethical approval was obtained from the school of public health–Al-Quds University and Helsinki committee to carry out the study.In addition an approval letter was obtained from UNRWA health department-Gaza Field to conduct the research in the field of UNRWA health centers.Also consent form with all its requirement was obtained from all study participants.

3.14 Limitation of the study

- Few number of cases.
- Frequent electricity cut off.
- References that didn’t cover all dimensions of supposed risk factors and some assumed risk factors were not studied before.
- There were difficulties in conducting anthropometric measurements for the father and this sometimes led the researcher to visit the newborns' fathers at home to do so.
- Statistical analysis that necessitate advanced methods.

Chapter Four

Results and discussion

4.1 Introduction

This chapter illustrates the results of statistical analysis of the data, including descriptive analysis that presents the sociodemographic characteristics of the study sample and the answers to the questions of the study. The researcher used statistical procedures such as frequencies, percentages, mean and standard deviation, and some statistical tests such as Chi-square, Odds Ratio, Fisher's exact test, independent samplet-test, simple logistic regression and multiple logistic regression.

4.2 Socio-demographic characteristics of participants

4.2.1 Distribution of study participants according to the health center and residency

Table 4.1: Distribution of study participants according to the health center and residency

Type of subject		**Cases N (%)**	**Control N (%)**	**Total N (%)**
Health center	Japanese (South area)	12 (9.2)	12 (9.2)	24 (9.2)
	Maen (South area)	28 (21.4)	28 (21.4)	56 (21.4)
	DeirAlbalah(Middle area)	22 (16.8)	22 (16.8)	44 (16.8)
	Nusairat (Middle area)	22 (16.8)	22 (16.8)	44 (16.8)
	Rimal (North area)	34 (26.0)	34 (26.0)	68 (26.0)
	Beach (North area)	13 (9.9)	13 (9.9)	26 (9.9)

	Total	131 (100)	131 (100)	262(100.0)

Table (4.1) shows that the study sample consisted of 262 infants (131 cases and 13control). The table shows the matching between cases and controls in term of health centers which reflect the same catchment area (location). The table, also shows that 30.6% of the study sample is from South area, 33.6% is from Middle area and 35.9% is from North area of Gaza strip. The table also shows that 12 (9.2%) of cases and 12 (9.2%) of controls are from Japanese health center, 28 (21.4%) of cases and 28 (21.4%) of controls are from Maen health center, 22 (16.8%) of cases and 22 (16.8%) are from Deir-Balah health center, 22 (16.8%) of cases and 22 (16.8%) of controls are from Nusairat health center, 34 (26.0%) of the cases and 34 (26.0%) of the controls are from Rimal health center and 13 (9.9%) of the cases and 13 (9.9%) of the controls are from Beach heath center.

4.2.2 Distribution of newborns according to their weight at birth

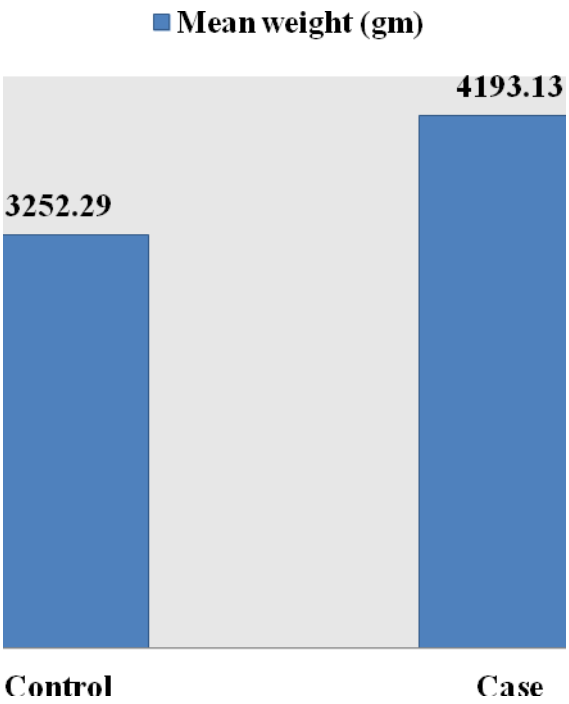

Figure 4.1: Distribution of newborns according to their mean weight at birth

Figure (4.1) shows the mean and standard deviation of infants' weight. The figure shows that the mean weight of cases is 4193.13 gram with standard deviation (233.920 and the mean weight controls is 3252.29 gram with standard deviation (346.12).

Table 4.2: Distribution of study participants according to their birth weight's category

Type of subject		**Number**	**Percent**
Birth weight category (control group)	2500 – 2999 gram	22	16.8%
	3000 – 3499 gram	70	53.4%
	3500 – 3999 gram	39	29.8%
	Total	131	100%
Birth weight category (case group)	4000 - 4499 gram	110	84%
	4500 – 4999 gram	19	14.5%
	5000 – 5499 gram	2	1.5%
	Total	131	100%

Table (4.2)shows that the majority of control group (53.4%) were within the category of 3000 – 3499 gram,while (84%) of cases were within the category of 4000 – 4499 gram.

4.2.3 Distribution of mothers according to their age at delivery time

Table 4.3:Distribution of mothers according to their age at delivery time

Variable		Case N (%)	Control N (%)	Total N (%)
Mother's age at delivery	23 years and below	22 (16.8)	44 (33.6)	66 (25.2)
	24-29 years	51 (38.9)	48 (36.6)	99 (37.8)
	30-33 years	33 (25.2)	18 (13.7)	51 (19.5)
	34 years and more	25 (19.1)	21 (16)	46 (17.6)
	Total	131 (100)	131 (100)	262 (100)

Table (4.3) shows that 51 (38.9%) of cases' mothers and 48 (36.6%) of controls' mothers are between the age of 24 and 29 years, while 25 (19.1%) of cases' mothers and 21 (16%) of controls' mother are 34 age and above. However, the mean age of cases' mothers is 28.77 years with standard deviation 5.57 and the mean age of controls' mothers is 27.13 years with standard deviation 6.03 (Annex 5).

4.2.4 Distribution of study participants according to their residence

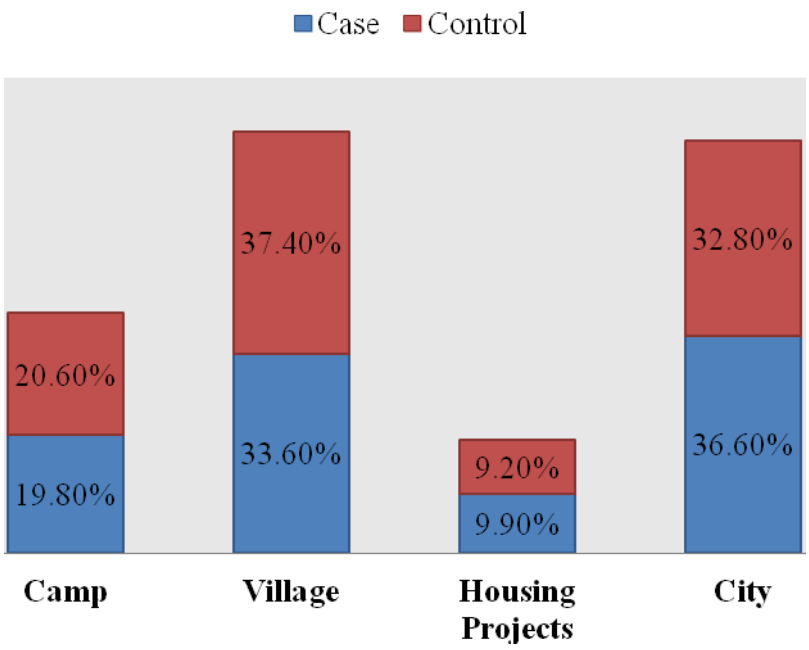

Figure 4.2: Distribution of study participants according to their residence

Figure (4.2) shows that37.4% of controls and 33.6% of cases are living in villages, while 20.6% of controls and 19.8% of cases are living in camps. The table also shows that 36.6% of cases and 32.8% of controls are living in cities. Moreover the table shows that 9.2% of controls and 9.9% of cases are living in housing projects noting that housing projects contains different groups of people.

4.2.5 Distribution of parents according to their educational level

Table 4.4: Distribution of mothers according to their educational level

Type of subject		Cases N (%)	Control N (%)	Total N (%)
Mother's education level	Illiterate	0 (0)	0 (0)	0 (0)
	Can Read and Write	0 (0)	1 (0.8)	1 (0.4)
	Elementary school	5 (3.8)	2 (1.5)	7 (2.7)
	Preparatory school	18 (13.7)	27 (20.6)	45 (17.2)
	Secondary school	49 (37.4)	41 (31.3)	90 (34.4)
	Associate Diploma	16 (12.2)	15 (11.5)	31 (11.8)
	Bachelor and above	43 (32.8)	45 (34.4)	88 (33.6)
	Total	131 (100)	131 (100)	262 (100)

Table (4.4) shows that 49 (37.4%) of cases' mothers and 41 (31.3%) of controls' mothers have degree of secondary school while 43 (32.8%) of cases' mothers and 45 (34.4%) of controls' mothers have bachelor and above degree and regarding to the category of mothers who can read and write, only represents 0.4% of participants' mothers. The table also shows that 79.8% of the mothers are from the groups of secondary school and above that reflects the educational level of studied mothers that was no mother illiterate in the study sample.however the Palestinian Statistics Bureau showed that the people ≥ 15 years who illiterate was 3.1% (Palestinian Central Bureau of Statistics, 2017).

Table 4.5: Distribution of fathers according to their educational level

Type of subject		Cases N (%)	Control N (%)	Total N (%)
Father's education level	Illiterate	0 (0)	0 (0)	0 (0)
	Can Read and Write	4 (3.1)	4 (3.1)	8 (3.1)
	Elementary school	6 (4.6)	8 (6.1)	14 (5.3)
	Preparatory school	17 (13)	27 (20.6)	44 (16.8)
	Secondary school	44 (33.6)	39 (29.8)	83 (31.7)
	Associate Diploma	19 (14.5)	15 (11.5)	34 (13)
	Bachelor and above	41 (31.3)	38 (29)	79 (30.2)
	Total	131 (100)	131 (100)	262 (100)

Table (4.5) shows that 44 (33.3%) of cases' fathers and 39 (29.8%) of controls' fathers have degree of secondary school while 41 (31.3%) of cases' fathers and 38 (29%) of controls' fathers have bachelor and above degree and regarding to the category of fathers who can read and write, only expresses 3.1% of participants' fathers. The table also shows that 74.9% of the fathers are from the groups of secondary school and above and no father was illiterate in the study sample.however the Palestinian Statistics Bureau showed that the people ≥ 15 years who illiterate was 3.1% (Palestinian Central Bureau of Statistics, 2017)..

4.2.6Distribution of parents according to their employment status

Table 4.6:Distribution of parents according to their employment status

Type of subject		Case N (%)	Control N (%)	Total N (%)
Mother's employment	Employed	13 (9.9)	12 (9.2)	25 (9.5)
	Not employed	118 (90.1)	119 (90.8)	237 (90.5)
	Total	131 (100)	131 (100)	262 (100)
Father's employment	Employed	103 (78.6)	100 (76.3)	203 (77.5)
	Not employed	28 (21.4)	31 (23.7)	59 (22.5)
	Total	131 (100)	131 (100)	262 (100)

Table (4.6) shows that only of 13 (9.9%) of cases' mothers and 12 (9.2%) of controls' mothers are employed, while 103 (78.6) of cases' fathers and 100 (76.3%) of controls' father are employed. This reflected that the predominant employee in Gaza is male in comparison to female employees. The Palestinian statistics Bureau showed that the percent of female participation in workplace was 19,3% of total participation in workplace(Palestinian Central Bureau of Statistics, 2017).

4.2.7 Distribution of study participants according to the family income in Shekel

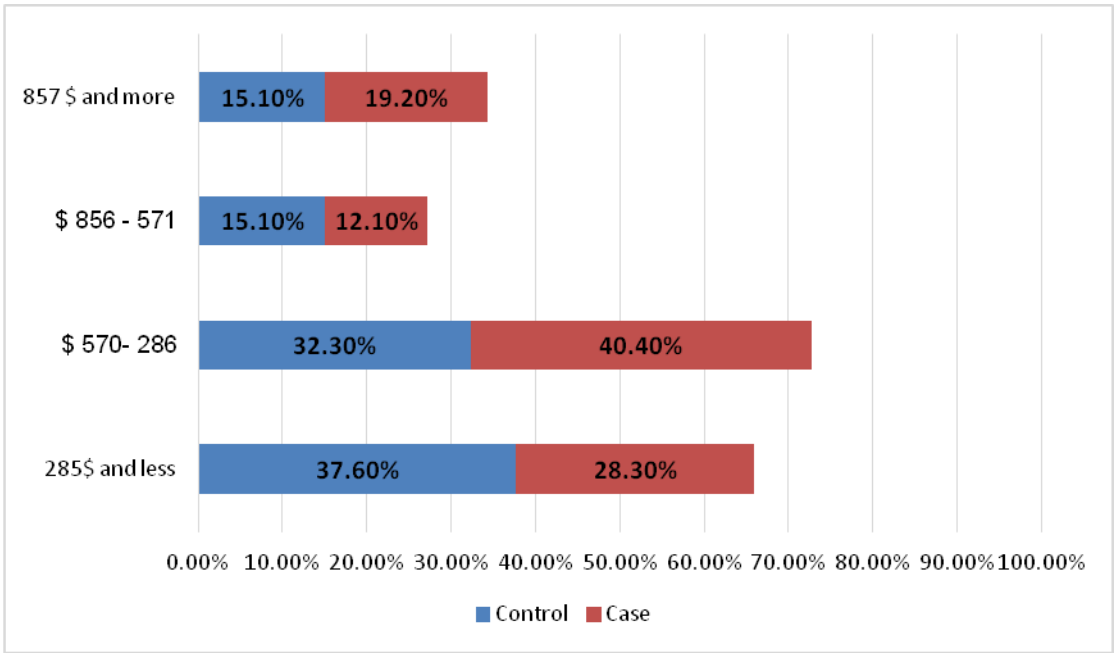

Figure 4.3: Distribution of study participants according to the family income in Shekel

Figure (4.3) shows that 32.3% of the controls and 40.4% of the cases have income level between 286 – 570 $, while 37.6% of the control and 28.3% of the cases have income level 285 $ and less.The mean income was 774 $, Median 428 and Std 357 which distributed (mean case 519, mean control 520 $). However, according to Palestinian Statistics Bureau the average monthly household expenditure in Gaza strip (average household size 6.6 person) is 1028 $(Palestinian Central Bureau of Statistics, 2017).

4.3 Association between some socio-demographic characteristics (Total monthly income and type of residency) and macrosomia

Table 4.7: Relationship between total monthly income and macrosomia

Variable	Research category	Number	Mean	Standard deviation	Mean diff	t-test	P-value
Total monthly income	Case	99	519.76	338.76	-0.36	-0.007	0.995
	Control	93	520.12	378.39			

Independent-samples t-test

Table (4.7) shows that there was no statistically significant differences between case and control groups in their family income with t: -0.007 and p-value: 0.995. Consistent with these findings, a cross-sectional study conducted in Northern Ethiopia, showed that there was no significant association between family income and macrosomia with p-value 0.31 and 0.45 for medium and high income families respectively(Mengesh Hayelom, 2017). On the other hand,in Turkey, a case-control study conducted among non-diabetic mothers to identify the risk factors for macrosomia showed that family income is significantly associated with macrosomia (p: 0.043)(Kaymaz, et al., 2016). however, in Turkey study the income categorized according to mother's perception into three categories; low, medium and high and the perception of mother might led to self-bias in determining her family income category.

Table 4.8: Association between type of residency area and macrosomia

Factor		Macrosomia		$\chi 2$ (df)	Crude OR (95%CI)	*p* Value
		Case N (%)	Control N (%)			
Type of residency area	City®	48 (36.6)	43 (32.8)	0.603 (3)	1	
	Housing Project	13 (9.9)	12 (9.2)		0.970 (0.40, 2.354)	0.947
	Village	44 (33.6)	49 (37.4)		0.804 (0.451, 1.435)	0.461
	Camp	26 (19.8)	27 (20.6)		0.863 (0.438, 1.699)	0.669

Table (4.8) shows that there is no significant statistical association between type of residency area and macrosomia ($p > 0.05$). These findings are consistent with Northern Ethiopia study which showed that there was no significant association between type of residency in term of urban or rural residency and macrosomia (p: 0.61)(Mengesh Hayelom, 2017). The same findings were observed in China that urban residency was not significantly associated with macrosomia (p: 0.5313)(Bao, et al., 2011). However, in Ghana, a study conducted by Abubakari et al. showed that the rural residency location is associated with decreased risk for macrosomia (p: 0.0001)(Abubakari, Kynast-Wolf, & Jahn, 2015).

4.4 Association between maternal factors and macrosomia

4.4.1 Association between maternal age at delivery, marital age and macrosomia

Table 4.9: Association between maternal age at delivery, marital age and macrosomia

Factor		Macrosomia		$\chi 2$ (df)	Crude OR (95%CI)	*p* Value
		Case N (%)	Control N (%)			
Mother's age at delivery	23 years and below®	22 (16.8)	44 (33.6)	12.392 (3)	1	
	24-29 years	51 (38.9)	48 (36.6)		2.125 (1.114, 4.054)	0.022
	30-33 years	33 (25.2)	18 (13.7)		3.667 (1.699, 7.913)	0.001
	34 years and more	25 (19.1)	21 (16)		2.381 (1.098, 5.161)	0.028
Marital age	18 years and below®	40 (30.5)	35 (26.7)	1.154 (3)	1.00	
	19-20 years	36 (27.5)	34 (26.0)		0.926 (0.483, 1.779)	0.818
	21 – 25 years	40 (30.5)	42 (32.1)		0.833 (0.445, 1.560)	0.569
	25 years and more	15 (11.5)	20 (15.3)		0.656 (0.292, 1.473)	0.307

Table (4.9) shows that there is a statistical significant association between maternal age at delivery and the occurrence of macrosomia ($p<0.05$), mothers with age 30–33 years are at risk 3.667 times to deliver macrosomic babies in comparison to mothers ≤ 23 years. This

result is consistent with a study conducted in Nigeria(Akindele RN, 2017)which showed that the Odds ratio of macrosomia for mothers with age ≥ 28 years was2.54 (confidence interval: 1.39–4.64) in comparison to mothers with age < 28 years. Anotherstudy conducted in China showed that the result of simple logistic regression analysis of maternal age (as non-categorical variable)is a risk factor for macrosomia with OR : 1.08 (CI: 1.03–1.12)(Li Yi, 2015) which is consistent with research findings (OR:1.05, CI: 1.006–1.096) when analyzing the maternal age as non-categorical variable by simple logistic regression.

On the other hand the table also shows that there is no a statistical significant association between macrosomia and marital age (p> 0.05). Consistent with this result a cross-sectional study conducted in Northern Ethiopia showed that the marital age was not a risk factor for macrosomia (Relative risk ratio: 0.79, CI: 0.48–1.29)(Mengesh Hayelom, 2017).

4.4.2 Association between parity, gravidity, abortion, the last birth space and macrosomia

Table 4.10: Association between parity, gravidity, abortion, the last birth space and macrosomia

Factor		Macrosomia		$\chi 2$ (df)	Crude OR (95%CI)	*p* Value
		Case N (%)	Control N (%)			
Para	Below 4®	60 (45.8)	88 (67.2)	12.488 (2)	1.00	
	4 – 6	51 (38.9)	33 (25.2)		2.267 (1.311, 3.918)	0.003
	More than 6	20 (15.3)	10 (7.6)		2.933 (1.283, 6.707)	0.011
Gravida	Below 4®	53 (40.5)	79(60.3)	10.407 (2)	1.00	
	4 – 6	49 (37.4)	34 (26.0)		2.148 (1.228, 3.757)	0.007
	More than 6	29 (22.1)	18 (13.7)		2.401 (1.213, 4.756)	0.012
Abortion	Never®	78 (59.5)	89 (67.9)	2.941 (2)	1.00	
	Once	39 (29.8)	27 (20.6)		1.648 (0.925, 2.935)	0.090
	More than once	14 (10.7)	15 (11.5)		1.065 (0.484, 2.345)	0.876
The last birth space[I]	24 – 36 months®	47 (41.2)	22 (23.9)	8.002 (2)	1.00	
	Below 24 months	24 (21,1)	31 (33.7)		0.362 (0.174, 0.756)	0.007
	Above 36 months	43 (37.7)	39 (42.4)		0.516 (0.265, 1.005)	0.052

[I]56 subjects were excluded since they are para 1

Table (4.10) shows that there are statistical significant association between para, gravida and macrosomia ($p > 0.05$) with OR > 2 for the groups of 4–6 and the groups of more than

6, which means that gravida more than 3 and para more than 3 carry more than two timesthe risk for macrosomia occurrence compared with para ≤ 3 and gravid ≤ 3. A case control study conducted in Northwest Ethiopia by Wondie et al. showed that multiparity was a significant risk factor for macrosomia with OR: 1.61 (CI: 1.21–2.13) in comparison with primiparous mothers and they used the definition of multiparity as ≥ 2(Wondie, Jara, & Ayana, 2014). In Pakistan, a study showed that dose-response relationship existed between parity and macrosomia with p-value 0.001 and the OR > 2 for mothers with para 4 and more (Ali & Ishtiaque, 2014). Another study conducted among Latin women at San Francisco General Hospital showed that the gravidity of 3 or more was significantly associated with macrosomia (OR: 2.56, CI: 1.29–5.11) (Wojcicki, Hessol, Hyeman, & Fuentes-Afflick, 2008). However, these results are inconsistent with a study conducted in South Africa, which showed that there was no statistical significant association between parity and macrosomia (Toweel, 2009). The small sample size included in the analysis (74 case, 74 control) of Toweel's study might affect the result of his study.The table also shows that women with birth space (in the last birth) below 24 months are considered as statistically significant protective factor for macrosomia with OR 0.362 (CI: 0.174-0.756). however, short birth spacegenerally is associated with low birth weight newborns. In their meta-analysis, Conde-Aguldelo et al.(2006) found that inter-pregnancy intervals shorter than 18 months are associated with low birth weight newborns and starting at 18 months interval, for every month the inter-pregnancy interval was shortened, the risk of delivering a LBW newborn increased by 3 percent(Conde-Agudelo, Rosas-Bermudez, & Kafury-Goeta, 2013). So it is not rational to consider shorter birth space as a recommended behavior.

On the hand, the table shows that there is no statistical significant associations between abortion and the occurrence of macrosomia (p>0.05). In congruence to this finding a study conducted in Habrin, China showed that there was no relationship between abortion and macrosomia (Bao, et al., 2011).

4.4.3 Association between previous history of macrosomic birth, family history of diabetes mellitus and macrosomia

Table(4.11): Association between previous history of macrosomic birth, family history of diabetes mellitus and macrosomia

Factor		Macrosomia		$\chi 2$ (df)	Crude OR (95%CI)	*p* Value
		Case N(%)	Control N (%)			
History of macrosomia	No®	78 (59.5)	116 (88.5)	28.679 (1)	1.00	
	Yes	53 (40.5)	15 (11.5)		5.255 (2.768, 9.976)	0.000
Number of previous history of macrosomic births	No history®	78 (59.5)	116 (88.5)	34.342 (2) (Fisher's exact test value:33.2 , *p*:0.000)	1.00	
	History of one macrosomic birth	27 (20.6)	12 (9.2)		3.346 (1.60, 7.00)	0.001
	History of ≥2 macrosomic births	26 (19.8)	3 (2.3)		12.889 (3.771, 44.05)	0.000
Family history of DM	No®	66 (50.4)	82 (62.6)	3.975 (1)	1	0.047
	Yes	49 (37.4)	49 (37.4)		1.648 (1.007, 2.697)	

Table (4.11) shows that there is a statistical significant association between previous history of macrosomic births and the occurrence of macrosomia with odds ratio 5.255 (CI: 2.768–9.976) in comparison with mothers with no previous history of macrosomic births and this association shows a dose-response pattern that the OR increases with the history of 2 or more macrosomic births (OR:12.889, CI: 3.771–44.055). In Iran, a study with similar finding showed that the history of macrosomic delivery was associated with the occurrence of macrosomia (OR:5.7, CI:1.6–20.0)(Mohammadbeigi, Farhadifar, Soufi Zadeh, Mohammadsalehi, Rezaiee, & Aghaei, 2013). Another study conducted in Cameroon

showed a higher OR 13.1 (p< 0.05) of delivering macrosomic babies for the mothers who had a previous history of macrosomic birth (Nkwabong & Nzalli Tangho, 2015).The table also shows a statistically significant association between family history of DM and the occurrence of macrosomia with OR: 1.648 and CI: 1.007–2.697. Levy et al. in their population based study, found that mothers with family history of DM had higher rates of macrosomia (5.7%) compared with mothers without family history of DM (4.6%) with p-value < 0.001 (Levy, Wiznitzer, Holcberg, Mozar, & Sheiner, 2010). In Canada, a retrospective study was carried out among pregnant women diagnosed with GDM between 2005–2011 and a cohort of non-diabetic women who delivered in 2011, showed that family history of DM was one of the major determinants of macrosomia among GDM population(Yang, et al., 2013).

4.4.4 Association between maternal smoking, maternal education, maternal employment and macrosomia

Table 4.12: Association between maternal smoking, maternal education and maternal employment and macrosomia

Factor		Macrosomia		χ^2 (df)	Crude OR (95%CI)	*p* Value
		Case N(%)	Control N (%)			
Maternal smoking	Passive smoker	49 (37.4)	51 (38.9)	0.065 (1)	0.937 (0.56, 1.54)	0.799
	None smoker®	82 (62.6)	80 (61.1)		1.00	
Maternal education	Below secondary	23 (17.6)	30 (22.9)	1.644 (2)	0.641	0.203
	Secondary	59 (45.0)	60 (45.8)		0.823 (0.47, 1.42)	0.486
	University®	49 (37.4)	41 (31.3)		1.00	
Maternal Employment	Employed	13 (9.9)	12 (9.2)	0.044 (1)	1.093	0.833
	Not employed®	118 (90.1)	119 (90.8)		1.00	

Table (4.12) shows that there are no statistical significant association between maternal smoking, education, employment and the occurrence of macrosomia with p-value > 0.05, noting that there is no active maternal smoking was found in the study sample and workermothers are only 25 subjects in the sample and this reflects the context of Gaza strip that the predominant employees are male. Consistent with thesefindings, Gu S et al. found that there were no statistical significant association between smoking during pregnancy, maternal education and macrosomia (Gu, et al., 2012). In Nigeria, a study showed that there was no relationship between maternal education status and macrosomia (p > 0.05) (Mengesh Hayelom, 2017).However, maternal smoking and maternal employment generally are associated with low birth weight as found ina study conducted in Taiwanwhich showed that there wasassociation between maternal smoking and delivery of newborns with low birth weight (Ko, et al., 2014), and a study conducted in Iran, showed that LBW among employed mothers was 5 times more likely than unemployed ones (OR: 5.35, *P*< 0.001)(Mahmoodi, et al., 2015).

4.4.5 Association between mother's anthropometric measurement and macrosomia

Table 4.13:Association between mother's anthropometric measurement and macrosomia

Factor		Macrosomia		$\chi 2$ (df)	Crude OR (95%CI)	*p* Value
		Case N(%)	Control N (%)			
Height of mother	1.57 m and below®	32 (24.4)	42(32.1)	2.575(2)	1	
	1.58–1.65m	68 (51.9)	66(50.4)		1.352 (0.764, 2.39)	0.300
	1.66m and more	31 (23.7)	23(17.6)		1.769 (0.871, 3.59)	0.115
	As continuous variable	131	132	3.598 (1)	58.433 (0.827, 4129)	0.061
Weight of mother during first trimester[1]	Below 70 kg®	10 (10.9)	43 (42.2)	25.589 (2)	1	
	70–85 kg	45 (48.9)	39 (38.2)		4.962 (2.20, 11.16)	0.000
	Above 85 kg	37 (40.2)	20 (19.6)		7.955 (3.30, 19.12)	0.000
	As continuous variable	92	102	12.695 (1)	1.042 (1.018, 10.66)	0.001
First trimester maternal BMI[1]	<18.5 (underweight)	0 (0)	2(2)	16.816 (3) (Fisher's exact test value: 16.540 *P*:0.000)	NA	0.999
	18.5–24.9 (Normal)®	23 (25)	51(50)		1.0	
	25.0–29.9 (Overweight)	40 (43.5)	29 (28.4)		3.058 (1.65, 6.63)	0.001
	30.0 and above (Obese)	29 (31.5)	20 (19.8)		3.215 (1.57, 7.17)	0.002

[1]68 participants have been excluded from this analysis since gestational age is > 13

Table (4.13) shows that there are statistical significant dose-response association between weight of the mother during the first trimester, first trimester BMI and macrosomia ($p < 0.05$). The OR of delivering macrosomic baby for mothers with initial pregnancy weight70–85 kg and above 85 kg are 4.962 (CI: 2.205–11.162) and 7.955 (CI: 3.309–10.124) respectively in comparison with mothers' weight less than 70 kg during the first trimester. The increases pattern of OR also have been noticed for overweight and obese women (OR: 3.058, 3.215 and CI: 1.653–6.636, 1.575–7.173 respectively) in comparison to women with normal weight during first trimester, in addition no woman with low birth weight was observed in case group. In congruence to these findings a case–control study showed that there was association between pre-pregnancy body weight and macrosomia with OR: 3.4 (CI: 1.95–5.91) for women with pre-pregnancy weight ≥ 78 kg in comparison with the women < 78 kg, and also showed that women with pre-pregnacy BMI ≥ 30 had more risk for delivering macrosomic infants with OR: 3.04 (CI:1.67–5.51) in comparison with women with BMI< 30(Akindele RN, 2017).Another study in Iran, showed that BMI of women (as quantitative variable) prior to pregnancy and also prior to delivery were significant risk factor for occurrence of macrosomia with p-value 0.001 and 0.01 respectively (Mohammadbeigi, et al., 2013).

On the other hand, the table shows that there is no statistical significant association between the height of mother and macrosomia ($p>0.05$). In consistency with this findings, in San Francisco a study showed that there was no statistically significant relationship between mother's height andmacrosomia (OR: 1.57, CI: 0.91–2.73) (Wojcicki, Hessol, Hyeman, & Fuentes-Afflick, 2008). Inconsistent to this finding, a study showed that women with height ≥ 170cm have more chance to deliver macrosomic infants than women with height < 170 cm with OR: 2.10 (CI: 1.14–3.87)(Akindele RN, 2017). Another study also showed that there was a statistically significant association between macrosoma and maternal height with the mean height of case group: 162.3 cm and control group: 160.49 cm (t: -2.51, p: 0.012) but when they used multiple logistic regression the significance no longer existed(Li Yi, 2015). However, the relation between macrosomia and height might be subject to different factors such as ethnicity, genetics, and other social determinants of health.

4.4.6 Association between maternal sedentary behavior, physical activity and macrosomia

Table 4.14: Association between maternal sedentary behavior, physical activity and macrosomia

Factor		Macrosomia		$\chi 2$ (df)	Crude OR (95%CI)	*p* Value
		Case	Control			
Watching TV	No ®	58 (44.3)	58 (44.3)	3.428 (3)	1.00	
	1 hour and below	29 (22.1)	30 (22.9)		0.967 (0.516, 1.809)	0.916
	1.1 – 2 hours	31 (23.7)	22 (16.8)		1.409 (0.731, 2.717)	0.306
	More than 2 hours	13 (9.9)	21 (16.0)		0.619 (0.283, 1.353)	0.229
Using computer /Internet/ Phone	No ®	56 (42.7)	61 (46.6)	2.307 (3)	1.00	
	1 hour and below	22 (16.8)	25 (19.1)		0.959 (0.487, 1.889)	0.903
	1.1 – 2 hours	26 (19.8)	17 (13.0)		1.666 (0.818, 3.391)	0.159
	More than 2 hours	27 (20.6)	28 (21.4)		1.050 (0.553, 1.994)	0.881
Sleeping hours	7 – 8 hours®	59 (45.0)	61 (46.6)	4.000 (2)	1.00	
	Below 7 hours	31 (23.7)	19 (14.5)		1.687 (0.860, 3.310)	0.128
	More than 8 hours	41 (31.3)	51 (38.9)		0.831 (0.482, 1.434)	0.506
Physical Activity*	Low®	108 (82.4)	106 (80.9)	0.535 (2)	1.00	
	Moderate	16 (12.2)	19 (14.5)		0.827 (0.404, 1.693)	0.426
	High	7 (5.3)	6 (4.6)		1.145 (0.373, 3.520)	0.782

* Physical activities measured based on the second Global Physical Activity Questionnaire that established by WHO.

Table (4.14) shows that there are no statistical significant associations between mother's sedentary behavior “watching TV, using computer, internet and/or phone and sleeping hours” , physical activity and occurrence of macrosomia ($p>0.05$). Consistent with these finding Thangaratinam S. et al. in their systematic review and meta-analysis study which included 44 relevant randomized controlled trials with total 7278 women enrolled in the study, they concluded that there was no statistically significant association between physical activity and macrosomia (Relative Risk: 0.85, CI: 0.66 – 1.09)(Thangaratinam, et al., 2012). In Iran, also the researchers found no relationship between physical activities and the occurrence of macrosomia (p-value: 0.60) (Mohammadbeigi, et al., 2013). On the other hand a study conducted in Northern Ireland, showed that there were association between maternal reducedphysical activities, increased sedentary behavior and macrosomia with p-value: 0.021 and 0.020 respectively(Reid, McNeil, Alderdice, Tully, & Valerie, 2014). However, Northern Ireland's study it was a prospective case - control study based on probability criteria to deliver macrosomic birth or not with 50 probable cases and 50 probable controls and actually after delivery the expected situation was changed that some control delivered newborns with weight ≥4000 gram and vice versa, that led to change of some participants category which resulted in 33 cases and 47 controls which considered as small sample size which might affect the representativeness of the study.

4.4.7 Association between maternal dietary habits and macrosomia

4.4.7.1 Association between number of meals, main meal, snacks and macrosomia

Table 4.15: Association between number of meals, main meal, snacks and macrosomia

Factor		Macrosomia		$\chi 2$ (df)	Crude OR (95%CI)	*p* Value
		Case N (%)	Control N (%)			
Number of meals/day	One meal®	1 (0.8)	2 (1.5)	1.917 (3) (Fisher's exact test value:3.38 *P*:0.534)	1.00	
	Two meals	44 (33.6)	35 (26.7)		2.514 (0.21, 28.88)	0.459
	Three meals	81 (61.8)	87 (66.4)		1.862 (0.16, 20.92)	0.615
	More than 3 meals	5 (3.8)	7 (5.3)		1.429 (0.10, 20.43)	0.793
Main meal	Breakfast ®	30 (22.9)	29 (22.1)	2.336 (2)	1.00	
	Lunch	85 (64.9)	93 (71.0)		0.884 (0.490, 1.59)	0.680
	Dinner	16 (12.2)	9 (6.9)		1.719 (0.656, 4.50)	0.270
Snacks	No®	18 (13.7)	14 (10.7)	0.570(1)	1.00	
	Yes	113 (86.3)	117 (89.3)		0.751 (0.35, 1.58)	0.451

Table (4.15) shows the dietary pattern of respondent mothers that the majority of cases' mothers (61.8%) and the majority of controls' mothers (66.4) take 3 meals per day, moreover the main meal is the lunch with percent of 64.9 of the cases' mothers and 71% of the controls' mothers and its shown also that the majority of cases' and controls' mothers

(86.3%, 89.3%) take snacks between the meals. The table also shows that there are no statistical significant associations between the occurrence of macrosomia and the factors "number of meals per day and the main meal at the day" ($p>0.05$).Regarding frequency of meals and snacks during pregnancy there are scarcity of studies done, one of them, a study conducted in Australia among overweight and obese pregnant women by Grivell et al concluded that an antenatal dietary and lifestyle intervention did not result in any significant difference in fetal growth in the third trimester(Grivell, Yelland, Staehr, Earl, & Dodd, 2014).Consistent with these finding,The UK Pregnancies Better Eating and Activity Trial (UPBEAT) whichwasrandomized controlled trial conductedat antenatal clinics in eight hospital in multi-ethnic, inner-city locations in the UK, concluded that a behavioral intervention addressing diet and physical activity in women with obesity during pregnancy was not adequate to reduce the incidence of large-for-gestational age infants(Poston, et al., 2015). While in Brazil, a study showed that there was a statistical significant positive association (p: 0.04) between birth weight and taking snacks in pregnant adolescents group only(Coelho, Cunha, Esteves, Lacerda, & Filha, 2015). However Coelho et al. didn't categorize the birth weight in categories to examine whether there was association between macrosomia or not.A different study was carried out in North Carolina to study the frequency of eating during pregnancy and its effect on preterm delivery, found that there was association between decreased frequency of eating and preterm delivery(Seiga-Riz, Herrmann, Savitz, & Thorp, 2001).

4.4.7.2 Association between fast food and macrosomia

Table 4.16: Association between fast food and macrosomia

Factor		Macrosomia		χ2 (df)	Crude OR (95%CI)	*p* Value
		Case N (%)	Control N(%)			
Fast food	No®	84 (64.1)	93 (71.0)	1.413(1)	1.00	0.236
	Yes	47 (35.9)	38 (29.0)		0.730 (0.434, 1.228)	
Number of times taking fast food	No fast food®	84 (64.1)	93 (71.0)	1.724 (2)	1.00	
	Once per week	32 (24.4)	28 (21.4)		1.265 (0.704, 2.275)	0.432
	2-3 times per week	15 (11.5)	10 (7.6)		1.661 (0.708, 3.896)	0.244

Table (4.16) shows the dietary pattern of respondent mothers that; 47 (35.9%) of cases' mothers and 38 (29%) of controls' mothers ate fast foot during the period of pregnancy and the frequency of eating fast food as shown in the table. The table also shows that there are no statistical significant association between taking fast food, number of times taking fast foot and the occurrence of macrosomia (p>0.05). Consistent with these finding Coelho et al. (2015) mentioned in his study that the fast foot as western dietary pattern, and they didn't find association between it and birth weight(Coelho, Cunha, Esteves, Lacerda, & Filha, 2015). Consistent with these finding The UK Pregnancies Better Eating and Activity Trial (UPBEAT) concluded that a behavioral intervention addressing diet and physical activity in women with obesity during pregnancy was not adequate to reduce the incidence of large-for-gestational age infants(Poston, et al., 2015)

4.4.7.3 Association between types and frequency of food during pregnancy and macrosomia

Table 4.17-A:Association between types and frequency of food during pregnancy and macrosomia

Factor		Macrosomia		χ2 (df)	Crude OR (95%CI)	*p* Value
		Case N (%)	Control N (%)			
Egg	≥ 6 times weekly	30 (22.90)	36 (27.5)	9.421(4)	0.833 (0.327, 2.124)	0.702
	3-5 times weekly	75 (57.30)	54 (41.2)		1.389 (0.580, 3.326)	0.461
	1-2 times weekly	10 (7.60)	22 (16.8)		0.455 (0.152, 1.359)	0.158
	Once / 2 weeks or more	4 (3.10)	7 (5.3)		0.571 (0.132, 2.476)	0.454
	Never®	12 (9.20)	12 (9.2)		1.00	
Red meat	≥ 6 times weekly	2 (1.50)	1 (0.8)	2.160 (4) (Fisher's exact test value:2.229 *P*:0.713)	1.545 (0.129, 18.50)	0.731
	3-5 times weekly	25 (19.10)	28 (21.4)		0.690 (0.300, 1.585)	0.382
	1-2 times weekly	57 (43.50)	53 (40.5)		0.831 (0.398, 1.733)	0.622
	Once / 2 weeks or more	25 (19.10)	32 (24)		0.604 (0.266, 1.372)	0.228
	Never®	22 (16.80)	17 (13)		1.00	
White meat	3-5 times weekly	44 (33.60)	29 (22.1)	5.195 (3) (Fisher's exact test value:5.173 *P*:0.153)	1.517 (0.351, 6.553)	0.577
	1-2 times weekly	81 (61.80)	93 (71.0)		0.871 (0.211, 3.594)	0.849
	Once / 2 weeks or more	2 (1.50)	5 (3.8)		0.400 (0.047, 3.424)	0.403
	Never®	4 (3.10)	4 (3.1)		1.00	

Table(4.11-A) shows the dietary pattern of respondent mothers that; 80.2% of cases' mothers and 68.7% of controls' mothers eat egg ≥ 3times weekly, 64.1 of cases and 62.7 of

controls eat red meat once or more weekly, and 95.4% of cases and 93.1% of controls eat white meat once or more weekly. The table also shows that there are no statistical significant association between frequencies of eating eggs, red meat, white meat and occurrence of macrosomia ($p>0.5$).Consistent with these findings, Boer et al.(2009) in their review study, found that there was no significant association between maternal protein intake in the second trimester and birth weight, the review also found high protein intake was associated with a non-significant reduction in birth weight (Boer, Van Bakel, Hoogervorst, Luijten, & Vries, 2009). Another study conducted in Brazil, showed that there was no significant association between prudent pattern diet (milk, yogurt, cheese, fruits and fresh-fruit juice, and chicken/beef/fish/liver) and birth weight(Coelho, Cunha, Esteves, Lacerda, & Filha, 2015).

Table 4.17-B: Association between types and frequency of food during pregnancy and macrosomia(continued)

Factor		Macrosomia		χ2 (df)	Crude OR (95%CI)	*p* Value
		Case N (%)	Control N (%)			
Organ (liver, kidney ..)	3-5 times weekly	12 (9.20)	13 (9.9)	13.40(3)	1.762 (0.689, 4.507)	0.237
	1-2 times weekly	59 (45.00)	34 (26.0)		3.313 (1.701, 6.451)	0.000
	Once / 2 weeks or	38 (29.00)	42 (32.1)		1.727 (0.878, 3.400)	0.114
	Never®	22 (16.80)	42 (32.1)		1.00	
Fish	≥ 6 times weekly	0 (0.0)	1 (0.8)	4.654 (4) (Fisher's exact test value:4.198 *P*:0.358)	NA	1.00
	3-5 times weekly	14 (10.7)	12 (9.2)		1.5 (0.530, 4.245)	0.445
	1-2 times weekly	63 (48.1)	50 (38.2)		1.620 (0.735, 3.573)	0.232
	Once / 2 weeks or	40 (30.5)	50 (38.2)		1.029 (0.456, 2.319)	0.946
	Never®	14 (10.7)	18 (13.7)		1.00	
Legumes	≥ 6 times weekly	18 (13.7)	26 (19.8)	4.283 (4)	0.495 (0.135, 1.806)	0.287
	3-5 times weekly	75 (57.30)	70 (53.4)		0.765 (0.232, 2.523)	0.660
	1-2 times weekly	25 (19.10)	19 (14.5)		0.940 (0.258, 3.426)	0.925
	Once / 2 weeks or	6 (4.60)	11 (8.4)		0.390 (0.085, 1.779)	0.224
	Never®	7 (5.30)	5 (3.8)		1.00	
Milk derivatives	≥ 6 times weekly	98 (74.80)	84 (64.1)	7.064 (4) (Fisher's exact test value:6.702 *P*:0.145)	4.667 (0.964, 22.581)	0.055
	3-5 times weekly	20 (15.30)	28 (21.4)		2.857 (0.547, 14.912)	0.213
	1-2 times weekly	8 (6.10)	6 (4.6)		5.333 (0.817, 34.831)	0.800
	Once / 2 weeks or	3 (2.30)	5 (3.8)		2.400 (0.291, 19.784)	0.416
	Never®	2 (1.50)	8 (6.1)		1.00	

Table (4.17-B) shows the dietary pattern of respondent mothers that; 45% of cases' mothers and 26% of controls' mothers eat organ (liver, kidney,..) 1-2 times weekly, 48.1% of cases' mothers and 38.2% of controls' mothers eat fish 1-2 times weekly, 71% of cases' mothers and 73.2% of controls' mothers eat legumes ≥ 3 times weekly, and 90.1% of cases' mothers 85.5% of controls' mothers eat milk derivatives ≥ 3 times weekly. The table also shows that there is a statistical significant association between eating organ 1-2 times weekly with OR: 3.313 (CI: 1.701–6.451) compared with group of never eating organ. However, the group who eat organ more frequently (3-5 times weekly) does not show significant association, that might be due to the small proportion of participants who eat frequent organ weekly. It's not feasible in our community to eat organ 3 times or more weekly and eating too frequent organ might reflect the highest socioeconomic class. However, a study conducted in Iran showed that the protein consumption during pregnancy was associated with birth weight with p-value: 0.014(Akbari, Mansourian, & Kelishadi, 2015).

On the other hand, the table shows that there are no statistical significant association between the frequency of eating fish, legumes, milk derivatives and the occurrence of macrosomia (p> 0.05). In Brazil study, according to their perspectives, organ (liver), fish and milk derivatives were included into prudent eating pattern which showed no association with birth weight(Coelho, Cunha, Esteves, Lacerda, & Filha, 2015). In Malaysia, a study showed that higher intake of legumes was not associated with birth weight (p: 0.22)(Loy, Marhazlina, Azwany, & Jan, 2011). However, in Iran study the investigators found that fish consumption was associated with birth weight with (p: 0.002) while, milk derivatives were not associated (p: 0.552)(Akbari, Mansourian, & Kelishadi, 2015). Iran study was a cohort study consisted of 225 pregnant women and their pregnancy outcomes were; 213 women delivered newborns with normal birth weight, 12 women delivered newborns with low birth weight and no woman delivered any macrosomic newborn. The outcome might be less than to be studied for this context and case – control study might be a better way to study dietary pattern as a risk factor for phenomena with low incidence and with a reasonable number of the sample size.. Another study conducted in Norway, defined fish and potatoes as traditional dietary pattern and concluded that traditional dietary pattern was associated with reduced risk for preterm delivery (relative risk: 0.91, CI: 0.83–0.99)(Englund-Ogge, et al., 2014). A different result was found by Medin A. (2007) in Norway, showed that a high maternal intake of protein in week 14- 16 of gestation reduced the risk of having macrosomic infant (Medin, 2007).

Table 4.17-C: Association between types and frequency of food during pregnancy and macrosomia (continued)

Factor		Macrosomia		$\chi 2$ (df)	Crude OR (95%CI)	*p* Value
		Case N (%)	Control N (%)			
Cereal and bread	≥ 6 times weekly	129 (98.5)	130 (99.2)	0.344 (1)	0.496 (0.044, 5.540)	0.569 (Fisher' exact test sig:1.00)
	3-5 times weekly®	2 (1.5)	1 (0.8)		1.00	
Fruits	≥ 6 times weekly	99 (75.6)	81 (61.8)	17.727 (2) (Fisher's exact test value:17.0 *P*:0.000)	7.333 (2.445, 21.997)	0.000
	3-5 times weekly	28 (21.4)	26 (19.8)		6.462 (1.975, 21.14)	0.002
	1-2 times weekly®	4 (3.1)	24 (18.3)		1.00	
Vegetables	≥ 6 times weekly	105 (80.2)	99 (75.6)	1.197 (2) (Fisher's exact test value:1.17 *P*:0.573)	1.856 (0.527, 6.535)	0.336
	3-5 times weekly	22 (16.8)	25 (19.1)		1.540 (0.397, 5.973)	0.532
	1-2 times weekly®	4 (3.1)	7 (5.3)		1.00	
Sweets and deserts	≥ 6 times weekly	21 (16.0)	21 (16)	1.518 (4)	0.900 (0.405, 1.998)	0.796
	3-5 times weekly	17 (13.0)	16 (12.2)		0.956 (0.405, 2.256)	0.919
	1-2 times weekly	25 (19.1)	33 (25.2)		0.682 (0.327, 1.422)	0.307
	Once / 2 weeks or more	38 (29.0)	34 (26)		1.006 (0.502, 2.017)	0.987
	Never®	30 (22.9)	27 (20.6)		1.00	
Oils	≥ 6 times weekly	8 (6.1)	12 (9.2)	2.860 (4)	0.528 (0.180, 1.551)	0.245
	3-5 times weekly	33 (25.2)	41 (31.3)		0.637 (0.299, 1.358)	0.243
	1-2 times weekly	44 (33.6)	37 (28.2)		0.941 (0.447, 1.981)	0.874
	Once / 2 weeks or more	22 (16.8)	22 (16.8)		0.792 (0.341, 1.840)	0.587
	Never®	24 (18.3)	19 (14.5)		1.00	

Table (4.17-C) shows the dietary pattern of respondent mothers that; the majority of cases' mothers and controls' mothers (98.5% and 99.2% respectively) eat cereal & bread ≥ 6 times weekly, 80.2% of cases' mothers and 75.6% of controls' mothers eat vegetables ≥ 6 times weekly, 48.1% of cases' mothers and 53.4% of controls' mothers eat sweets & deserts ≥ once weekly, 31.3 of cases' mothers and 40.5% of controls' mothers eat oily food ≥ 3

times weekly, and 75.6% of cases' mothers and 61.8% of controls' mothers eat fruits ≥ 6 times weekly. The table also shows that there are no statistical significant associations between the occurrence of macrosomia and the frequency of taking cereal & bread, vegetables, sweets & deserts, and oils (p>0.05).Coelho et al. in their study, included beans, rice, breads and vegetables in the traditional dietary pattern in Brazil and they didn't find association between it and birth weight (p: 0.462)(Coelho, Cunha, Esteves, Lacerda, & Filha, 2015). In Malaysia, a study conducted to examine that, is higher intake of vegetables in pregnancy associated with birth size, found that all types of vegetables didn't associated with birth size (p > 0.05)(Loy, Marhazlina, Azwany, & Jan, 2011). In addition, In Singapore Chong et al. (2015) in their multiethnic Asian population study,found that maternal intake of carbohydrate and fat during pregnancywere not associated with birth weight(p > 0.05)(Chong, et al., 2015).

On the other hand, the table shows that there is a statistical significant association between fruits intake during pregnancy and occurrence of macrosomia with dose-response pattern that means the odds ratio increases with increasing the frequency of fruits intake. The OR for the group of mothers who eat fruits 3-5 times weekly is 6.462 (CI: 1.975–21.144) and for the group of mothers who eat fruits 6 or more times weekly the OR is 7.333 (CI: 2.445–21.997). Loy et al. in their prospective study, found that fruits intake during pregnancy was associated with birth weight (multiple regression, β: 0.19, p: 0.04)(Loy, Marhazlina, Azwany, & Jan, 2011). In Denmark, Mikkelsen et al. (2006) in their large prospective study(among 43,585 Danish women), they found that fruits consumption during pregnancy was significantly associated with birth weight and they reported that a 10.4 gram increase in birth weight per quintile increases in fruits intake (p < 0.0001) (Mikkelsen, Osler, Orozova-Bekkevold, Knudsen, & Olsen, 2006). In these two study the researchers didn't study macrosomia definitely but they studied the relationship between fruits intake and birth weight. However in literature the researcher didn't found a study that mentioned the relationship between fruits intake and macrosomia. The researcher thinks that the association between fruits intake and macrosomia might be subject to different variables like nutritional and socio-economic status of Palestine women.

4.4.7.4 Relationship between multiple types of drinks taken during prgnancy and macrosomia

Table 4.18: Relationship between multiple types of drinks and macrosomia

Variable	Research category	Number	Mean	Standard deviation	Mean diff.	t-test	p-value
Milk Cups/day	Case	131	0.602	0.707	0.0043	0.054	0.957
	Control	131	0.597	0.604			
Yogurt Cups/day	Case	131	0.706	0.541	0.007	0.068	0.946
	Control	131	0.699	1.059			
Fresh juice Cups/day	Case	131	1.161	1.072	-0.0867	-0.580	0.562
	Control	131	1.284	1.332			
Gaseous drinks Cups/day	Case	131	0.5289	1.231	0.192	1.568	0.118
	Control	131	0.3364	0.677			
Tea, coffee and cacao Cups/day	Case	131	1.417	1.172	-0.165	-1.011	0.313
	Control	131	1.583	1.464			

Independent-samples t-test analysis

Table (4.18) shows that there are no statistical significant association between the occurrence of macrosomia and the factors “milk, yogurt, fresh juice, gaseous drinks and tea, caffee, cacao” ($p>0.05$). These finding are consistent with Brazil study which included the factors of milk, yogurt and fresh juice into their prudent dietary pattern and the researchers found that, the prudent dietary pattern were not associated with birth weight ($p >0.05$) and they included the gaseous (soft) drinks in their western dietary pattern and they also found no association between it and birth weight ($p > 0.05$)(Coelho, Cunha, Esteves, Lacerda, & Filha, 2015). Medin in her researchmentioned that avoidance or decrease in consumption of soft drinks during pregnancy could be beneficial but she hypothized the claim on the ground of excessive consumption of sweetened soft drinks might lead to overweight and obesity and thus leads to higher birth weight or even to macrosomic birth (Medin, 2007). Her claim was hypothized on ground of indirect relationship but there no evidences to establish a causality association between sweetened soft drinks and macrosomia.

4.4.7.5Association between sugar added to the drinks and macrosomia

Table 4.19: Association between sugar added to the drinks and macrosomia

Drink		Macrosomia		χ2 (df)	Crude OR (95%CI)	*p* Value
		Case N (%)	Control N (%)			
Juice, tea, coffee	Without sugar®	21 (16.0)	23 (17.6)	5.053(4) (Fisher's exact test value:4.774 *p*:0.313)	1.00	
	Little sugar	46 35.1)	35 (26.7)		1.439 (0.689, 3.008)	0.333
	Moderate sugar	41 (31.3)	53 (40.5)		0.847 (0.413, 1.738)	0.651
	A lot of sugar	19 (14.5)	19 (14.5)		1.095 (0.460, 2.610)	0.837
	Artificial sweeteners (Saccharin/fructose)	4 (3.1)	1 (0.8)		4.381 (0.453, 42.39)	0.202

Table (4.19) shows that there is no statistical significant association between the occurrence of macrosomia and the level of sugar added to drinks or juices (p>0.05). this finding is consistent with Brazil study which included sugar in their traditional dietary pattern and the study found that the traditional dietary pattern was not associated with birth weight (p > 0.05)(Coelho, Cunha, Esteves, Lacerda, & Filha, 2015). The Chong et al. study also showed that high maternal intake of carbohydrate and fat during pregnancy were not associated with birth weight (p .> 0.05)(Chong, et al., 2015). Also Medin A. in her study, didn't found significant association between sugar added to drinks and macrosomia(Medin, 2007).

4.4.7.6 Summary for the frequency of food taken during pregnancy:

In summary, regarding dietary habits of respondent mother, the study findings shows that there is statistical significant association between the occurrence of macrosomia and frequency of eating organ (liver, kidney,..) 1 - 2 times weekly in comparison to group who never eat organ with OR: 3.313 (CI: 1.701–6.451). In addition, there is dose – response significant association between macrosomia and the frequency of taking fruits 3 – 5 times weekly and 6 or more weekly during pregnancy with OR: 6.462 (CI: 1.975–21.144) and

OR: 7.333 (CI: 2.445–21.997) respectively in comparison with women who eat fruits 1-2 times weekly. There are several studies in literature that examined the relationship of dietary pattern and birth weight showing different findings but these researches didn't study the relationship between dietary pattern and macrosomia and they studied dietary pattern in term of protein, carbohydrate and fat. However dietary habits are related to people culture and socioeconomic factors which in turn affect the macro-nutritional and micro-nutritional status of people including the pregnant women as at highly vulnerability period which in turn might affect the birth outcome. Every region or even country is different in its dietary pattern and need to adapt its requirement according to the existing situation. In Gaza, there is a need for national study to identify the recommended dietary pattern and nutritional support on ground of energy need, macronutrients consumption, micronutrients deficiencies and body mass index.

4.4.7.7 Association between supplements taken during the last pregnancy and macrosomia

Table 4.20-A: Association between supplements taken during the last pregnancy and macrosomia

Type of supplement		Macrosomia		$\chi 2$ (df)	Crude OR (95%CI)	*p* Value
		Yes N (%)	Control N (%)			
Folic acid	Did not take®	16 (12.2)	14 (10.7)	1.445(3) (Fisher's exact test value:1.485 *p*:0.724)	1.00	
	1-3 times weekly	3 (2.3)	1 (0.8)		2.625 (0.244, 28.196)	0.426
	4-6 times weekly	3 (2.3)	2 (1.5)		1.313 (0.191, 9.021)	0.782
	Daily	109 (83.2)	114 (87)		0.837 (0.390, 1.796)	0.647
Iron and folic acid	Did not take®	13 (9.90)	23 (17.6)	4.112 (3)	1.00	
	1-3 times weekly	20 (15.3)	21 (16)		1.685 (0.675, 4.208)	0.264
	4-6 times weekly	5 (3.8)	7 (5.3)		1.264 (0.333, 4.797)	0.731
	Daily	93 (71.0)	80 (61.1)		2.057 (0.978, 4.323)	0.057
Omega- 3	Did not take®	85 (64.9)	86 (65.6)	0.206 (3) (Fisher's exact test value:0.520 *p*:1.00)	1.00	
	1-3 times weekly	1 (0.8)	1 (0.8)		1.012 (0.062, 16.439)	0.993
	4-6 times weekly	3 (2.3)	2 (1.5)		1.518 (0.247, 9.312)	0.652
	Daily	42 (32.1)	42 (32.1)		1.012 (0.600, 1.706)	0.965

Table (4.120-A) shows that there are no statistical significant associations between the occurrence of macrosomia and the frequency of taking supplements during the last pregnancy such as folic acid, iron and folic acid and omega- 3 ($p>0.05$).Similar to these

finding a prospective study conducted in Algeria, showed that iron supplementation during first, second and third trimester had no significant association with birth weight (p- value were 0.11, 0.96, and 0.46 respectively for trimesters)(Tebbani, Oulamara, & Agli, 2017). On the other hand,Palma et al studied the association of low birth weight and folic acid, iron and iron-folic acid supplementation during antenatal period, the extracteddata from antenatal care records showed that the crude ORwere 1.26 (CI: 0.45–3.44), 0.61 (CI:0.34–1.11), and 0.60 (CI: 0.34–1.08) respectively however, after the adjustment only iron-folic acid participants' group had a significant association with adjusted OR: 0.55 (CI: 0.31 – 0.96) (Palma, Perez-Iglesias, Prieto, Pardo, Liorca, & Delgado-Rodriguez, 2008), this meant that the only iron-folic acid had an effect on birth weight while iron alone or folic acid alone didn't have effect on birth weight. However, Palma et al.'s study didn't explore the effect of iron and folic acid on macrosomia occurrence. Regarding omega–3 a randomized clinical trial study was conducted in USA, showed thatno significant effects of omega-3 on birth weight (birth weight mean for control, omega-3 cap 300mg, omega-3 cap 600mg and nutrition education groups were :3165, 3220, 3210, 3218 respectively)(Harris, et al., 2015). While, Horan et al. (2015) found that omega-3 were associated with abdominal circumference but not associated with birth weight(Horan, McGown, Gibney, Donnelly, & McAuliffe, 2015).

Table 4.20-B: Association between supplements taken during the last pregnancy and macrosomia(continued)

Factor		Macrosomia		$\chi 2$ (df)	Crude OR (95%CI)	*p* Value
		Case N (%)	Control N (%)			
MV	Did not take®	80 (61.1)	88 (67.2)	7.392 (3) (Fisher's exact test value:6.713 *p*:0.051)	1.00	
	1-3 times weekly	3 (2.3)	0 (0)		NA	0.999
	4-6 times weekly	4 (3.1)	0 (0)		NA	0.999
	Daily	44 (33.6)	43 (32.8)		1.126 (0.671, 1.889)	0.654
Calcium	Did not take®	85 (64.9)	93 (71)	3.257 (2) (Fisher's exact test value:3.144 *p*:0.207)	1.00	
	4-6 times weekly	7 (5.3)	2 (1.5)		3.829 (0.774, 18.944)	0.100
	Daily	39 (29.8)	36 (27.5)		1.185 (0.691, 2.034)	0.537

Table (4.20-B) shows that there are no statistical significant associations between the frequency of taking multivitamins and calcium supplements during the pregnancy period and the occurrence of macrosomia (p>0.05). In contrast, Algeria study was about the role of vitamins and trace elements (including calcium) in the pregnancy, showed that there were no significant association between birth weight and vitamins and trace elements except magnesium (p: 0.02) and vitamin B9 (p: 0.004) were (magnesium and vit.B9) correlated significantly with birth weight(Tebbani, Oulamara, & Agli, 2017) while, intake of calcium during third trimester showed a positive correlation with birth weight but not significant (r: 0.12, p: 0.06)(Tebbani, Oulamara, & Agli, 2017). Inconsistent with these findings, Buppasiri et al. in his meta-analysis found that women with calcium supplementation gave birth weight to slightly heavier than the control group with a statistically significant difference of 80 gram identified in mean infant birth weight(Buppasiri, Lumbiganon, Thinkhamrop, Ngamjarus, & Laopaiboon, 2011).

4.5 Association between pregnancy related factors and macrosomia

4.5.1 Association between DM during the last pregnancy and macrosomia

Table 4.21:Association between DM during the last pregnancy and macrosomia

Factor		Macrosomia		χ2 (df)	Crude OR (95%CI)	*p* Value
		Case N (%)	Control N (%)			
DM during the last pregnancy	No®	115 (87.8)	129 (98.5)	11.692(1)	1.00	0.004 (Fisher's exact test sig:0.001)
	Yes	16 (12.2)	2 (1.5)		8.974 (2.020, 39.870)	
Type of DM	Without®	115 (87.8)	129 (98.5)	11.703 (2) (Fisher's exact test value:11.7, *p*:0.002)	1.00	
	Pre-existing DM	7 (5.3)	1 (0.8)		7.852 (0.952, 64.78)	0.056
	GDM	9 (6.9)	1 (0.8)		10.096 (1.260, 80.90)	0.029

Table (4.21) shows that there are 16 diabetic (gestational or pr-existing) mothers among case group and 2 diabetic mothers among control group with total 18 diabetic mother in the sample, the OR of diabetic mothers to deliver macrosomic newbornsis 8.974 (CI: 2.020 – 39.879) in comparison with non-diabetic mothers, that means diabetic mother have a chance 8.974 times to deliver macrosomic infants in comparison with non-diabetic one. Regarding the types of diabetes mellitus there are 10 participants with gestational diabetes and 8 participants with pre-existing diabetes, and there are statistically significant association between types of diabetes mellitus and the occurrence of macrosomia with Fisher's exact test value: 11.705 (p:0.002). Similar to these finding, a study conducted in Kingdom of Saudi Arabia showed that the odds of having a macrosomic newborn was 5 times for mothers with diabetes compared to mothers without diabetes(Shahnaz, Jamil, & Hamld, 2015). Consistent with these findings, in Iran, a study found that the odds ratio of diabetic mothers to had macrosomic newborns was 10.02 (CI: 4.1–24.7) compared with non-diabetic mothers(Mohammadbeigi, Farhadifar, Soufi Zadeh, Mohammadsalehi,

Rezaiee, & Aghaei, 2013). In contrast with types of diabetes mellitus, a study showed that there was no significant differences (p: 0.80) between diabetes mellitus and pre-gestational diabetes mellitus (which is diagnosed before 12 weeks of gestation) in their effect on macrosomia occurrence and the article showed that early diabetes (pre-gestational or chronic type 2 DM) carried a higher risk for macrosomia with p: 0.0001(Sweeting, et al., 2016). In fact for tackling the difference between the time of onset of diabetes during the period of pregnancy and the occurrence of macrosomia, a large sample with different design is needed, however even pre-existing diabetes, or gestational diabetes all of them carry a risk for developing macrosomia. On the other hand, a prospective study conducted in USA among latina women, showed that there was no statistical significant association between macrosomia and any type of diabetes mellitus (Wojcicki, Hessol, Hyeman, & Fuentes-Afflick, 2008).The different finding of Wojcicki et al. research might be due two reasons; the first is the smallest sample size for prospective study with less incident phenomena like macrosomia which showed an incidence of 11% in the selected sample of total 350 participants, the other reason might be due to the under self- reportingbecause that the data collection was depended on interview and self-reporting of a disease like diabetes not based on the medical records.

4.5.2 Association between hypertensive disorders during pregnancy and macrosomia

Table 4.22: Association between hypertensive disorders during pregnancy and macrosomia

Factor		Macrosomia		$\chi 2$ (df)	Crude OR (95%CI)	*p* Value
		Case N (%)	Control N (%)			
Hypertensive disorders during pregnancy	No®	112 (85.5)	123 (93.9)	5.130(1)	1.00	0.030
	Yes	19 (14.5)	8 (6.1)		2.608 (1.098, 6.193)	
Type of HTN	Without	112(85.5)	123 (93.9)	6.306(2) (Fisher's Exact test value:5.69 Sig: 0.054)	1	
	Chronic	6 (4.6)	1 (0.8)		6.589 (0.781, 55.58)	0.083
	PIH	13 (9.9)	7 (5.3)		2.040 (0.786, 5.294)	0.143

Table (4.22) shows that there is a statistically significant association between hypertensive disorders during pregnancy and the occurrence of macrosomia with OR: 2.608, and CI: 1.098–6.193. However there are no statistically significant association between any types of HTN during pregnancy and macrosomia ($p > 0.05$).A study conducted in Iran showed that pre-eclampsia was a risk factor for macrosomia (OR: 3.7, CI: 1.3 – 10.8) and it was one of the main predictors for macrosomia (adjusted OR: 3.3, CI: 1.04–10.4) (Mohammadbeigi, Farhadifar, Soufi Zadeh, Mohammadsalehi, Rezaiee, & Aghaei, 2013). Another study conducted in China among pregnant women with gestational diabetes showed that hypertensive disorders of pregnancy was associated with an increased risk of macrosomic birth by 2.02 (CI: 1.23–3.31)(Zhang, et al., 2017). However, the researcher thinks that the relation between macrosomia and hypertensive disorders during pregnancy might be subject for confounding effects of different variables like BMI, excess weight gain and so on. In addition the underlying risk factors (like maternal age, obesity,

excessive weight gain,..) for macrosomia and hypertensive disorders in pregnancy generally interlinked with each other. So when studying the relation of macrosomia and hypertensive disorders in pregnancy, advanced methodological and statistical tools should be applied for controlling a variety of suspected confounders.

4.5.3 Association between weight gain during antenatal care period and macrosomia

Table 4.23:Association between weight gain during antenatal care period and macrosomia

Factor		Macrosomia		$\chi 2$ (df)	Crude OR (95%CI)	*p* Value
		Case N (%)	Control N (%)			
Weight increase during antenatal period[*1]	Less than 8 kg®	25 (27.2)	33 (32.4)	1.332 (2)	1.00	
	8 -12 kg	35 (38)	41 (40.2)		1.127 (0.566, 2.242)	0.734
	More than 12 kg	32 (34.8)	28 (27.5)		1.509 (0.730, 3.118)	0.267
Excessive weight increase during antenatal period[*2]	No®	56 (60.9)	81 (79.4)	8.066 (1)	1.00	
	Yes	36 (39.1)	21 (20.6)		2.480 (1.312, 4.688)	0.005

*****68 Subjects who were not registered during first trimester were excluded fro analysis.
[1]Weight increases irrespective of BMI.
[2]Weight increase based on first trimester BMI (Institute of Medicine criteria, 2009)

Table (4.23) shows that there is no statistical significant association between macrosomia and crude weight increase (which not based on BMI), while there is a statistical significant association between the occurrence of macrosomia and excessive weight gain during antenatal care period based on first trimester BMI with OR: 2.480 (CI: 1.312-4.688). Excessive weight gain is defined according to Institute of Medicine as an excess weight gain during antenatal period based on pre-pregnancy or first trimester weight and body mass index and they are;>18 kg for underweight, >16 kg for normal weight, >11.5 for overweight and >9 kg suppose that the weight gain during first trimester is minimal with 0.5 – 2 kg and could be ignored (Institute of Medicine, 2009). Consistent with

thesefindings, a study conducted in Cuba showed that excessive pregnancy weight gain was a significantly associated with macrosomia occurrence with OR: 3.1 and CI: 2.34–9.84 (Cruz, et al., 2015). A similar finding was observed in Canada cohort study with OR: 2.86 and CI: 2.09–3.92 for the group who exceed the recommended weight gain by IOM (Institute of Medicine) compared by the group who didn't exceed the recommended weight gain (Ferraro, et al., 2012).These findings support IOM recommendations regarding the initial BMI and recommended weight gain during pregnancy period.

4.5.4 Relationship between GA at delivery, mean systolic BP, mean diastolic BP, FBG at registration and at 24 weeks of gestation, mean Hb and macrosomia

Table 4.24: Relationship between GA at delivery, mean systolic BP, mean diastolic BP, FBG at registration and at 24 weeks of gestation, mean Hb and macrosomia

Variable	Research category	Number	Mean	Standard deviation	Mean diff	t-test	p-value
GA at delivery	Case	131	281.25	10.27	4.083	3.317	0.001
	Control	131	277.16	9.64			
Mean systolic BP	Case	131	108.55	6.61	1.412	1.862	0.062
	Control	131	107.14	5.62			
Mean diastolic BP	Case	131	70.11	4.74	1.118	1.869	0.063
	Control	131	68.99	4.92			
FBG at ANC registration	Case	108	87.46	27.28	5.516	1.784	0.076
	Control	86	81.95	9.81			
FBG at 24 weeks	Case	129	82.77	14.70	5.736	3.814	0.000
	Control	129	77.03	8.69			
Mean Hb	Case	131	10.89	0.81	-0.123	-1.157	0.248
	Control	131	11.01	0.90			

Independent-samples t-test

Table (4.24) shows that there are statistical significant association between the occurrence of macrosomia and factors of gestational age at delivery by days and FBG level at 24 weeks of gestation with mean difference 4.083 and 5.736 respectively and t: 3.317 (p: 0.001) and 3.814 (p: 0.000) respectively. Regarding gestational age similar findingswere observed in China, which showed that the gestational age was significantly associated with macrosomia with t: 3.91 and p-value: 0.001(Li Yi, 2015). Similar finding also was

observed in Northern Ethiopia which showed that the relative risk for developing macrosomia among pot-term pregnant women was 2.22 (CI: 1.1–4.56)(Mengesh Hayelom, 2017). Regarding FBG a population based study conducted in Hungary revealed the presence of a significant association between maternal FBG and birth weight with p-value: 0.004 and therisk of having LGA,increased significantly when FBG > 90mg/dl compared with the group of mothers withwith FBG: 72 – 81mg/dl, and the odds of having macrosomia for the groups of mothers 90 – 99 and > 99 were 1.53 (CI: 1.15–2.05) and 2.45 (CI: 1.50–4.03) respectively(Kereayi, et al., 2009). Mohammadbeigi et al. also found similar findings in Iran that, there was a statistically significant difference between mothers of case and control groups in their FBG level with p-value 0.01, the high FBG level was observed in mothers of case group(Mohammadbeigi, Farhadifar, Soufi Zadeh, Mohammadsalehi, Rezaiee, & Aghaei, 2013). while in China, a study showed that there was no statistical significant association between FBG and macrosomia with t: 0.09 (p: 0.927)(Li Yi, 2015).In China study, the checked FBG was not determined by gestational weeks that might affect the findings of their study because FBG shows fluctuation during the course of pregnancy and as shown in the table (4.24) that there is no statistical significant association between FBG (at registration for antenatal care) and macrosomia.

On the other hand, the table also showed that there are no statistical significant associations between macrosomia and the other factors "mean systolic BP, mean diastolic BP, FBG at registration and mean Hb" with p-value > 0.05. Regarding BP, Mohaamadbeigi et al. found that there were no statistical significant association between the occurrence of macrosomia and systolic BP and diastolic BP with p-value 0.28 and 0.09 respectively(Mohammadbeigi, Farhadifar, Soufi Zadeh, Mohammadsalehi, Rezaiee, & Aghaei, 2013). Regarding Hb level, a prospective study conducted in Switzerland showed that there was no significant association between Hb < 11 with low ferritin level or Hb < 11 with normal ferritin level and the occurrence of macrosomia with p-value 0.25 and 0.82 respectively when they compared with mothers with normal Hb and ferritin level(Bencaiova & Breymann, 2014), while in Turkey, a case-control study was carried out among non-diabetic mothers showed that there was a significantly association between Hb and macrosomia and the mean Hb for case and for control group were 11.1 and 11.8 with p-value: 0.005(Kaymaz, et al., 2016). Turkey study was included only healthy mothers with no any disease might affect the representativeness of the study and it was clearly expressed in the mean of Hb which was 11.1 and 11.8 for case and control groups respectively and this inclusion criterion might

affected its representativeness. In India a study showed that Hb level was significantly associated with birth weight with p-value 0.005 (Bora & Das, 2015), but the investigators only studied low and normal birth weight and there was no macrosomic subjects in their study.

4.6 Association between new-born related factors and macrosomia

Table 4.25: Association between macrosomia and newborn gender and birth order

Factor		Macrosomia		$\chi 2$ (df)	Crude OR (95%CI)	*p* Value
		Case N (%)	Control N (%)			
Newborn Sex	Female®	39 (29.8)	61 (46.6)	7.828 (1)	1.00	0.005
	Male	92 (70.2)	70 (53.4)		2.056 (1.237, 3.417)	
Birth order	1st®	18 (13.7)	40 (30.5)	15.798 (3)	1.00	
	2nd and 3rd	42 (32.1)	48 (36.6)		1.944 (0.972, 3.89)	0.060
	4th and 5th	40 (30.5)	26 (19.8)		3.419 (1.625, 7.193)	0.001
	6th and more	31 (23.7)	17 (13)		4.052 (1.799, 9.127)	0.001

Table (4.25) shows that there are statistical significant association between the gender of newborn, birth order and the occurrence of macrosomia ($p< 0.05$). The odds of male fetus 2.056 (CI: 1.237–3.417) to be born with macrosomia in comparison with female fetus and from the table it's clear that the relation between macosomia and birth order is dose-response relationship. Regarding the gender of newborn, similar to these finding were observed by Li et al. in their study that, the gender of newborn was significantly associated with macrosomia with p-value < 0.001 and when cross-tabulating the data the odd of male fetuses to be delivered with macrosomia was 2.48 in comparison to female fetuses(Li Yi, 2015). A similar findings were also observed in Northern Ethiopia that the relative risk for female fetuses to be born with macrosomia was 0.58 (CI: 0.35–0.9) compared with male fetuses(Mengesh Hayelom, 2017). However , in Iran, the researcher didn't find a

significant association between the gender of newborn and macrosomia with p-value 0.34(Mohammadbeigi, Farhadifar, Soufi Zadeh, Mohammadsalehi, Rezaiee, & Aghaei, 2013). In Iran study the findings might be affected by the small sample size which consisted 160 mothers, 32 of them delivered macrosomic newborns and the study design was prospective cohort study which might be unsuitable for studying less incident phenomena with reasonable sample size. Regarding birth order, in Iranthe investigators found that birth order was associated significantly with the occurrence of macrosomia(Maroufizadeh, Omani, Amini, & Sepidarkish, 2016), and a similar finding also was observed in Korea(Kang, et al., 2012).

4.7: Association between paternal factors and macrosomia

Table 4.26: Association between paternal smoking, education, employment and BMI, and macrosomia

Factor		Macrosomia		χ^2 (df)	Crude OR (95%CI)	*p* Value
		Control N (%)	Case N (%)			
Paternal smoking	None smoker®	62 (47.3)	66 (50.4)	0.395 (2)	1.00	
	Smoker	66 (50.4)	63 (48.1)		0.897 (0.55, 1.463)	0.662
	Past smoker	3 (2.3)	2 (1.5)		0.626 (0.101, 3.87)	0.615
Paternal education	University®	53 (40.5)	60 (45.8)	2.917 (2)	1.00	
	Below secondary	39 (29.8)	27 (20.6)		0.612 (0.331, 1.13)	0.117
	Secondary	39 (29.8)	44 (33.6)		0.997 (0.565, 1.75)	0.991
Paternal employment	Employed®	100 (76.3)	103 (78.6)	0.197 (1)	1.00	0.657
	Not employed	31 (23.7)	28 (21.4)		1.140 (0.638, 2.03)	
Paternal BMI	Below 18.5 (Underweight)	2 (1.5)	2 (1.5)	2,020 (3)	0.583 (0.051, 6.66)	0.664
	18.5 – 24.9 (Normal) ®	49 (37.4)	42 (32.3)		1.00	
	25.0 – 29.9 (Overweight)	62 (47.3)	62 (47.7)		1.167 (0.679, 2.00)	0.577
	30.0 and above (Obese)	18 (13.7)	25 (19.2)		1.620 (0.779, 3.37)	0.197

Table (4.26) shows that there are no statistical significant associations between the occurrence of macrosomia and the factors "paternal smoking, paternal education, paternal occupation and paternal BMI" ($p>0.05$). Consistent with these findings, a study conducted in China, showed that paternal smoking and paternal education were not significantly associated with high birth weight ($p > 0.05$)(Fan, Huang, Cui, Gao, Song, & Wang, 2015). A study conducted in Turkey showed that no significant association between paternal smoking, paternal BMI and the occurrence of macrosomia with p-value > 0.05(Kaymaz, et al., 2016). Consistent with these findings Lepereq et al. found that paternal characteristics

had no significant effect on offspring birth weight(Lepereq, Timsit, & Hauguel-de, 2000). On the other hand, a cross-sectional study conducted in Cameroon, showed that the odds of having macrosomic babies for the mothers whose husbands' BMI ≥ 30 was 3.7 (CI: 1.7–6.9) when compared with fathers with BMI < 25(Nkwabong & Nzalli Tangho, Risk Factors for Macrosomia, 2015). In Cameroon study the smallest sample size (232 subjects) for cross-sectional study might affect it's finding. This area needs more study eventhough at the level of genetic predisposition.

Table 4.27: Relationship between paternal height, weight and macrosomia

Variable	Research category	Number	Mean	Standard deviation	Mean diff	t-test	p-value
Height of Father	Case	131	1.763	0.070	0.0133	1.458	0.146
	Control	131	1.750	0.077			
Weight of Father	Case	131	83.38	13.23	3.77	2.300	0.022
	Control	131	79.61	13.30			

Independent-samples t-test

Table (4.27) shows that there is a statistical significant association between weight of father and the occurrence of macrosomia with t: 2.30 (p< 0.05), while there is no statistical significant association between macrosomia and paternal height with t: 1.458 (p: 0.146). In Sydney, a study showed that there were significant association between paternal weight, paternal height and large-for-gestational age with mean difference 7.2kg (p: 0.007) and 0.03 meter(p: 0.002) respectively among the fathers(Donnelley, Raynes-Greenow, Turner, Carberry, & Jeffery, 2014). In Northern Ireland, the researchers didn't find significant association between paternal weight, paternal height and the occurrence of macrosomia with difference in means between the groups were 0.239 kg (p: 0.62) and 0.3 cm (p: 903) respectively(Reid, McNeil, Alderdice, Tully, & Valerie, 2014). However, Northern Ireland study might be not representative due to the smaller sample size (112) of mothers who recruited in prospective design. In literature there are scarcity of articles which studied the paternal risk factors of macrosomia, so this area need to be focused on.

4.8 Multivariate analysis of risk factors for macrosomia among newborns attending health services at UNRWA health centers in Gaza governorates

Table 4.28:Multivariate analysis of risk factors for Macrosomia among newborns attending health services at UNRWA health centers in Gaza governorates (Final Model)

Factor		Crude OR[a] (95% CI)	Adjusted OR[b] (95% CI)	Wald statistics[b]	B[b]	P Value[b]
History of macrosomia	No®	1.00	1.00			
	Yes	5.255 (2.768, 9.976)	4.662 (1.829, 11.881)	10.400	1.539	0.001
First Trimester BMI	18.5-24.9 (Normal) ®	1.00	1.00			
	25-29.9 (Overweight)	3.058 (1.653, 6.636)	2.740 (1.229, 6.106)	6.073	1.008	0.014
	30 and more (Obese)	3.215 (1.575, 7.173)	2.739 (1.086, 6.907)	4.561	1.008	0.033
Taking fruits	1-2 times weekly®	1.00	1.00			
	3-5 times weekly	6.462 (1.975, 21.144)	7.481 (1.311, 42.675)	5.131	2.012	0.024
	≥ 6 times weekly	7.333 (2.445, 21997)	10.686 (2.056, 55.527)	7.938	2.369	0.005
Gender of newborn	Female®	1.00	1.00			
	Male	2.056 (1.237, 3.417)	2.075 (1.001, 4.301)	3.851	0.730	0.050
Gestational age at delivery by days(continuous)		1.042 (1.016, 1.069)	1.058 (1.020, 1.098)	9.271	0.057	0.002
FBG at 24 weeks(continuous)		1.044 (1.019, 1.070)	1.047 (1.010, 1.086)	6.101	0.046	0.014

[a]Simple logistic regression, [b]Multiple logistic regression (Final model)

Logistic regression analysis was used to predict the probability that an infant will born with macrosomia. All variables with p-value ≤ 0.10in bivariate analysis, were employed in multivariate analysis and consecutive exclusions of variables with at least significance level was done till achieving the model with statistically significant predictor variables for

macrosomia among newborns attending health services at UNRWA health centers in Gaza governorates and the final model of main predictor risk factors for macrosomia occurrence as shown in the table (4.28) are; previous history of macrosomic birth, first trimester BMI of the mother, eating fruits during pregnancy period, the gender of newborn, gestational age and FBG at 24 weeks of gestation.

Table (4.28) shows that the mothers who have previous history of macrosomia; have increased odds of delivering babies with macrosomia by 4.662 times than who do not have the history (CI: 1.829–11.881), and the mothers who were in the first trimester overweight and obese have risk of delivery with macrosomic baby with adjusted OR 2.74 (CI: 1.229–6.106) and 2.739 (CI: 1.086–6.907) respectively in comparison to mothers with first trimester normal body mass index. The table also shows that the groups of mothers who ate fruits during the period of pregnancy ≥ 6 times weekly and 3-5 weekly have a risk of delivering macrosomic newborns by 10.686 (CI: 2.056-55.527) and 7.481 (CI: 1.311-42.675) times respectively in comparison to group of mothers who ate fruits 1-2 times weekly during the period of pregnancy. Moreover, being a male fetus will significantly increase the odds of birth with macrosomia by 2.075 times in comparison to female fetus (CI: 1.001-4.301). In addition, gestational age by days and FBG at 24 weeks of gestation are significantlyassociated with the occurrence of macrosomia with adjusted OR 1.058 (CI: 1.020–1.098) and 1.047 (CI: 1.010 – 1.086) respectively. That means, an increase of 1 days in gestational age, will significantly increase the odds of delivery with macrosomia by 1.058 times and with increase FBG at 24 weeks of gestation by 1mg/dl, will significantly increase the odds of delivery with macrosomia by 1.047 times.In China, a study conducted by Li et al. showed that the main predictors of macrosomia were pre-pregnancy BMI, gravidity, parity, gestational age, maternal age and weight gain in pregnancy(Li Yi, 2015). In Canada, Ferraro et al. found that the main predictors of macrosomia were maternal BMI, parity, maternal age, maternal height, excessive maternal weight gain (according to IOM criteria) and maternal smoking(as protective factor) (Ferraro, et al., 2012). In Turkey, Kaymaz et al. conducted a study among non-diabetic mothers showed that the main predictors risks for macrosomia were male infant, gestational age at delivery and mother age ≥ 35(Kaymaz, et al., 2016). In Iran, Mohammadbeigi et al. found that gestational diabetes, previous history of macrosomic birth and preeclampsia in pregnancy period as the main predictors of macrosomia occurrence(Mohammadbeigi, Farhadifar, Soufi Zadeh, Mohammadsalehi, Rezaiee, & Aghaei, 2013).

Chapter Five

Conclusion and Recommendation

5.1 Conclusion

This study aimed to determine the risk factors for macrosomia among newborns attending health care services at UNRWA health centers in Gaza governorates in order to improve maternal &child health care and contribute to reducing mortalities and morbidities. A case-control study was carried out among newborns in their first neonatal visit at Rimal, Beach, Nusairat, Deir-Balah, Japanese and Maen health centers. Thestudy population consisted of two groups; the first was case group which consisted newborns with birth weight 4 kg or more and the second was control group which consisted newborns with normal birth weight (from 2.5 to less than 4 kg) who attended the same first neonatal visit and from the same catchment area (location) of the health center, matching was done for age and location in term of the same catchment area. During study period all eligible cases from the randomly selected health centers were enrolled in the study with total sample size of 262 respondents; 131 of them were cases and 131 were controls. A validated constructed questionnairewith face to face interview was carried out to all respondents, measure of paternal anthropometrics was carried out and record based abstraction sheet was abstracted from e-medical records. 35.9%, 33.6% and 30.5 of the study population were from North area, Middle area and South area respectively. Different statistical tests were used as bivariate and multivariate analysis.

Among maternal risk factors; bivariate analysis showed that there were statistically significant positive associations between macrosomia and the factors "maternal age at delivery, parity, gravidity, previous history of macrosomic birth, family history of DM, maternal weight during first trimester, maternal BMI during first trimester, eating organ(like liver, kidney,..) once weekly, eating fruits" (p-value < 0.05) and statistically significant negative association with birth space less than 24 months (p-value < 0.05). on the other hand there were no statistical significant association between macrosomia and the factors "marital age, history of abortions, maternal passive smoking, maternal education, maternal employment, maternal height, sedentary behavior, physical activity, other dietary habits and supplements taken during pregnancy" (p-value > 0.05).

Among pregnancy related factors; bivariate analysis showed that there were statistical significant positive association between macrosomia and the factors "DM during pregnancy, excessive maternal weight gain during pregnancy, gestational age at delivery and FBG at 24 weeks of gestation" (p-value < 0.05). On the other hand there were no statistical significant association with the factors "weight increase during pregnancy not based on initial BMI, mean systolic BP, mean diastolic BP, mean Hb and FBG at registration for antenatal care" (p-value > 0.05).

Among newborn related factors; bivariate analysis showed that there were statistically significant positive association between being male newborn, birth order and macrosomia (p-value < 0.05).

Among paternal factors; bivariate analysis only showed that there was a statistically significant positive association between macrosomia and paternal weight (p-value < 0.05). on the other hand there were no statistically significant association between macrosomia and the factors "paternal smoking, paternal education, paternal employment, paternal height and paternal BMI" (p-value > 0.05).

A prediction model was employed using multivariate logistic regression analysis, showed that the main predictor risk factors for macrosomia among newborns attended UNRWA health services were; previous history of macrosomic birth, first trimester BMI, eating fruits, gender of newborn, gestational age and FBG at 24 weeks of gestation. The adjusted odds of delivering macrosomic birth for mothers with previous history of macrosomic birth was 4.662 (CI: 1.83–11.88), for being male newborn the adjusted OR was 2.075 (CI: 1.001–4.301), the adjusted OR of delivering macrosomic birth for overweight and obese mother was 2.74 (CI: 1.229–6.106) and 2.739 (CI: 1.086–6.907) respectively, the adjusted OR for mothers who eat fruits 3-5 times weekly and ≥ 6 times weekly were 7.481 (CI: 1.311–42.67) and 10.686 (CI: 2.056–55.52) respectively. Gestational age at delivery also was significantly associated with macrosomia with adjusted OR 1.058 (CI: 1.020–1.098) that means with increase in gestational age by one day, will increase the odds of macrosomic birth by 1.058 times, moreover FBG at 24 weeks of gestation was significantly associated with macrosomia with adjusted OR 1.047 (CI: 1.010–1.086) and this means that with increase in one mg/dl in FBG at 24 weeks of gestation, will increase the odds of macrosomic birth by 1.047 times.

5.2 Recommendations

1. Supporting epidemiological studies in the area of maternal child health and encouraging further studies to prove new emerged risk factors for macrosomia occurrence as fruits intake.
2. Adopting health education program to work on the modifiable risk factors for macrosomia occurrence like maternal weight and maternal BMI during preconception period and excess weight gain and glycemic curve to be worked on during pregnancy period.
3. UNRWA and MOH should refine its criteria for diagnosing gestational DM by reducing the threshold of FBG at 24 weeks of gestation that UNRWA adopted cut point of FBG of 126 mg/dl for diagnosing GDM and a risk was developed for macrosomia at lower FBG level (the mean FBG for case group was 82.77 mg/dl) and also the target FBG for diabetic pregnant women should be reduced.
4. Targeting macrosomic infants for maintaining normal body weight in accordance to z-score for weight and weight/length to prevent childhood obesity and thus adulthood obesity which in turn reduces the pandemic of obesity in later life and thus also reduces the pandemic of NCDs in their later life.
5. Considering all these risk factors during all periods of life cycle health delivery by maintain normal BMI before pregnancy and controlling weight gain and glycemic control during pregnancy and adopting risk scoring for macrosomia to be used as indication for fetal ultrasonographic and estimating fetal weight. In addition macrosomic infants and also macrosomic children should be monitored closely for maintain normal body weight in order to contribute to reduce the pandemic of obesity and its complications at short and long run.

5.3 Recommended further research

1. Conducting studies to explore the prevalence of macrosomia among Palestine women.
2. Conducting more studies to identify the possible short term complications of macrosomia for the mother and for newborns.
3. Conducting more studies to identify the possible long term complications of macrosomia among children and adults who were born with macrosomia.

4. Conducting more in-depth studies to investigate the effect of dietary pattern on macrosomia development.
5. Conducting interventional studies aiming to control the fetus weight especially for the expected macrosomic newborns.

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Annex (1): Palestine map

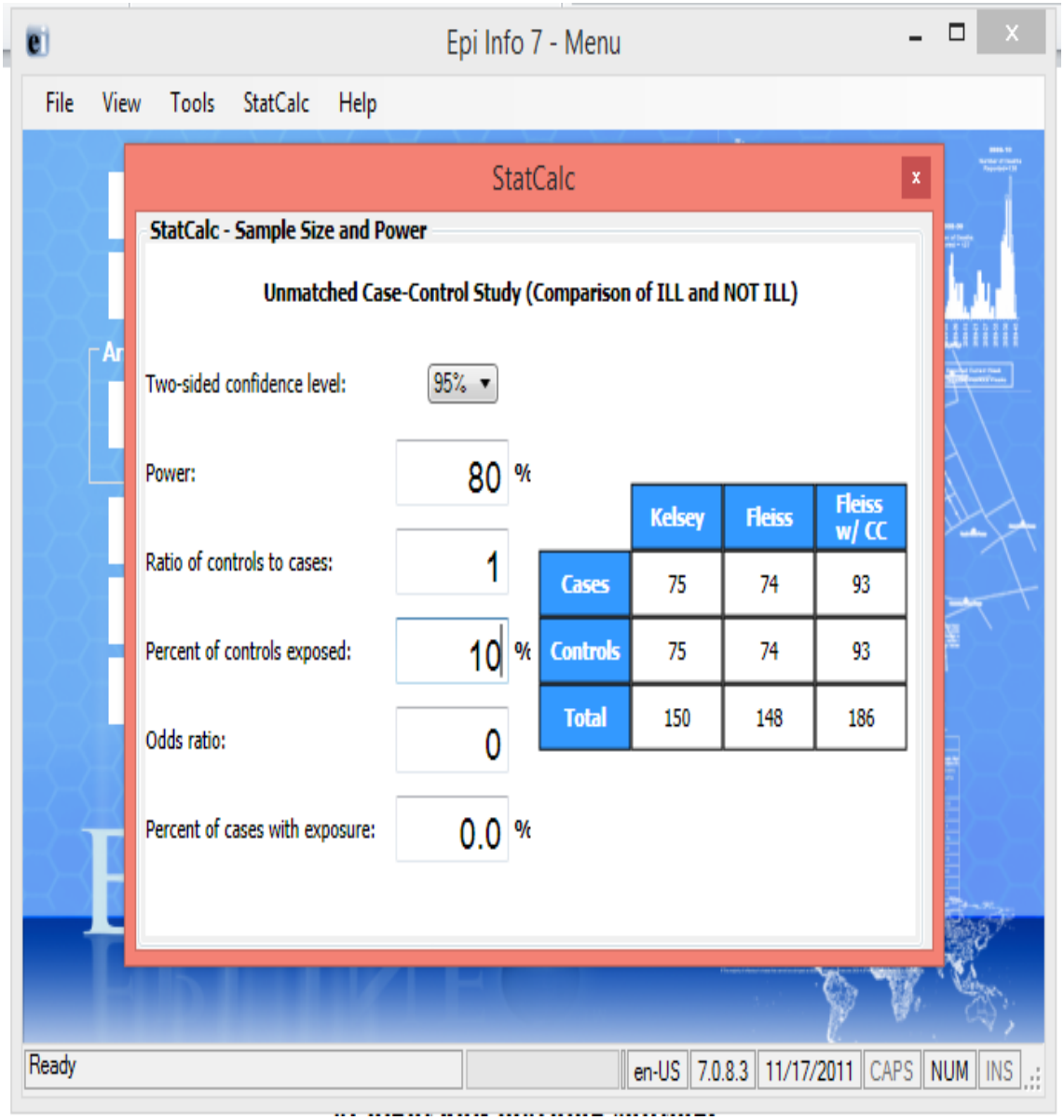
Source: Palestinian Central Bureau of statistics (2017)

Annex (2): Recommended total weight gain during pregnancy by pre-pregnancy or early pregnancy BMI

Pre-pregnancy or early pregnancy BMI (kg/m^2)	**Total weight gain range**
Underweight (<18.5)	12.5 kg–18 kg
Healthy weight (18.5 - 24.9)	11.5 kg–16 kg
Overweight (25.0 - 29.9)	7 kg–11.5 kg
Obese (≥ 30.0)	5 kg–9 kg

Source: IOM and NRC 2009

Annex (3) Sample size calculation



Annex (4): Sampling by health center

Health center	2015 Births	Pecent	No. of cases	Pilot-cases	Total No. of cases
Rimal	3042	24.6	30	4	34
Beach	1331	10.8	13	0	13
Nuseirat	2252	18.2	22	0	22
Deir-Balah	1979	16	19	3	22
Japanese	934	7.5	9	3	12
Maen	2836	23	28	0	28
Total	12374	100	121	10	131

Annex (5): Maternal age at delivery as continuous variable (mean, st dev., t-value and p-value)

Variable	Research category	Number	Mean	Standard deviation	Mean diff	t-test	p-value
Maternal age at delivery	Case	131	28.771	5.576	1.6335	2.276	0.024
	Control	131	27.137	6.032			

Independent samples t-test

Annex (6): Association between multiple types of drinks and macrosomia

Cups / weekly	B	Adjusted OR (95%CI)	Wald statistics (df)	p value*
Milk	0.020	1.021 (0.964, 1.080)	0.488(1)	0.485
Yogurt	0.004-	0.996 (0.953, 1.041)	0.031(1)	0.860
Fresh juice	0.009-	0.991 (0.962, 1.021)	0.336(1)	0.562
Gaseous drinks	0.045	1.046 (0.992, 1.103)	2.819(1)	0.093
Tea, coffee and cacao	0.012-	0.988 (0.961, 1.015)	0.759(1)	0.384

*Multiple Logistic Regression

Annex (7): Association between macrosomia and the duration of supplements taken during pregnancy

Duration of taken supplements	B	Crude OR (95%CI)	Wald statistics (df)	p value*
FA duration	-0.129	0.879 (0.713, 1.082)	1.480 (1)	0.224
Iron-FA duration	0.044	1.045 (0.911, 1.198)	0.394 (1)	0.530
Omega-3 duration	0.060	1.062 (0.890, 1.268)	0.449 (1)	0.503
MV duration	0.013	1.013 (0.848, 1.210)	0.021 (1)	0.886
Calcium duration	0.070	1.073 (0.901, 1.277)	0.622 (1)	0.430

Simple logistic regression

Annex (8): Association between different continuous factors during the last pregnancy and macrosomia

Factor	Crude OR (95%CI)	Wald statistics (df)	p value*
Gestational age at delivery by days	1.042 (1.016, 1.069)	10.218 (1)	0.001
Mean systolic BP	0.998 (0.991, 1.004)	0.44 (1)	0.503
Mean diastolic BP	1.050 (0.997, 1.105)	3.42 (1)	0.064
FBG at registration	1.025 (0.999, 1.053)	3.444 (1)	0.063
FBG (24 weeks)	1.044 (1.019, 1.070)	12.331 (1)	0.000
Mean Hb	0.846 (0.638, 1.123)	1.334 (1)	0.248

Simple logistic regression

Annex (9): Association between paternal height and weight, and macrosomia

Factor	**Crude OR (95%CI)**	**Wald statistics (df)**	**p value***
Height of father	11.566 (0.426, 314.336)	2.111 (1)	0.146
Weight of father	1.022 (1.003, 1.042)	5.115 (1)	0.024

Simple logistic regression

Annex (10): Helsinki Approval

المجلس الفلسطيني للبحث الصحي

Palestinian Health Research Council

تعزيز النظام الصحي الفلسطيني من خلال مأسسة استخدام المعلومات البحثية في صنع القرار

Developing the Palestinian health system through institutionalizing the use of information in decision making

Helsinki Committee

For Ethical Approval

Date: 01/08/2016 **Number:** PHRC/HC/150/16

Name: MUSTAFA M. SHAATH **الاسم:** مصطفى محمد شعث

We would like to inform you that the committee had discussed the proposal of your study about:

نفيدكم علماً بأن اللجنة قد ناقشت مقترح دراستكم حول:

Risk Factors for Macrosomia among Newborns Attending Health Services at UNRWA Health Centers in Gaza Governorates

The committee has decided to approve the above mentioned research. Approval number PHRC/HC/150/16 in its meeting on 01/08/2016

و قد قررت الموافقة على البحث المذكور عاليه بالرقم والتاريخ المذكوران عاليه

Signature

Member Member

Chairman

Genral Conditions:-

1. Valid for 2 years from the date of approval.
2. It is necessary to notify the committee of any change in the approved study protocol.
3. The committee appreciates receiving a copy of your final research when completed.

Specific Conditions:-

E-Mail:pal.phrc@gmail.com

Gaza - Palestine غزة - فلسطين

شارع النصر - مفترق العيون

Annex (11): Managerial approval

Al-Quds University
Jerusalem
School of Public Health

جامعة القدس
القدس
كلية الصحة العامة

التاريخ:2016/8/29

حضرة الدكتورة/غادة أبو نحلة المحترمة
مدير برامج الصحة– وكالة الغوث

تحية طيبة وبعد،،،

الموضوع: مساعدة الطالب مصطفى شعت

نهديكم أطيب التمنيات ونتمنى لكم دوام التقدم والإزدهار. ونرجو تكرم سيادتكم بالعلم بأن الطالب المذكور أعلاه يقوم بإجراء بحث بعنوان:

"Risk Factors for Macrosomia among Newborns Attending UNRWA Health Centers in Gaza Governorates"

كمتطلب للحصول على درجة الماجستير في الصحة العامة–مسار علم الأوبئة، وعليه نرجو التكرم بالموافقة والايعاز لمن يلزم للسماح للطالب بجمع البيانات الخاصة ببحثه، حيث تشمل عينة البحث الأطفال حديثي الولادة المسجلين في مراكز الرعاية الأولية التابعة لإدارتكم الموقرة وأمهاتهم وأبائهم.

علماً بأن المعلومات ستكون متوفرة لدى الباحث والجامعة فقط وسنطلعكم على النتائج في حينها .

و اقبلوا فائق التحية و الاحترام،،،

د. بسام أبو حمد
منسق عام برامج الصحة العامة
فرع غزة

نسخة:
- الملف

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ص.ب. 51000 القدس

Annex (12): Consent form

استبانة

جامعة القدس – فلسطين

كليــة الدراســات العليــا

كليــة الصحــة العامـــة

الأخت الفاضلة:

تحية تقدير واحترام وبعد،،،

أنا الباحث د. مصطفى محمد شعث طالب ماجستير بجامعة القدس كلية الدراسات العليا- برنامج الصحة العامة تخصص وبائيات أقوم بإجراء هذا البحث كمتطلب رئيسي من متطلبات الحصول على شهادة الماجستير، حيث أن الدراسة تهدف إلى **التعرف على العوامل التي تؤدي إلىإنجاب مواليد بوزن فوق المعتاد أي بوزن 4كجم أو أكثر من بين الذين يتلقون خدماتهم الصحية في عيادات وكالة الغوث في محافظات قطاع غزة.**

حيث ان هذه الدراسة ستساهم في تحسين الوضع الصحي للأمهات والأطفال في قطاع غزة. لقد تم اختيارك للمشاركة في هذا البحث عشوائيا و لمطابقتك لشروط البحث العلمي . إنإجراء هذا البحث لا يتطلب عمل أي تحاليل مخبريهأو تناول أي نوع من الأدوية.

لذلك يرجى التكرم بالإجابة على جميع أسئلة الاستبانة بكل أمانة وصدق، مع العلم أن مشاركتك في هذه الدراسة طوعية، كما يمكنك الإجابة على كل او بعض الأسئلةأو التوقف متى شئت كما أن البيانات التي سيتم جمعها منك أو من الملف الطبي الخاص بك سيتم استخدامها للبحث العلمي فقط ولن يطلع عليها احد.

هذه الاستبانة سوف تستغرق حوالي 15 دقيقة لاستكمالها مهما تكن المعلومات التي تعطيها سوف تبقى سرية وطي الكتمان.

مع جزيل الشكر والتقدير لسيادتكم

د. مصطفى محمد شعث

Annex (13): Questionnaire

Risk Factors for Macrosomia among Newborns Attending Health Services at UNRWA Health Centers in Gaza Governorates.

(case – control study)

(Questionnaire form)

Serial No: □□□□

Date of interview: ……/……/……

Research category: 1. □Case 2. □Control

Name of the newborn:……

Registration card:……

No. of newborn record…….

No. of maternal record…….

Name of Primary Health care center:……..

Address: ……..

Area of residency:

1. □City 2. Housing projects 3 . □Village 4.□Camp

Tel. No:…….....

Mobile :……..

Average family income: ……..…… (NIS)

1.Maternal Data

1.1 Mother's date of birth: __/__/__

1.2 Marital age:……Year

1.3 Gravida …… , Para …….. , Abortion ……....

1.4 How many children do have? Male……Female……..

1.5 Do you have previous history of macrosomic birth (equal 4 kg or more)?

1. □ Yes 2.□ No (if No skip to Q1.7)

1.6 If yes, How many births?.....

1.7 Education:

1. □Illiterate
2. □Can read and write
3. □Elementary
4. □Preparatory
5. □Secondary
6. □Associate diploma
7. □Bachelor and above

1.8 Employment:

1. □Employed
2. □Unemployed

1.9 If the answer in the previous question is " employed " , please specify your job:……

1.10 Smoking during concerned pregnancy?

1. □Smoker
2. □Past smoker
3. □Passive smoker
4. □ Non smoker

1.11 Do you suffer from any chronic conditions?

1.Diabetes Mellitus	1. □ Yes	2.□ No
2.Cardiac disease	1. □ Yes	2.□ No
3.Hypertension	1. □ Yes	2.□ No
4.Eating disorder	1. □ Yes	2.□ No
5.Psychosocial problems	1. □ Yes	2.□ No

6.Others (specify)……

1.12 Do you have family history of diabetes mellitus? 1. □ Yes 2.□ No

1.13 If yes, specify the degree of the relation…….

1.14 What is your weight before the pregnancy?.....Kg

2.Pregnancy related Data

2.1 Actual Date of Delivery : ……/……/…….

2.2 Did you suffer from diabetes mellitus during the last pregnancy?

1. □ Yes 2.□ No (if No skip to Q2.5)

2.3 What type of diabetes?

1. □Chronic Diabetes 2.□Gestational Diabetes

2.4 What the type of management had you received?

1. □Only lifestyle 2.□Insulin and lifestyle

2.5 Did you suffer from pregnancy-induced hypertension?

1. □ Yes 2.□ No

2.6 Did you suffer from any other health event during pregnancy?

1. □ Yes 2.□ No (if No skip to Q2.8)

2.7 If yes, please specify……

2.8 Did you take any medication during pregnancy?

1. □ Yes 2.□ No(if No skip to next page)

2.9 If yes, please specify……

3.Newborn Data

3.1 Gender of newborn? 1. □Male 2. □Female

3.2 Birth weight…….kg

3.3 Birth order……..

3.4 Does the child suffer from any medical conditions?

1. □ Yes 2.□ No (if No skip to next page)

3.5 If yes, please specify……

4.Paternal Data

4.1 Education:

1. □Illiterate
2. □Can read and write
3. □Elementary
4. □Preparatory
5. □Secondary
6. □Associate diploma
7. □Bachelor and above

4.2 Employment:

1. □Employed
2. □Unemployed

4.3 If the answer in the previous question is " employed " , please specify your job :……

4.4 Smoking? 1. □Smoker

2. □Past smoker
3. □Passive smoker
4. □ Non smoker

5.Physical activity and dietary habits of the mother during pregnancy

Physical activity and sedentary behavior

5.1 How many hours do you watch TV?..... : .....hrs : min./day.

5.2 How much time do you usually spend sitting on computer or phone(internet, social media,…) on a typical day? …..... : .....hrs : min./day.

5.3 How many hours do you sleep daily?..... : .....hrs : min./day.

Now I'm going to ask you about time you spend doing different physical activities in a typical week. Please answer even you do not consider yourself to be physically active person.

	Question	Response	Code
Activity at work			
5.4	Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like for at least 10 minutes continuously?	1. □Yes 2. □No(If No skip to P4)	P1
5.5	In a typical week, on how many days do you do vigorous intensity activities as part of your work?	Number of days:.....	P2
5.6	How much time do you spend doing vigorous-intensity activities at work on a typical day?	Hrs : Min .....:.....	P3
5.7	Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate for at least 10 minutes continuously?	1. □Yes 2. □No(If No skip to P7)	P4
5.8	In a typical week, on how many days do you do moderate intensity activities as part of your work?	No. of days:.....	P5
5.9	How much time do you spend doing moderate-intensity activities at work on a typical day?	Hrs : Min .....:.....	P6

Travel to and from places			
The next questions exclude the physical activities at work that you have already mentioned. Now I would like to ask you about the usual way you move to and from places. For example to work, for shopping, to market, to place of worship.			
5.10	Do you walk for at least 10 minutes continuously to get to and from places?	1. □Yes 2. □No (If No skip to P10)	P7
5.11	In a typical week, on how many days do you walk for at least 10 minutes continuously to get to and from places?	Number of days:.....	P8
5.12	How much time do you spend walking for travel on atypical day?	Hrs : Min .....:.....	P9
Recreational activities			
Now I would like to ask you about sports, fitness and recreational activities (leisure)			
5.13	Do you do any vigorous-intensity sports, fitness or recreational (leisure) activities that cause large increases in breathing or heart rate for at least 10 minutes continuously?	1. □Yes 2. □No(If No skip to P13)	P10
5.14	In a typical week, on how many days do you do vigorous intensity sports, fitness or recreational (leisure) activities?	Number of days…….	P11
5.15	How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day?	Hrs : Min .....:.....	P12
5.16	Do you do any moderate intensity sports, fitness or recreational (leisure) activities that cause a small increase in breathing or heart rate such as brisk walking, (cycling, swimming, and volleyball) for at least 10minutes continuously?	1. □Yes 2. □No (If No Stop questions)	P13
5.17	In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational (leisure) activities?	Number of days……..	P14

5.18	How much time do you spend doing moderate-intensity sports, fitness or recreational (leisure) activities on a typical day?	Hrs : Min .....:.....	P15

Dietary habits

5.19 How many meals did you take per day? ……

5.20 What was your main meal ?

1. □ Breakfast
2. □ Lunch
3. □ Dinner

5.21 Did you take snack in between meal ?

1. □ Yes
2. □ No (if No skip to Q5.23)

5.22 If the answer was yes , what was the kind of snack do you take?

1. □ Fruit
2. □ Sweet
3. □ Juice
4. □ Sandwiches
5. □ chocolate
6. □ chips
7. □ biscuits

5.23 Did you take fast food (ready food, delivery food) ?

1. □ Yes
2. □ No (if No skip to next page)

5.24 If the answer was yes, how many times did you take delivery meal per week?

1. □ one per week
2. □ 2-3 times per week
3. □ more than three times per week

5.25 In the following table, which food you take during pregnancy and the frequency of its intake:

Food Frequency	6 or more times weekly	3-5 times weekly	1-2 times weekly	Once every 2 weeks or more	Never take it during pregnancy
Egg					
Red meet					
White meet					
Organs (liver, kidney…..)					
Fish					
Legumes (beans, lentils…)					
Milk derivatives (cheese…)					
Cereal & bread					
Fruits					
Vegetables					
Sweets & desserts					
Oil					
Other…..					

5.26 How many cup you drink daily / weekly from the following drinks during the last pregnancy:

Drinks	No. of cups daily	No. of cups weekly	Never take it during pregnancy
Water			
Milk			
Yogurt			
Fresh fruit juice			
Gaseous drinks			
Tea, caffee, cacao			

5.27 How do you take your drinks " juice , tea, coffee " ?

1. □Without sugar
2. □ little sugar
3. □ Moderate sugar
4. □ A lot of sugar
5. □ Artificial sweeteners (Saccharin/fructose)

5.28 Which type of supplement did you take during the last pregnancy?

Type of supplement	Did not take it	1-3 times a week	4-6 times a week	Daily	Gestational age when take (month)	
					From	To
Folic acid						
Iron & folic acid						
Omega-3						
Multi vitamins						
Calcium						
Other						

Any non-mentioned comments

……

……

ABSTRACTION SHEET

1.Data Obtained from Maternal Health Record

1. Registration date for antenatal care: ..…/…../…..
2. Gravida …… , Para …….. , Abortion …..
3. Last Menstrual Period : …./…../…..
4. Expected Date of Delivery : ……/……/…….
5. Actual date of delivery : ……/……/…….
6. Gestational age at registration…….week
7. Gestational age at delivery ……. week
8. The last birth space……...month
9. Mother age at delivery…….....year

10. Anthropometric measurement of the mother:

	1.Trimester	The last ANC visit(3.trimester)	
Height			Increases
Weight			
BMI			

11. Did the mother suffer from hypertension during the last pregnancy?

1. □ Yes 2.□ No (if No skip to Q14)

12. If yes, 1. What type of hypertension?

1. □Chronic HTN 2.□PIH

13. Which medications did the mother take for HTN?

1. □Methyldopa 2. □Amlodipine3. □Nifidipine 3. □Other……..

14. Blood pressure measurements during pregnancy:

Readings	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	Mean
Systole													
Diastole													

15. Lab. Tests during pregnancy:

	At registration	At 24. week
FBG		
OGTT		
HbA1C		
Hb		

16. Hb readings during the last pregnancy:

All readings	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Mean
Hb											

17. Does the mother suffer from diabetes mellitus during the concerned pregnancy?

1. □ Yes 2.□ No (if No skip to next page)

18. If yes, 1. What type of diabetes?

1. □Chronic Diabetes 2.□Gestational Diabetes

19. What is the mean fasting blood glucose?

All readings	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Mean
FBG											
PPBG											

20. What the type of management had the mother received?

1. □Only lifestyle 2.□Insulin and lifestyle

21. Control status? 1. □Controlled 2. □uncontrolled

2.Data Obtained from Child Health Record

1. Birth weight……gram
2. Age of newborn at BCG…… by days
3. Weight of newborn at BCG……gram
4. Length…….cm

2.Data for the Father

1. Height……cm
2. Weight……..kg
3. BMI……..

Any non-mentioned comments

……
……

Annex (14): Experts' arbitration form

السيد /..... المحترم

تحية طيبة وبعد:

تحكيم إستبانة

أنا الباحث مصطفى محمد شعث , ملتحق ببرنامج ماجستير صحة عامة – علم الأوبئة بجامعة القدس أبو ديس وأقوم بإعداد رسالة الماجستير كمتطلب تكميلي لنيل الدرجة والتي هي بعنوان :

Risk Factors for Macrosomia among Newborns Attending Health Services at UNRWA Health Centers in Gaza Governorates.

Objectives

1.To determine the relationship between maternal characteristics and macrosomia .

2.To study the relationship between paternal characteristics and macrosomia.

3.To identify the relationship between pregnancy related factors and macrosomia.

4.To examine the relationship between newborn related factors and macrosomia.

5.To set recommendations to reduce the macrosomia and improve maternal and child health.

أرجو من سيادتكم التكرم والإطلاع على الإستبانة وإفادتنا برأيكم وإقتراحاتكم وإبداء الملاحظات الهادفة للتعديل.

مع خالص الشكر والتقدير

الباحث : د.مصطفى محمد شعث

جوال:0592223750

Annex (15): Control panel

No.	Name	Position
1.	Dr. Bassam Abu Hamad	Al-Quds University
2.	Dr. Yahya Abed	Al-Quds University
3.	Dr. Khitam Abu Hamad	Al-Quds University
4	Dr Ashraf El-Jedi	Islamic University – Gaza
5.	Dr. Waleed Abu Hatab	Consultant Obstetrician – MoH
6.	Dr. Tareq Al-Daghma	Consultant Pediatrician – MoH
7.	Dr. Mohammed Arafat	Consultant Pediatrician – MoH
8.	Dr. Emad El-Aour	Area Health Officer – UNRWA
9.	Dr. Zuheir El-Khatib	Field Family Health Officer – UNRWA
10.	Dr. Tayseir El-Ammassi	Senior Medical Officer - UNRWA