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Determinants of Gestational Diabetes Mellitus in Southern Area of the West Bank: A Case-Control Study.

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Determinants of Gestational Diabetes Mellitus in Southern area of the West Bank: A Case-Control Study.

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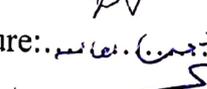
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Dedication

Mom and Dad,

I could never have done this without your faith, support, and constant encouragement. Thank you for teaching me to believe in myself, in God, and in my dreams.

Sisters and brother,

I am so thankful that you are always beside me. I have learned so much from you and I can honestly say that you are a blessing to me.

My fiancée,

You've been an inspiration. Thank you for your support and encouragement.

Ghadir Saed, 2019

Declaration

I certify that this thesis submitted for the degree of Master of Public Health is the result of my own research, except where otherwise acknowledged, and that this thesis has not been submitted for a higher degree to any other university or institution.

Signed: *Ghadir Saed*

Date: 29 / 05 / 2019

Ghadir Hanna Nasri Issa Saed

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Abstract

Background: The prevalence of gestational diabetes mellitus (GDM) is increasing throughout the world. In Palestine, the prevalence of GDM in 2010 among pregnant women was 4.8% in the West Bank and 2.2% in Gaza Strip. This study aims to identify the extent to which physical inactivity and bad eating patterns may contribute to the risk of GDM in Palestinian pregnant women. Similar studies are not available in Palestine, which makes it a rich area for research.

Methodology: A Retrospective Case-Control Study was conducted from July 2018 to April 2019 using questionnaires and anthropometric measurements. The target population of this study was Palestinian pregnant women with gestational age between 24 – 28 weeks, being treated at Holy Family Hospital (HFH) diabetic and antenatal clinics. The total number of pregnant women who participated in the study was 180, 60 cases and 120 controls with case: control ratio 1:2 matched by age and gestational age. Data were collected by face-to-face interview using a questionnaire. The questionnaire gathers data about dietary patterns, physical activity, demographic factors, anthropometric measurements, socioeconomic factors, maternal obstetric variables, and medical history. Height and current weight were measured during the data collection period by the interviewer. Glucose tests needed in the study were extracted from the files.

Results: The researcher documented 60 cases of GDM during 5 months of the data collection period. After matching by age and gestational age, cases were found to have significantly higher pre-pregnancy BMI, where 41.7% and 4.2% of cases and controls, respectively, had pre-pregnancy BMI $\geq 30\text{kg/m}^2$.

Regarding the dietary pattern, cases were found to eat significantly higher number of servings per day of animal protein, oils and fats, sweets and sugars, and milk and dairy products. On the other hand, controls were found to eat significantly higher number of servings per day of fruits, vegetables, and grains and starchy vegetables.

When assessing the total physical activity, controls were found to practice significantly higher level of physical activity than cases.

Conclusion: These findings suggest that several modifiable risk factors in particular maternal obesity before pregnancy, dietary patterns, and physical activity may be related to GDM risk.

محددات سكري الحمل في المنطقة الجنوبية من الضفة الغربية : دراسة الحالات المرضية والمجموعات الضابطة.

المشرفة الدكتورة : اميرة عمرو.

اعداد : غدير حنا نصر عيسى سعد.

ملخص

الخلفية: يزداد انتشار مرض سكري الحمل في جميع أنحاء العالم. في فلسطين، بلغ معدل انتشار سكري الحمل في عام 2010 بين النساء الحوامل الى 4.8% في الضفة الغربية، 2.2% في قطاع غزة. تهدف هذه الدراسة الى تحديد مدى تأثير قلة النشاط البدني والعادات الغذائية السيئة في زيادة خطر الإصابة في سكري الحمل لدى النساء الفلسطينيات الحوامل. لا يوجد دراسات مماثلة متوفرة في فلسطين مما يجعلها دراسة غنية للبحث.

المنهجية: أجريت دراسة الحالات والشواهد بأثر رجعي في الفترة من يوليو 2018 إلى نيسان 2019 باستخدام الاستبيانات والقياسات البشرية. الفئة المستهدفة في هذه الدراسة هي النساء الفلسطينيات الحوامل التي تتراوح اعمار الحمل بين 24 و 28 أسبوعًا، ويتم علاجهن في عيادات مرضى السكري. كان العدد الإجمالي للنساء الحوامل التي شاركن في الدراسة 180, 60 حالة سكري حمل و 120 من النساء الأصحاء بنسبة 1: 2. تم جمع البيانات عن طريق المقابلة وجها لوجه باستخدام الاستبيان. يشمل الاستبيان بيانات عن الأنماط الغذائية، والنشاط البدني، والعوامل الديموغرافية، والمقاييس البشرية، والعوامل الاجتماعية والاقتصادية، والمتغيرات التوليدية للأمهات والتاريخ الطبي. تم قياس الطول والوزن الحالي خلال فترة جمع البيانات من قبل الباحثة. تم استخراج اختبارات السكري اللازمة في الدراسة من الملفات.

النتائج: جمعت الباحثة 60 حالة من سكري الحمل خلال 5 أشهر من فترة جمع البيانات. بعد عمل تطابق بين العمر و عمر الحمل بالأسابيع، تبين أن السيدات المصابات بسكري الحمل كان لديهن مؤشر كتلة الجسم قبل الحمل أعلى من السيدات السليمات، حيث كانت نسبة السيدات اللواتي لديهن مؤشر كتلة الجسم ≤ 30 كغم/م2, 41.7% و 4.2% للسيدات المصابات والسليمات على الترتيب.

فيما يتعلق بالنمط الغذائي، وجد أن السيدات المصابات يتناولن عدد أكبر من الحصص اليومية من كل من البروتين الحيواني، الزيوت والدهون، والسكريات والحلويات.

بينما وجد أن السيدات السليمات يتناولن عدد أكبر من الحصص اليومية من كل من الفواكه، الخضروات، والحبوب والخضار النشوية.

عندما تم تقييم مجمل النشاط البدني، تبين أن السيدات السليمات يمارسن النشاط البدني بمستوى أعلى من السيدات المصابات كان الفرق بينهم ذات دلالة إحصائية.

الملخص: تشير هذه النتائج إلى أن العديد من عوامل الخطر القابلة للتعديل وأهمها السمنة قبل الحمل، وأنماط النظام الغذائي، والنشاط البدني قد تكون ذات صلة بخطر الإصابة بسكري الحمل.

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List of Abbreviations

ACOG	American College of Obstetricians and Gynecologists
ADA	American diabetes association
ADIPS	Australian diabetes in pregnancy society
BMI	Body mass index
CC	Carpenter/Coustan
CDA	Canadian diabetes association
CI	Confidence interval
DM	Diabetes Mellitus
FFQ	Food frequency questionnaire
GDM	Gestational diabetes mellitus
GWG	Gestational weight gain
HAPO	Hyperglycemia and adverse pregnancy outcome
HFH	Holy family hospital
HRP	High-risk pregnancy
IADPSG	International association of diabetes and pregnancy study groups
IOM	Institute of medicine
IPPAQ	International pregnancy physical activity questionnaire
LCD	Low carbohydrate diet
MCH	Mother and Child health
MET	Metabolic equivalent rate
MOH	Ministry of health
NDDG	National diabetes data group
OR	Odds ratio
PRAMS	Pregnancy risk assessment monitoring system
RR	Relative Risk
T2DM	Type 2 diabetes mellitus
UK	United Kingdom
UNRWA	United Nations Relief and Works Agency for Palestine Refugees in the Near East
US	United States
WHO	World health organization

Chapter One

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Introduction and Background

1.1 Introduction

Gestational Diabetes Mellitus (GDM) is a common but controversial disorder (Turok et al., 2003). It is defined as any degree of glucose intolerance that is first detected during pregnancy, it is a complication associated with adverse health effects on the mother as well as fetal and neonatal development and it goes away after delivery (Pang et al., 2017)

The cause of GDM is not completely understood. It is a form of hyperglycemia which is characterized by insulin resistance and decreased insulin secretion. GDM usually occurs midway through pregnancy, during the second trimester and usually goes away after pregnancy. Because of the effects of the pregnancy hormones, there is a decrease in the ability of cells to produce insulin; this is known as increased insulin resistance. Women who have GDM are unable to produce extra insulin to overcome this resistance and, as a result, the level of glucose in the blood becomes higher than usual (Australian Institute of Health and Welfare (AIHW), 2008).

Often, intense antenatal education is given to women upon a diagnosis of GDM and throughout pregnancy. Attention to diet is the main therapeutic strategy for controlling blood glucose levels, and physical activity is encouraged if there are no underlying contra-indicating medical or obstetric conditions (The Australian Diabetes in Pregnancy Society (ADIPS), 2002).

The reported prevalence of GDM is increasing throughout the world (Bener et al., 2012). In the United States (US), the prevalence of GDM in the pregnancy risk assessment monitoring system (PRAMS) is as high as 9.2% (DeSisto et al., 2014). In Palestine the annual report of the department of health in the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) health care facilities showed that, agency-wide the prevalence of diabetes mellitus (DM) during pregnancy in 2010 was stable compared with 2009 (3.2% and 3.1% respectively) but has increased compared with previous years (1.9% in 2006). While on the country level, the prevalence of GDM in 2010 among pregnant women was 4.8% in West Bank, 4.6% in Lebanon, 4.0% in Jordon, 2.7% in Syria and 2.2% in Gaza Strip (UNRWA, 2010).

GDM has a massive impact on the health of the mother and adverse consequences on child health. Regarding the mother, GDM act as a facilitator to the development of type 2 diabetes mellitus (T2DM) (Javid et al., 2016) and more likely to experience preterm birth, require a Cesarean delivery, and to have preeclampsia which is a dangerous spike in blood pressure (Preidt, 2017). On the other hand consequences for the child can range from high birth weight over the 90th percentile, macrosomia, neonatal hypoglycemia, premature delivery, shoulder dystocia, birth injury, hyperbilirubinemia, polycythemia, and respiratory distress syndrome (Zolezzi et al., 2017).

There are several risk factors associated with developing GDM. These risk factors are divided into two main categories: non-modifiable risk factors, and modifiable risk factors. Non-modifiable risk factors for GDM include advanced maternal age (older than 35), a family history of type 2 diabetes, a personal history of GDM and a previous infant with macrosomia. Modifiable risk factors include marked obesity before pregnancy, excessive gestational weight gain (GWG), dietary pattern, and level of physical activity. Obesity is the most commonly investigated modifiable risk factor with the most predictable findings. Unhealthy dietary patterns and physical inactivity become an inevitable lifestyle nowadays (World Health Organization (WHO), 2013).

Modifiable risk factors for GDM have been identified. Obesity before pregnancy is the major modifiable risk factor, thus dietary patterns and physical activity represents key strategies for the prevention of obesity and the reduction of risk for GDM among pregnant women. A case-control study examined the association between pre-pregnancy body mass index (BMI) and risk of GDM found that for each 1 kg/m^2 increase in BMI the odds ratio (OR) of developing GDM was 1.08 and for 5 kg/m^2 was 1.48, so pre-pregnancy BMI plays an important role in the risk of GDM (Singh, 2012).

During pregnancy, household chores, childcare, and occupational activities constitute a significant proportion of physical activity. Exercise in early pregnancy was associated with a lower risk of GDM and was also significantly protective (Deidre et al., 2011). There are several studies about the role of physical activity and the occurrence of GDM. Dempsey and colleagues (2004), Taber and partners (2008) and Sauder and fellow workers (2016) showed that physical activity was significantly associated with reduced risk of GDM.

The observational literature supports the link between dietary patterns and GDM. Results from different studies showed that high consumption of refined grains, fat, added sugars, low intake of fruits and vegetables (Shin et al., 2015), high total dietary protein intake (Pang et al., 2017), high saturated fat (Bo et al., 2001), high processed red meat and high glycemic index foods (Zhang et al., 2006) were associated with higher risk for GDM.

Several studies reported how lifestyle factors before and during pregnancy are related to GDM. The Nurse's Health Study in the US showed that 47.5% of GDM risk could be prevented if women stick to a low-risk lifestyle before pregnancy with regard to weight, diet and physical activity (Zhang et al., 2014).

In Palestine, associations of dietary patterns and physical activity with GDM risk have not been investigated. The aim of this study is to compare adherence to healthy eating patterns and physical activity among pregnant women with and without gestational diabetes mellitus.

1.2 Problem Statement

This study aims to identify the extent to which physical inactivity and bad eating patterns may contribute to the risk for GDM in Palestinian pregnant women. These data are not available in Palestine, which makes it a rich area for research. Results of this research will be the baseline for any future plans in the area of reducing the risk of GDM.

1.3 Study Justification

In this study, the concern will be on the modifiable risk factors of GDM that include marked obesity before pregnancy, excessive GWG, dietary pattern, and level of physical activity. A healthful eating pattern is needed to improve overall health, specifically achievement and maintenance of weight goals and prevention or delay of type 2 diabetes.

However, if a specific pattern of caloric or nutrient intake and physical activity influence the development of GDM during pregnancy, dietary and physical activity guidelines would provide a low cost and effective way to reduce risk.

1.4 Research Question

Is there a significant difference in dietary patterns and physical activity level between pregnant women with and without GDM in southern area of the West Bank?

1.5 Aim of the Study

The overall aim of this study is to assess dietary patterns and physical activity level of pregnant women with and without GDM in southern area of the West Bank.

1.6 General Objective

The objective of this study is to compare dietary patterns and physical activity among pregnant women with and without GDM in southern area of the West Bank.

1.7 Specific Objectives

1. To study the effect of dietary patterns on the risk of GDM.

2. To study the effect of physical activity level on the risk of GDM.

3. To find the demographic factors associated with the risk of GDM.

4. To find the anthropometric measurements associated with the risk of GDM.

5. To find the socio-economic factors associated with the risk of GDM.

6. To examine the association between maternal obstetric variables and the risk of GDM.

7. To examine the relationship between pregnant women medical history and risk of GDM.

1.8 Expected Outcomes

This study has the following expected outcomes:

1. To inform health professionals and others who work with women of childbearing age, on the need for a healthful diet and lifestyle to reduce the risk of GDM.

2. To emphasize the key components of a health-promoting lifestyle during pregnancy: appropriate weight gain, physical activity, and consumption of a variety of foods to reduce the risk of GDM.

3. To provide nutritionist in Mother and Child Health (MCH) clinics with reliable information on various nutrition issues related to maternal care during pregnancy to reduce the risk of GDM.

Chapter Two

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Literature Review

2.1 Definition of GDM

The broadly acknowledged definition that is given by the American Diabetes Association (ADA) for GDM is "any degree of glucose intolerance with onset or first recognition during pregnancy that subsequently resolves postpartum" (Canivell et al., 2014). Also, The International Association of Diabetes and Pregnancy Study Groups (IADPSG) in 2010 defined GDM as follows: "any degree of glucose intolerance with onset or first recognition during pregnancy that is not clearly overt diabetes" (IADPSG, 2010).

2.2 Prevalence of GDM

Because of varying diagnostic criteria and screening practices, a comparison of prevalence across countries is difficult. In a study by Schneider and his colleagues (2012), in advanced economies diagnosed by varying criteria, the prevalence of GDM was between 1.7% and 11.6% (Schneider et al., 2012).

Defined by uniform IADPSG criteria, in the Hyperglycemia and Adverse Pregnancy Outcome (HAPO) study in 2012, including 15 centers on five continents, the overall frequency of GDM was 17.8%. The highest prevalence of GDM was in California (25.5%), Singapore (25.1%), and

Manchester, UK (24.3%). The lowest prevalence was in Australia (15.5% in Newcastle and 12.4% in Brisbane) and Israel (9.3%) (Sacks et al., 2012).

The reported prevalence of GDM is increasing throughout the world (Bener et al., 2012). In the United States, up to 14% of pregnancies are complicated by GDM, representing 200,000 cases every year (ADA, 2010), while in Canada according to the Canadian Diabetes Association (CDA) the prevalence of GDM varies between 8% - 18 % (CDA, 2009).

In India, there is an exceptionally high estimated prevalence of GDM (27.5%) when compared to 9.9% in Sri Lanka, 9.8% in Bangladesh (Guariguata et al., 2014) and 6.8% – 10.4% in China (Hirst et al., 2012).

In Palestine, the annual report of the department of health at the United Nations Relief and works Agency for Palestine Refugees in the Near East (UNRWA) health care facilities showed that, agency-wide, the prevalence of diabetes mellitus (DM) during pregnancy in 2010 was stable compared to that in 2009 (3.2% and 3.1%, respectively) but has increased compared with previous years (1.9% in 2006). While on the country level, the prevalence of GDM in 2010 among pregnant women was 4.8% in West Bank, 4.6% in Lebanon, 4.0% in Jordon, 2.7% in Syria and 2.2% in Gaza Strip (UNRWA, 2010).

2.3 Screening and Diagnostic criteria of GDM

2.3.1 The American College of Obstetricians and Gynecologists (ACOG) risk factors

Screening for GDM usually occurs at 24-28 weeks of gestation, but early screening is recommended in women with risk factors.

Several risk factors are connected to GDM. It additionally can happen in women who have no risk factors, yet it is more probable in women who:

- are overweight or obese

- are physically inactive

- had GDM in a previous pregnancy

- had a very large baby (4 kilograms or more) in a previous pregnancy

- have high blood pressure

- have polycystic ovary syndrome (PCOS)

- are of African American, Asian American, Hispanic, Native American, or Pacific Island race (ACOG, 2017).

2.3.2 The ACOG glucose challenge test (GCT)

GCT is done at 24-28 weeks of gestation, and it is step one in the diagnostic process of GDM. It is a non-fasting 50g oral glucose test with plasma glucose measurement after 1 hour. If the plasma glucose level is $\geq$ 140 mg/dL (7.8 mmol/L), then proceed to step two that is the 100g Oral Glucose Tolerance Test (OGTT) (Kehler et al., 2006).

2.3.3 The ACOG oral glucose tolerance test (OGTT): Diagnostic test of GDM

The 100gm OGTT should be performed when the patient does overnight fasting (8-10 h). The diagnosis of GDM is made when at least two of the following plasma glucose levels are met or exceeded (table 2.1).

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Table 2.1: Diagnostic thresholds for gestational diabetes mellitus (GDM).

	CC Thresholds (1982)*	NDDG Thresholds (1979)*
Fasting	95 mg/dL (5.3 mmol/L)	105 mg/dL (5.8 mmol/L)
1 h	180 mg/dL (10.0 mmol/L)	190 mg/dL (10.6 mmol/L)
2 h	155 mg/dL (8.6 mmol/L)	165 mg/dL (9.2 mmol/L)
3 h	140 mg/dL (7.8 mmol/L)	145 mg/dL (145 mmol/L)

Diagnosis: ≥ 2 exceeding values

* Two-step (100 gm load): Two-step approach is initiated with screening by 50 g oral glucose test; exceeding the threshold of 7.5 mmol/L leads to step two, the 100 gm OGTT.

CC, Carpenter/Coustan.

NDDG, National Diabetes Data Group (Kehler et al., 2006).

2.4 Pathophysiology of GDM

The critical components of the pathophysiology of GDM are β-cell dysfunction and chronic insulin resistance. The primary function of β-cell is to store and secrete insulin in response to a glucose load. At the point when β-cell lose the capacity to enough detect blood glucose concentration or to release sufficient insulin accordingly, this is classified as β-cell dysfunction. Insulin resistance occurs when cells no longer adequately respond to insulin (Plows et al., 1985).

Pregnancy is a diabetogenic state described by hyperinsulinemia and insulin resistance. This progressive change in maternal metabolism is due to the body's effort to provide adequate nutrition for the growing fetus. At the beginning of pregnancy, maternal hormones promote the release of insulin coupled with increased peripheral utilization with the end result of lower maternal blood glucose. As pregnancy advances, the dimensions of a large group of hormones

such as cortisol, estrogen, and human placental lactogen in addition to stress and obesity this lead to insulin resistance. The peak effect of these hormones is seen in the 26th to the 33rd weeks of gestation. This peak hormonal effect forms the reason for screening in the 24th to 28th weeks of gestation (Mumtaz, 2000).

2.5 Consequences of GDM

The majority of women with GDM who control their blood sugar levels give birth to healthy babies, whereas in some cases GDM can negatively affect the pregnancy, the child or the long-term maternal and child health (Reece, 2010).

2.5.1 The effects of GDM on the fetus and infant

Hyperglycemia affects the baby since they get nutrients from the mother's blood. The fetus stores the extra sugar as fat, which can make them grow larger than normal (Reece, 2010).

For the fetus or neonate there is an increased risk of perinatal mortality, and morbidity, macrosomia, an increased likelihood of birth defects and congenital abnormalities, birth trauma, hyperbilirubinemia and neonatal hypoglycemia (Turok et al., 2003). Offspring of mothers who had GDM are at increased risk of obesity, glucose intolerance and diabetes in late adolescence and adulthood (Australian Diabetes Society (ADS), 2003).

2.5.2 Maternal effects of GDM

Regarding the mother, GDM act as a facilitator to the development of T2DM (Javid et al., 2016) and more likely to experience preterm birth, require a cesarean delivery, nephropathy, preeclampsia

which is a dangerous spike in blood pressure and postoperative wound complications (Preidt, 2017).

2.6 Socioeconomic status

Socioeconomic factors such as education, income, and occupation can be connected to an individual's health status. Health and lifestyle habits such as diet and physical activity are connected to living conditions and environment, and these background factors can influence decisions and habits that can promote health or increase risk of disease (Folkehelse, 2014).

A large sample size study (nearly 1 million births over 11 years between 1995 and 2005 in Australia. The Association was confirmed between socioeconomic factors and the occurrence of GDM. Women living in the three lowest socioeconomic quartiles had higher adjusted ORs for GDM relative to women in the highest quartile (Anna et al., 2008).

2.7 Risk Factors of GDM

2.7.1 Non-Modifiable Risk factors of GDM

Non-modifiable risk factors for GDM include advanced maternal age (older than 35), a family history of type 2 diabetes, a personal history of GDM and a previous infant with macrosomia.

2.7.1.1 Maternal age

According to the ADA (2010), women age ≥25 years is the cutoff point for screening and prediction of GDM.

In China, Lao and his partners followed up 16,383 women in a cohort study. The study findings showed that there was a significantly increased risk for GDM as the women get older as follows: women age 25–29 years, OR= 2.59 (95% CI: 1.84 –3.67); women age 30–34 years, OR= 4.38 (95% CI: 3.13– 6.13); women age 35–39 years, OR= 10.85 (95% CI: 7.72–15.25); and women

age $\geq$ 40 years, OR= 15.90 (95% CI: 10.62–23.80). Also, they found that there was no significant association between women younger than 20 years and GDM. The study finding indicates that the risk of GDM becomes significantly and progressively increased from 25 years onwards. This supports the ADA recommendation on the use of age $\geq$25 years as the cutoff point for screening (Lao et al., 2006).

A case-control study was done in south India by Das and her partners in order to correlate maternal age to the risk of development of GDM. The study showed a significant difference in maternal age between cases (27.8 years) and controls (23.7 years). The positive correlation in the prevalence of GDM with increasing maternal age was statistically significant (p-value <0.001) (Das et al., 2017).

2.7.1.2 Family History of T2DM

First degree relative with T2DM will increase the risk of gestational diabetes. Level of risk depends on the age of the mother. If the mother is < 25 years old with family history the risk is like general pregnant population, while if the mother is $\geq$ 25 years old with family history the risk is 3 times higher than the general population (ADA, 2002).

A retrospective cohort study was done in Nairobi County by Adoyo and his colleagues (2016). The study findings showed that mothers with diabetic history in the family had twice the risk of developing GDM (OR=2.27; 95% C.I: 1.23-4.17) compared to those who did not observe diabetic history in the family (Adoyo et al., 2016).

In San Diego, California (USA) in the year of 2009, a study was done to examine the association between family history of diabetes and GDM. A self-administrated questionnaire was filled by 812 mothers. The results showed that there was a significant association between family history of diabetes and GDM (Villa-Caballero et al., 2009).

In the Nurses' Health Study II (n = 14,613), family history of diabetes was independently associated with the diagnosis of GDM, after adjustment for other maternal risk factors (RR= 1.68; 95% CI: 1.39–2.04) (Solomon, 1997).

Furthermore, in a case-control study involving 506 women (133 with GDM), Williams and his colleagues found that familial history of diabetes in a first-degree relative conferred a significantly increased risk of GDM, regardless of whether the diabetic history involved the patient's mother, father or siblings (Williams et al., 2003).

2.7.1.3 GDM Personal History

Previous pregnancy with GDM is a risk factor for future GDM (Ferrara, 2007; Nohira et al., 2005; Yogev & Langer, 2004). A retrospective observational study was done in Australia in 2007 to review the risk profiles of women with GDM. The findings showed that the strongest independent risk factor for GDM was a past history of GDM (OR = 10.7; 95% CI: 5.4–21.1). (Teh et al., 2011)

2.7.1.4 Infants macrosomia

Fetal macrosomia is used to describe a newborn who's significantly larger than average. A baby diagnosed with fetal macrosomia has a birth weight of more than 9 pounds or 4,000 grams (Mayo, 2018).

In mothers with GDM, higher levels of blood glucose pass through the placenta into the fetal circulation. From the second trimester onwards, the fetal pancreas responds to the hyperglycemia by secreting insulin, resulting in hyperinsulinemia. This combination of hyperinsulinemia and hyperglycemia leads to an increase in fat and protein stores of the fetus, resulting in macrosomia (Kamana et al., 2015).

Fetal macrosomia is a common adverse infant outcome of GDM if undiagnosed and untreated during pregnancy. For the infant, macrosomia increases the risk of shoulder dystocia, clavicle fractures and increases the rate of admissions to the neonatal intensive care unit (Juzoor, 2006).

For the mother, macrosomia increases the risk of cesarean delivery, postpartum hemorrhage, and vaginal lacerations. Infants of women with GDM later in life are at an increased risk of becoming overweight or obese at a young age and are more likely to develop T2DM.

In recent studies, the prevalence of macrosomia ranges from 6.3% to 10.9% in mothers without gestational diabetes and is approximately 14% in mothers diagnosed with gestational diabetes (Campbell, 2014; Elnour et al., 2008).

2.7.2 Modifiable Risk Factors

Modifiable risk factors include marked obesity before pregnancy, excessive gestational weight gain (GWG), dietary pattern, and level of physical activity.

2.7.2.1 Marked Obesity before Pregnancy

A case-control study was done in the US districts by Singh and his colleagues (2012) in order to evaluate the effect of pre-pregnancy BMI on the risk of developing GDM. The study findings showed that for each 1 kg/m^2 increase in BMI the OR of developing GDM was 1.08 (95% CI 1.08–1.09) and for each 5 kg/m^2 increase, the OR was 1.48 (95% CI 1.45–1.51) (Singh et al., 2012).

In Poland, another case-control study by Ogonowski and his partners (2009) examined the association between GDM and pre-pregnancy BMI. The study investigated 1121 women with GDM who were referred to the outpatient clinic for diabetic pregnant women between the years

2001 and 2005. Controls were 1011 healthy pregnant women. The cut point for pre-pregnancy BMI as a risk indicator for GDM was 22.9 kg/m^2. For all, except underweight women group, a significant relationship between pre-pregnancy BMI and GDM was found (Ogonowski et al., 2009).

A retrospective cohort study was done in the USA between 2004 – 2011 using the Pregnancy Risk Assessment Monitoring System (PRAMS) records to examine if pre-pregnancy BMI is a risk factor for GDM. The study findings showed that obese women with pre-pregnancy BMI (≥30 kg/m^2) had an increased odds ratio for GDM (OR= 2.78; 95% CI: 2.60-2.96) (Shin & Song, 2015).

Another retrospective cohort study was done in Nairobi County by Adoyo and his colleagues (2016). The study findings showed that weight before pregnancy was high with a mean of 74.04 (95% C.I: 70.82 - 77.30) among mothers with GDM compared to a mean of 60.27 (95% C.I: 58.59 - 61.96) among Non-GDM mothers.

2.7.2.2 Excessive Gestational Weight Gain (EGWG)

Fetal growth and healthy pregnancy development require sufficient maternal weight gain in pregnancy. In the context of this study and many others, excessive GWG is defined as weight gain that exceeds the 2009 Institute of Medicine (IOM) weight gain recommendations. The IOM recommends that underweight women (BMI of less than 18.5 kg/m^2) gain 28-40 pounds, normal weight women (BMI 18.5-24.9 kg/m^2) gain 25-35 pounds, overweight women (BMI 24.9-29.9 kg/m^2) gain 15- 25 pounds and obese women (BMI greater than 30.0 kg/m^2) gain 11-20 pounds (Table 2.2) (ACOG, 2014).

In the United States, excessive GWG has been persistent for many years. Data from the National Maternal and Infant Health Study, which includes a representative sample of women in the US found that in 1988, 36% of women gained above IOM recommendations. Ten years later in

1998, the prevalence had increased to 66% of women gaining weight above recommendations (Keppel et al., 1993).

A secondary analysis of a randomized controlled trial in the USA by Carreno and others (2013) in order to estimate whether there is an association between excessive GWG and the development of GDM. The study findings showed that the odds ratio of developing GDM were 43% higher in the excessive early GWG group [Adjusted OR 1.4 (95% CI: 1.1–1.9)], 73% had a total weight gain greater than the 2009 IOM recommendations (Carreno et al., 2013)

Table 2.2: Institute of Medicine (IOM) weight gain recommendations for pregnancy.

Pregnancy weight gain category	BMI	Recommended range of total weight gain
Underweight	$<18.5 \, kg/m^2$	12.5 – 18.0 kg
Normal Weight	$18.5 – 24.9 \, kg/m^2$	11.5 – 16.0 kg
Overweight	$25.0 – 29.9 \, kg/m^2$	7.0 – 11.5 kg
Obese	$\geq30 \, kg/m^2$	5 – 9 kg

Modified from the Institute of Medicine (US). (ACOG, 2014).

2.6.2.3 Dietary Patterns

Diet and food intake have a large impact on health. When becoming pregnant, a mother's diet and nutritional status affect not only her own health but also that of her offspring. It is recommended to eat a varied diet with at least five portions of vegetables or fruit daily (at least half of these vegetables), fish 2-3 times per week and whole grain products such as whole grain bread, rice, and pasta daily. Further, it is recommended to choose lean meat products and limit the amount of processed meat and red meat. It is advised to eat low-fat milk products, and use vegetable oils and soft margarine in place of butter. Finally, it is recommended to choose food

products low in salt, limit foods high in sugar and choose water when thirsty (Helsedirektoratet, 2014).

Adequate nutrient intake is important for successful pregnancy and positive outcome. Pregnant woman should be encouraged to plan their diet intake according to the dietary guide which presented in the table below (Cabalerro B. et al., 2016).

Table 2.3: Recommended intake of different food groups (number of servings/ day) during pregnancy.

	Food Group	Number of recommended servings/ day
1.	Refined and whole grains	9 serving
2.	Animal Protein	2 serving
3.	Plant protein (Legumes)	2 serving
4.	Dairy products	2-3 serving
5.	Fruits	3 serving
6.	Vegetables	4 serving
7.	Oils and fats	Eat less
8.	Sweets	Eat less

(Cabalerro et al., 2016)

Bao and his colleagues (2014) studied the association of three low carbohydrate diet (LCD) scores (LCD-animal (when carbohydrate sources were exchanged for animal-based protein or fat sources (chicken, beef, lamb, pork), and LCD-vegetable (when carbohydrate sources become plant-based (nuts, whole-grain bread, and vegetables)) with the risk of GDM. They found that pre-pregnancy LCD-animal was positively associated with GDM risk, whereas a pre-pregnancy LCD-vegetable was not associated with the risk. The association of LCD-animal score with GDM risk was no longer significant after adjusting for red meat, animal fat, or heme iron. This suggests that red meat, animal fat, and heme iron may be the main contributors to the observed association between LCD-animal score and GDM risk. Adjusting for vegetable protein and fat

sources did not alter the association between LCD-vegetable and GDM risk. In all of the available studies on the association between dietary indices and GDM, the associations between dietary patterns were not significantly modified by other risk factors of GDM such as age, parity, family history of diabetes, or physical activity (Bao et al., 2014)

The observational literature supports the link between dietary patterns and GDM. Results from different studies showed that high consumption of refined grains, fat, added sugars, low intake of fruits and vegetables (Shin et al., 2015), high total dietary protein intake (Pang et al., 2017), high saturated fat (Bo et al., 2001), high processed red meat and high glycemic index foods (Zhang et al., 2006) were associated with higher risk for GDM.

Four prospective (Zhang et al. 2006a, Radesky et al. 2008, Schoenaker et al. 2015, Tryggvadottir et al. 2016) and two cross-sectional (He et al. 2015, de Seymour et al. 2016) studies analyzed dietary patterns by factor or principal component analysis, or reduced rank regression in relation to GDM. In the 9-year follow-up of the diets of Australian women, Schoenaker et al. (2015) identified four dietary patterns: 'Meats, snacks, and sweets'1, 'Mediterranean style'2, 'Fruit and low-fat dairy'3, and 'Cooked vegetables'4. The pre-pregnancy Meats, snacks, and sweets pattern were associated with a higher risk of GDM, whereas the Mediterranean dietary pattern showed a lower risk of GDM.

Zhang and his colleagues (2006) described two main pre-pregnancy dietary patterns in the NHS II cohort: "prudent"5 and "Western"6 dietary patterns. The prudent dietary pattern was negatively and the Western dietary pattern positively associated with GDM. The association between Western dietary pattern and GDM was driven by red and processed meat.

Tryggvadottir and his partners (2016) extracted one dietary pattern from a population of early-stage pregnant women, the "prudent dietary pattern"7. They found this dietary pattern to be associated with a lower risk of GDM.

Radesky and his followers (2008) noted two main patterns in the Project Viva cohort with women in early pregnancy: the "prudent pattern"8, and the "Western pattern"9. In contrast to

other dietary pattern and GDM association studies, Radesky et al. (2008) found no association between dietary patterns and GDM risk.

In a cross-sectional setting in Asian populations, De Seymour et al. (2016) identified three dietary patterns: "vegetable-fruit-rice-based"10, "seafood noodle- based"11, and "pasta-cheese-processed-meat"12 patterns. High adherence to the "seafood-noodle-based" dietary pattern was associated with a lower risk of GDM. The other two dietary patterns were not associated with GDM in the adjusted analysis. The seafood-noodle-based dietary pattern seemed to include little rice, with rice replaced by noodles. The authors discussed that the noodle-rich dietary pattern may possess a lower glycemic index than the low-noodle/high-rice dietary pattern, which could attribute to the lower risk of GDM with adherence to that pattern.

Another cross-sectional study analyzed dietary patterns, by reduced rank regression, in relation to GDM (He et al. 2015). The authors identified four dietary patterns: "vegetable"13, "protein-rich"14, "prudent"15, and "sweets and seafood"16. The vegetable pattern showed an association with a decreased risk of GDM, whereas the sweets and seafood pattern was associated with an increased risk of GDM. No association emerged for the protein-rich or prudent patterns.

Table 2.4 a: Dietary patterns clarification.

Dietary pattern	Clarification
1.Meats, Snacks, and sweets	High consumption of red and processed meat, cakes, sweet biscuits, fruit juice, chocolate, and pizza.
2.Mediterranean style	High consumption of vegetables, legumes, nuts, tofu, rice, pasta, rye bread, red wine, and fish.
3.Fruit and low-fat dairy	High consumption of fruits and low-fat dairy including yogurt, low-fat cheese, and skimmed milk.
4.Cooked	High consumption of carrots, peas, cooked potatoes, cauliflower, and

vegetables	pumpkin.

Table 2.4 b: Dietary patterns clarification.

5.Prudent dietary pattern (Zhang et al., 2006)	High consumption of fruits, green leafy vegetables, poultry, and fish.
6.Western dietary pattern (Zhang et al., 2006)	High consumption of red meat, processed meat, refined grain products, sweets and desserts, French fries, and pizza.
7.Prudent dietary pattern (Tryggvadottir et al., 2016)	High consumption of eggs, vegetables, fruits and berries, vegetable oils, nuts and seeds, pasta, breakfast cereals, and coffee, tea, and cocoa powder, and low consumption of soft drinks and French fries
8.Prudent dietary pattern (Radesky et al., 2008)	High consumption of vegetables, fruits, legumes, fish, poultry, eggs, salad dressing, and whole grains.
9.Western dietary pattern (Radesky et al., 2008)	High consumption of red and processed meats, sugar-sweetened beverages, French fries, high-fat dairy products, desserts, butter, and refined grains.
10. Vegetable fruit rice based	High in vegetables, fruit, white rice, bread, low-fat meat and fish, and low in fried potatoes, burgers, carbonated and sugar-sweetened beverages.
11. Seafood noodle based	High in soup, fish and seafood products, noodles (flavored and/or in soup), low-fat meat, and seafood, and low in ethnic bread, legumes and pulses, white rice, and curry-based gravies.

Table 2.4 c: Dietary patterns clarification.

12. Pasta cheese processed meat	High in pasta, cheese, processed meats, tomato-based, and cream-based gravies.
13.Vegetable	High consumption of root vegetables, beans, mushrooms, melon vegetables, seaweed, other legumes, fruits, leafy and cruciferous vegetables, processed vegetables, nuts, and cooking oil.
14.Protein rich	High consumption of poultry, red meat, animal organ meat, grains (mainly refined), processed meat, fish, soups, leafy and cruciferous vegetables, and eggs.
15.Prudent dietary pattern (He et al., 2015)	High consumption of dairy products, nuts, eggs, fish, soups, fruits, and low consumption of processed meat, sugar-sweetened beverages, and processed vegetables.
16.Sweets and seafood	High consumption of Cantonese desserts, molluscs, and shellfish, and sugar-sweetened beverages and low consumption of grains (mainly refined) and leafy and cruciferous vegetables.

2.6.2.4 Physical Activity

Physical activity is one of the modifiable risk factors for lowering the risk of GDM (Dunstan et al., 2003).

Specific to pregnancy, the common pattern is that women do less exercise as their pregnancies progress (Bung et al., 1991; Clarke et al., 2004) and many women (irrespective of a diagnosis of

GDM) stop exercising when they become pregnant (Clarke et al., 2004). Evidence is clear that the benefits of physical activity during pregnancy far outweigh the risks (Bauman, 2004; Brown, 2002; Dempsey et al., 2005; Oken et al., 2006).

Evidence is emerging which suggests that physical activity both before (Zhang et al., 2006) and during pregnancy (Avery & Walker, 2001; Brankston et al., 2004; Clarke et al., 2004; Garcia-Patterson et al., 2001) has a positive effect on GDM. Some studies have reported that women who consistently engage in physical activity during pregnancy reduce their risk for GDM compared to inactive women (Dempsey et al., 2005).

Randomized trials, although with very small numbers, have demonstrated that physical activity reduces glucose levels in women who have GDM (Garcia-Patterson et al., 2001; Jovanovic-Peterson et al., 1989). Other observational studies have also shown that physical activity before pregnancy reduces the risk of GDM (Dempsey et al., 2004; Rudra et al., 2006; Zhang et al., 2006).

In a case-control study with 155 GDM cases and 386 normotensive nondiabetic controls (Dempsey et al., 2004), participation in any recreational activity during the first 20 weeks of pregnancy was assessed. Compared to inactive women, those who were active during the first 20 weeks of pregnancy experienced a 48% reduction in GDM risk (OR=0.52, 95% CI=0.33-0.80). Also, any type of activity was significantly associated with a lowered risk of GDM. Activity undertaken the year before pregnancy was also associated with a significant risk reduction and women who were active both before and during pregnancy experienced the greatest reduction in GDM risk (OR=0.40, 95% CI=0.23- 0.68).

The same authors sought to confirm the findings that maternal recreational physical activity reduces GDM risk in a prospective study of 909 normotensive non-diabetic women (Dempsey et al., 2004). Pregnant women were questioned during early gestation about their levels of physical activity, one year before their pregnancy and seven days before the interview. The results showed that women who exercised before becoming pregnant (active women) compared with inactive women experienced a 56% reduction in GDM risk (RR=.44, 95% CI=0.21-0.91) (Dempsey et al., 2004). Women who exercised before and during their pregnancy experienced a

69% reduced risk (RR=0.31, 95% CI=0.12-0.79). The results supported the findings of their first study: physical activity undertaken both before and during pregnancy reduces women's risk of GDM.

Dye and his colleagues (1997) also examined physical activity during pregnancy using data from a population-based birth registry and women were categorized as 'exercisers' or 'non-exercisers'. After delivery, 12,796 women were interviewed about physical activity during their pregnancies and were then grouped according to exercise status; those who exercised one to two times per week versus no exercise. Although evidence was found that women who exercised for at least 30 minutes a week at some time during their pregnancy had a lower risk of GDM, this result was only indicated for morbidly obese women (when the sample was stratified by pre-pregnancy BMI). Women who did not exercise had a BMI > 33 kg/m^2 were at greater risk than exercisers for developing GDM (OR=1.9, 95% CI=1.2-3.1). As pointed out by Dye and his colleagues (1997), obesity is an increasing, not a decreasing health problem and if exercise does indeed play a role in reducing the risk that obese women who become pregnant will develop GDM, it is critical that this relationship and its correlates be explored further.

On the other hand, a sedentary lifestyle before and during pregnancy has been reported to be inversely related to the risk of developing GDM (Oken et al., 2006; Zhang et al., 2006). One study did not observe any overall benefit of exercise during pregnancy. In this study, however, physical activity was assessed after delivery and women with GDM may have started exercising after a diagnosis of GDM which may have led to some misclassification (Dye et al., 1997).

2.7 Study conceptual framework

The ADA (2014), and Perkins and collaborators (2007) showed similar models of risk factors for GDM. These risk factors are divided into two main categories: non-modifiable risk factors, and modifiable risk factors. Non-modifiable risk factors for gestational diabetes include advanced maternal age (older than 35), a family history of type 2 diabetes, and a personal history of GDM and previous infant with macrosomia. Modifiable risk factors include marked obesity before pregnancy, excessive gestational weight gain (EGWG), dietary pattern, and level of physical activity. Obesity is the most commonly investigated modifiable risk factor with the most predictable outcomes.

This study conceptual model was built upon the above theoretical models for GDM risk factors as follows:

1. Dietary patterns: was evaluated using a special Food Frequency Questionnaire (FFQ) that is specific for dietary patterns during pregnancy.

2. Physical activity level: according to pregnancy Physical Activity Questionnaire (IPPAQ).

3. Demographic factors include age at marriage, current mother's age and place of residence.

4. Anthropometric measurements: height, pre-pregnancy weight, pre-pregnancy BMI and gestational weight gain (GWG).

5. Socioeconomic factors include education, occupation, and income.

6. Maternal obstetric variables include parity, gestational age, and number of abortions.

7. Medical history includes chronic diseases, family history of T2DM and a previous pregnancy with GDM.
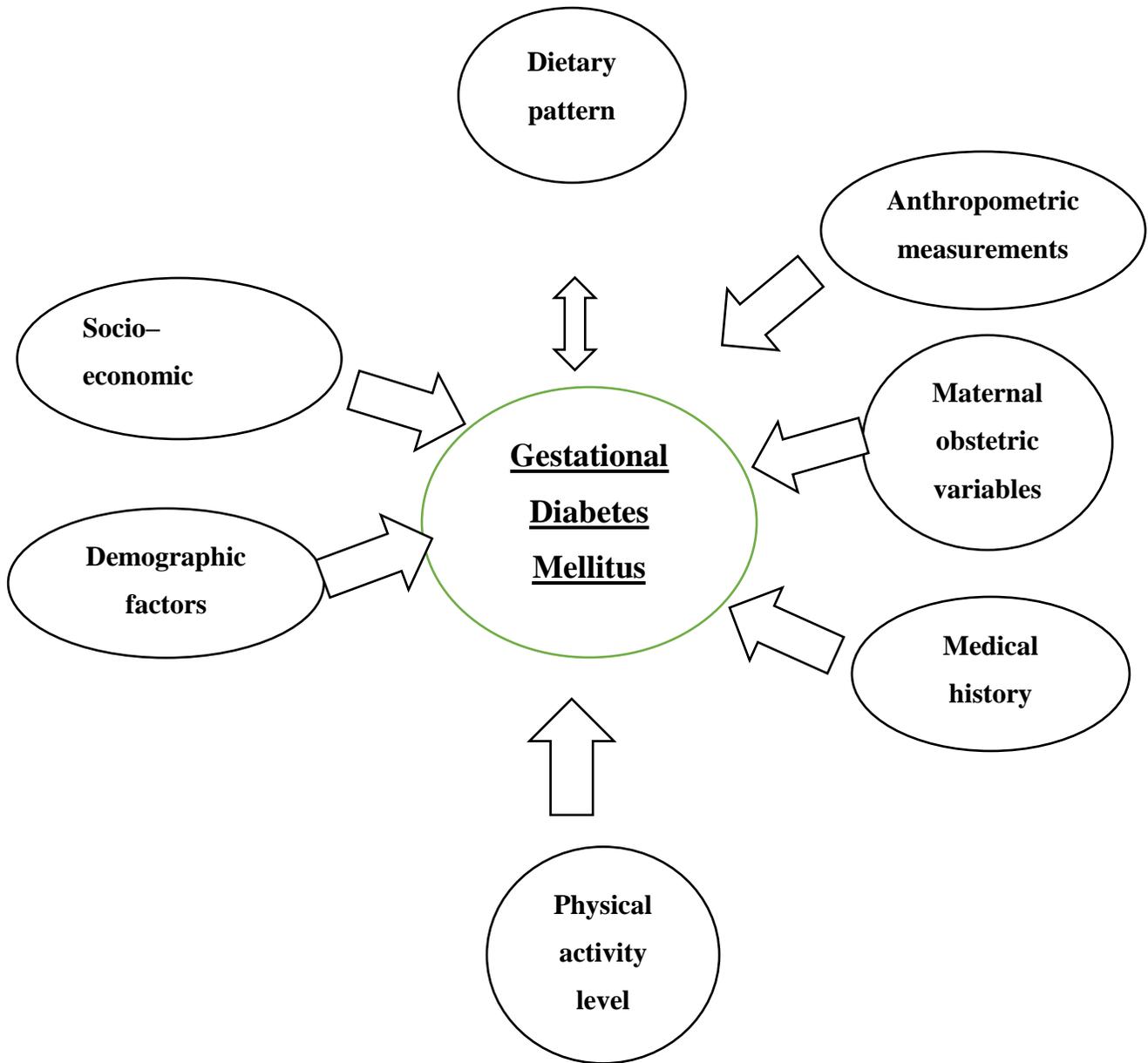
Figure 2.1: Study of conceptual framework.

2.8 Study Variables and Operational definitions

2.8.1 The Dependent Variable

Gestational Diabetes Mellitus (GDM): is "any degree of glucose intolerance with onset or first recognition during pregnancy that subsequently resolves postpartum". (Canivell et al., 2014)

2.8.2 The Independent Variables

Dietary pattern (serving/day): is defined as the quantity, variety, or combination of different foods and beverage in a diet and the frequency with which they are habitually consumed.

Physical activity (MET-hr. / wk.): defined as any movement of the body that requires energy expenditure (Lee & Nieman, 2013).

Age at marriage (years): age of mothers at marriage who participated in the study.

Current mother's age (years): current age of mothers who participated in the study.

Name of Governorate: city in which participant lives (Bethlehem and Hebron).

Place of Residence: place in which participant lives (City, Village, and Camp).

Height (cm): the distance from the bottom of the feet to the top of the head in a human body, standing erect (Lee & Nieman, 2013).

Weight (kg): persons' mass or weight in kilograms (Lee & Nieman, 2013).

Pre-pregnancy weight (kg): Weight before pregnancy in kilograms.

Pre-pregnancy BMI (kg/m^2): computed as reported weight (kg) divided by square of measured height (m^2) (Lee & Nieman, 2013).

Excess gestational weight gain: weight gain that exceeds the 2009 Institute of Medicine (IOM) weight gain recommendations (IOM, 2009).

Education: Depending on the years of studying, primary school studying (1-10) years, secondary (11-12) years, and college or university anything more than 12 years.

Occupation: the job of mothers who participated in the study.

Income (NIS): money received, especially on a regular basis, for work or through investments.

Gestational age (weeks): is measured in weeks, from the first day of the woman's last menstrual cycle to the current date.

Abortion: the deliberate termination of a human pregnancy.

Gravida: number of pregnancies.

Para: number of deliveries.

Chapter Three

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Methodology

The reason for this chapter is to determine the study design, study sample, methods used to collect and analyze the data to accomplish the aims and objectives of the study.

3.1 Setting of the study

Initially, the study was planned to be held at the Ministry of Health (MOH) high-risk pregnancy clinics (HRP) (see appendix 1 & 2). In MOH HRP clinics, there were a small number of cases because patients are used to go to other sectors for follow up, while MOH clinics are well equipped and the staff is of high qualifications, most cases preferred to go to Holy Family Hospital (HFH), maybe because they are free of charge. So the study was conducted on the diabetic and antenatal clinics of the HFH (see appendix 3).

3.2 Study design

A Retrospective Case-Control Study was conducted from July 2018 to April 2019 using questionnaires and anthropometric measurements. Cases were obtained from pregnant women who were attending diabetic clinics at HFH during the data collection period. Controls were obtained from pregnant women who were attending antenatal clinics at HFH during the data collection period. Random sampling was used.

3.3 Target Population

The target population of this study was Palestinian pregnant women with gestational age between 24 – 28 weeks, treated at HFH diabetic and antenatal clinics in Bethlehem.

3.4 Sample Size

GDM is a rare disease with a prevalence of 4.8%. So all pregnant women referred to HFH clinics during the data collection period and met the inclusion criteria were included in the study. The total number of pregnant women who participated in the study was 180, 60 cases and 120 controls with case: control ratio 1:2 matched by age and gestational age.

3.5 Inclusion Criteria for Cases and Controls

Table 3.1: Inclusion criteria for cases and controls.

Inclusion criteria for Cases	Inclusion criteria for Controls
- Palestinian pregnant women over 18 years old.	- Palestinian pregnant women over 18 years old.
- Pregnant women between 24-28 weeks of gestation and newly diagnosed.	- Pregnant women between 24-28 weeks of gestation.
- Single pregnancy	- Single pregnancy

3.6 Exclusion criteria for cases and controls:
- Having a history of macrosomia in previous pregnancies.
- Having a history of infertility and diagnosed with polycystic ovarian syndrome (PCOS).
- Having chronic diseases.
- Having a nutrition counseling.

3.7 Study tools

Part 1: Patient's file:

Glucose tests needed in the study were extracted from the files.

Part 2: Study Questionnaire:

Data were collected by face-to-face interview bases using a questionnaire (see appendix 4). The questionnaire gathers data about dietary patterns, physical activity, demographic factors, anthropometric measurements, socioeconomic factors, maternal obstetric variables, and medical history. Height and current weight were measured during the data collection period by the interviewer.

3.8. Pilot study, reliability and validity

The questionnaire was tested for face validity with referral to 4 experts in the field (Dieticians, Academics, Statisticians, Gynecologist Specialist). The questionnaire's validity is verified by the determination of the internal arrangement of the standard paragraphs that reached the rate of (0.73) according to Cronbach-Alpha, which is an acceptable rate. This indicates if the data collection process was carried out at a later stage, the statistic results would have been very close to the present ones. It is evidence for the survey's reliability, validity, and its instrument.

3.9 Measures

3.9.1 Assessment of Dietary Patterns

Data about dietary patterns were collected by the interviewer, using a validated semi-quantitative food frequency questionnaire (FFQ). The FFQ is relatively easy and inexpensive to administer and can be used to measure dietary intake over a prolonged time period. The FFQ in our study contains a list of 32 food items (Table 3.2). All participants were asked to estimate the number of times per day, week or month she consumed these particular food products and the amount usually eaten per food item by making comparisons with the specified reference portion. The answer categories ranged from 1 to 9 times (9 categories) ranging from 'never' to 'more than six times a day' for each food. The selected frequency category for each food item was converted to daily intake. For example, a response of 'two to four servings per weeks' was converted to 0.43 servings per day.

Table 3.2 a: Food groups included in FFQ.

Food groups	Food items
Refined and whole grains	White bread, Wheat bread, cooked white rice, macaroni, cooked cereals (as bulgur and the like) and potatoes.
Animal protein	Eggs, beef and lamb meat, poultry, fish and shellfish products, sardines and tuna.
Plant protein	Cooked (lentils, chickpeas, black beans or white)
Fruits	Fresh fruits, dried fruits, and fruit juices.
Vegetables	Cooked Spinach, (cabbage, cauliflower, broccoli), (cucumber, green pepper, tomato), (zucchini, eggplant).

Table 3.2 b: Food groups included in FFQ.

Dairy products	Low-fat dairy products (Skim milk, skimmed milk powder, yogurt)
	High-fat dairy products (Whole milk, condensed milk, milk powder, yogurt)
	Yellow cheese, fresh white cheese
Oils and fats	(Corn, sunflower and olive oils), olives, Margarine, butter, sesame seeds.
Sweets	Chocolate, biscuit, pastries, jams, honey.

3.9.2 Assessment of Physical Activity Level

Data on physical activity were obtained using the International Pregnancy Physical Activity Questionnaire (IPPAQ) (see appendix 5)

The IPPAQ is a validated questionnaire that takes on average 10–15 minutes to complete, and has been used to assess the current physical activity levels of pregnant women This questionnaire is composed of 32 questions, grouped into different types of activities (i.e., household/care giving (13 questions), occupational (5 questions), sports/exercise (8 questions), transportation (3 questions), and as well as inactivity (3 questions)]. Specifically, the semi-quantitative questionnaire asked women to estimate the duration and frequency spent per activity (i.e. "none," "less than 1/2 hour per day," "1/2 to almost 1 hour per day," "1 to almost 2 hours per day," "2 to almost 3 hours per day," "3 or more hours per day") during the current 1 month. Women were also given the opportunity to provide 2 activities that were not listed on the questionnaire. In brief, an estimated average metabolic equivalent (MET-hr. / wk.) which is a unit for measuring energy cost of physical activities (the rate of energy consumption for a physical activity during a specific time) was calculated using the duration of the time spent in each activity multiplied by the established categorical intensity value associated with the question.

 Activities were categorized by intensity (i.e., light, moderate, vigorous), type (i.e., household, occupation, sport), or as total activity (sum of all intensity and type scores).

3.9.3 Assessment of Anthropometric Measurements

Height (cm) was measured in all participants (participants barefooted and head upright) with a measuring rod attached to the balance beam scale. Weight (kg) was measured using a standard scale (Seca), the scale was placed on a hard-floor, participants were asked to remove their heavy outer garments and weight was measured. The pre-pregnancy BMI was calculated by dividing weight in kilograms by the square of height in meters.

3.9.4 Ascertainment of GDM

The diagnosis of GDM was based on OGTT test results using Carpenter/Coustan criteria, if no test results were found, GDM was confirmed by physician report and signature on patient file.

3.9.5 Assessment of Other Variables

Additional information regarding demographic, socioeconomic, maternal obstetric variables and medical history were obtained with an interview-based questionnaire.

3.10 Data collection procedure

First, height and weight were measured then the questionnaire was filled. On the same day, patients files were reviewed to obtain results for glucose tests needed for the study.

3.11 Data analysis

Data analysis was carried out using the SPSS software, version 22. Values of all studied variables were displayed as counts and percentages. Mean, standard deviations, Chi-square, independent sample T-test was also performed. The difference was considered significant when the p-value was ≤ 0.05.

3.12 Ethical consideration

In order to launch this study, this proposal was submitted to Al Quds University-School of the public health research committee for discussion and approval and to Al Quds University graduate studies committee approval. All participants were informed about the study aim and objectives and were asked to sign a consent form before participation.

Chapter Four

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The Results

4.1 Introduction:

The questionnaire's general objective was to assess dietary patterns and physical activity level of pregnant women with and without GDM in the southern area of the West Bank. In more specific terms, it aims to evaluate the effect of dietary patterns on the risk of GDM, to evaluate the effect of physical activity level on the risk of GDM, to relate the demographic factors, anthropometric measures, and socio-economic factors associated with the risk of GDM. Finally, it examines the association between maternal obstetric variables and the risk of GDM, and the relationship between pregnant women medical history and risk of GDM.

The questionnaire's validity was verified by the determination of the internal arrangement of the standard paragraphs that reached the rate of (0.73) according to Cronbach-Alpha, which is an acceptable rate. This indicates if the data collection process was carried out at a later stage, the statistic results would have been very close to the present ones. It is evidence for the survey's reliability, validity, and its instrument. The survey standard is applied to a sample consisting of (180) pregnant women; 60 cases and 120 controls with case: control ratio 1:2 matched by age and gestational age.

The required statistical processing of the data has been carried out by extracting the figures and the percentages. The hypotheses of the survey were examined at the rate of $\alpha = 0.05$ by using the SPSS "Statistical Package for the Social Sciences" software version 22.

4.2 List of hypothesis

4.2.1 First hypothesis (Dietary patterns)

H0: There are no differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls in their dietary patterns during pregnancy. It includes the following sub-hypotheses:

- H0: There are no differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls in their dietary patterns regarding the daily intake of grains and starchy vegetables (servings/day).

- H0: There are no differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls in their dietary patterns regarding the daily intake of animal protein (servings/day).

- H0: There are no differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls in their dietary patterns regarding the daily intake of plant protein (Legumes) (servings/day).

- H0: There are no differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls in their dietary patterns regarding the daily intake of fruits (servings/day).

- H0: There are no differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls in their dietary patterns regarding the daily intake of dairy products (servings/day).

- H0: There are no differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls in their dietary patterns regarding the daily intake of vegetables (servings/day).

- H0: There are no differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls in their dietary patterns regarding the daily intake of Oils and fats (servings/day).

- H0: There are no differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls in their dietary patterns regarding the daily intake of Sweets (servings/day).

4.2.2 Second hypothesis (Physical activity)

H0: There are no differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls in their physical activity (MET-hr. /week). It includes the following sub-hypotheses:

- H0: There are no differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls in their total physical activity (MET-hr. /week).

- H0: There are no differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls in their Sedentary activity (MET-hr. /week).

- H0: There are no differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls in their Light-intensity activity (MET-hr. /week).

- H0: There are no differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls in their Moderate-intensity activity (MET-hr. /week).

- H0: There are no differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls in their Vigorous-intensity activity (MET-hr. /week).

- H0: There are no differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls in their Household/caregiving activity (MET-hr. /week).

- H0: There are no differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls in their Occupational activity (MET-hr. /week).

- H0: There are no differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls in their Sports/exercise activity (MET-hr. /week).

4.2.3 Third hypothesis (Demographic factors)

H0: There are no differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls attributed to an age when got married.

H0: There are no differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls attributed to the governorate.

H0: There are no differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls attributed to the place of residency.

4.2.4 Fourth hypothesis (Anthropometric measurements)

H0: There are no differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls attributed to pre-pregnancy BMI.

H0: There are no differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls attributed to gestational weight gain (GWG).

4.2.5 Fifth hypothesis (Socio-economic factors)

H0: There are no differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls attributed to the level of education.

H0: There are no differences of statistical significance at the rate of α = 0.05 between cases and controls attributed to the occupation.

H0: There are no differences of statistical significance at the rate of α = 0.05 between cases and controls attributed to household income.

4.2.6 Sixth hypothesis (Maternal obstetric variables)

H0: There are no differences of statistical significance at the rate of α = 0.05 between cases and controls attributed to number of abortions.

H0: There are no differences of statistical significance at the rate of α = 0.05 between cases and controls attributed to parity.

4.2.7 Seventh hypothesis (Medical history)

H0: There are no differences of statistical significance at the rate of α = 0.05 between cases and controls attributed to chronic diseases.

H0: There are no differences of statistical significance at the rate of α = 0.05 between cases and controls attributed to a family history of type 2 diabetes mellitus.

H0: There are no differences of statistical significance at the rate of α = 0.05 between cases and controls attributed to previous pregnancy with GDM.

4.3 Testing the hypothesis

4.3.1 Description and differences between study participants regarding dietary patterns

The results of the T-Test reveals the following:

- There <u>are significant</u> differences of statistical significance at the rate of α = 0.05 between cases and controls in their dietary patterns regarding the daily intake of grains and starchy vegetables, and the results were in favor of controls with an average of 4.6 (servings/day) comparatives to an average of 3.9 (servings/day) for cases. Apparently, cases ate fewer grains and starchy vegetables than controls.

- There <u>are significant</u> differences of statistical significance at the rate of α = 0.05 between cases and controls in their dietary patterns regarding the daily intake of animal protein, and the results were in favor of cases with an average of 1.2 (servings/day) for cases comparative to an average of 1.0 (servings/day) for controls. Actually, cases ate more animal protein than controls.

- There are <u>no differences</u> of statistical significance at the rate of α = 0.05 between cases and controls in their dietary patterns regarding the daily intake of vegetable protein (p> 0.05).

- There <u>are significant</u> differences of statistical significance at the rate of α = 0.05 between cases and controls in their dietary patterns regarding the daily intake of vegetables, and the results were in favor of controls with an average of 1.4 (servings/day) comparatives to an average of 1.2 (servings/day) for cases. Actually, the controls ate more vegetables than cases.

- There <u>are significant</u> differences of statistical significance at the rate of α = 0.05 between cases and controls in their dietary patterns regarding the daily intake of fruits, and the results were in favor of controls with an average of 4.4 (servings/day) comparatives to an average of 2.1 (servings/day) for cases. Actually, the controls ate more fruits than cases.

- There <u>are significant</u> differences of statistical significance at the rate of α = 0.05 between cases and controls in their dietary patterns regarding the daily intake of dairy products, and the results were in favor of cases with an average of 1.5 (servings/day) comparatives to an average of 1.3 (servings/day) for controls. In reality, cases ate more dairy products than controls.

- There <u>are significant</u> differences of statistical significance at the rate of α = 0.05 between cases and controls in their dietary patterns regarding the daily intake of oils and fats, and the results were in favor of cases with an average of 3.3 (servings/day) comparatives to an average of 2.7 (servings/day) for controls. Seemingly, cases ate more oils and fats than controls.

- There <u>are significant</u> differences of statistical significance at the rate of α = 0.05 between cases and controls in their dietary patterns regarding the daily intake of sweets, and the results were in favor of cases with an average of 3.4 (servings/day) comparatives to an average of 2.1 (servings/day) for controls. On the face of it, cases ate more sweets than controls.

The above results are summarized in the descriptive table 4.1.

Table 4.1: Distribution of study participants according to dietary patterns.

Number	Food Group	Cases (60) Servings/day		Controls (120) Servings/day		Independent sample t-test P value
		Mean	SD	Mean	SD	
1	Grains and starchy vegetables	3.9	1.3	4.6	2.0	**0.012***
2	Animal protein (Meat and Fish)	1.2	0.9	1.0	0.5	**0.025***
3	Vegetable protein (Legumes)	0.1	0.1	0.2	0.1	0.061
4	Fruits	2.1	1.3	4.4	1.1	**0.011***
5	Vegetables	1.1	0.5	1.4	0.4	**0.000***
6	Milk and Dairy products	1.5	1.0	1.3	0.5	**0.046***
7	Oils and Fats	3.3	1.4	2.7	1.5	**0.006***
8	Sweets and Sugars	3.4	2.3	2.1	1.2	**0.000***

*Significance at p≤0.05

4.3.2 Description and differences between study participants regarding physical activity

The results of the T-Test reveals the following:

- There <u>are significant</u> differences of statistical significance at the rate of α = 0.05 between cases and controls in their total physical activity, and the results were in favor of controls with an average of 336.7 (MET-hr. / week) comparative to an average of 269.5 (MET-hr. / week) for cases, which means controls practice more than cases.

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- There <u>are significant</u> differences of statistical significance at the rate of α = 0.05 between cases and controls in their Sedentary activity, and the results were in favor of cases with an average of 53.2 (MET-hr. / week) compared to an average of 36.4 (MET-hr. / week) for controls, which means cases more sedentary than controls.

- There <u>are significant</u> differences of statistical significance at the rate of α = 0.05 between cases and controls in their Light activity, and the results were in favor of controls with an average of 197.4 (MET-hr. / week) comparative to an average of 154.7 (MET-hr. / week) for cases, which means controls practice light activities more than cases.

- There <u>are significant</u> differences of statistical significance at the rate of α = 0.05 between cases and controls in their Moderate activity, and the results were in favor of controls with an average of 100.1 (MET-hr. / week) comparative to an average of 84.7 (MET-hr. / week) for cases, which means controls practice moderate activities more than cases.

- There <u>are significant</u> differences of statistical significance at the rate of α = 0.05 between cases and controls in their Vigorous activity, and the results were in favor of controls with an average of 19.6 (MET-hr. / week) compared to an average of 14.7 (MET-hr. / week) for cases, which means controls practice vigorous activities more than cases.

- There <u>are significant</u> differences of statistical significance at the rate of α = 0.05 between cases and controls in their Household/Caregiving activity, and the results were in favor of controls with an average of 282.1 (MET-hr. / week) comparative to an average of 217 for cases, which means controls do household activities more than cases.

- There <u>are significant</u> differences of statistical significance at the rate of α = 0.05 between cases and controls in their Occupational activity, and the results were in favor of controls with an average of 18.9 (MET-hr. / week) compared to an average of 4.2 (MET-hr. / week) for cases, which means controls practice occupational activities more than cases.

- There <u>are significant</u> differences of statistical significance at the rate of α = 0.05 between cases and controls in their Sports/exercise activity, and the results were in favor of controls with an average of 46.9 (MET-hr. / week) compared to an average of 35 (MET-hr. / week) for cases, which means controls practice Sports/exercise activities more than cases.

The above results are summarized in the descriptive table 4.2.

Table 4.2: Distribution of study participants according to physical activity.

Number	Physical Activity	Total Mean (MET-hr. / week)	Cases Mean (MET-hr. / week)	Controls Mean (MET-hr. / week)	P value
1	Total Activity	303.1	269.5	336.7	**0.000***
2	Sedentary Activity	43.4	53.2	36.4	**0.016***
3	Light Activity	175	154.7	197.4	**0.030***
4	Moderate Activity	89.6	84.7	100.1	**0.011***
5	Vigorous Activity	16.1	14.7	19.6	**0.014***
6	Household/Caregiving	244.3	217	282.1	**0.000***
7	Occupational activity	14	4.2	18.9	**0.014***
8	Sports/Exercise	40.6	35	46.9	**0.042***

*Significance at p≤ 0.05

4.3.3 Description and differences between study participants regarding the demographic variables

As table 4.3 shows, the average age of participants was 27.4 years. Ages when they got married, were distributed as follows: 9.4% of them got married when they were 18 years old or less,

90.0% got married when they were 19 to 35 years old, and only one participant got married when she was older than 35 years. 82.8% of participants were from Bethlehem governorate, and 17.2% were from Hebron governorate (see figure 4.1). Of which, 53.3% are living in rural areas, 9.4% refugee camps, and 37.2% are living in urban areas (see figure 4.2).

Table 4.3 a: Distribution of study participants according to demographic variables.

Number	Variable	Total (180) N (%)	Cases (60) N (%)	Controls (120) N (%)	Chi-square P – value
1.	**Age (Years)**				
	Mean ± SD	27.4 ± 4.9	28.7 ± 2.5	26.9 ± 3.5	0.350
2.	**Age at marriage (Years)**				
	<18	17 (9.4%)	7 (11.7%)	10 (8.3%)	
	18-35	162 (90.0%)	52 (86.7%)	110 (91.7%)	0.275
	>35	1 (0.6%)	1 (1.7%)	0 (0.0%)	
3.	**Governorate name**				
	Bethlehem	149 (82.8%)	34 (56.7%)	115 (95.8%)	0.061
	Hebron	31 (17.2%)	26 (43.3%)	5 (4.2%)	

*Significance at p≤ 0.05

Table 4.3 b: Distribution of study participants according to demographic variables.

Number	Variable	Total (180) N (%)	Cases (60) N (%)	Controls (120) N (%)	Chi-square P – value
4.	**Residence place**				
	Rural	96 (53.3%)	25 (41.74%)	71 (59.2%)	
	Camp	17 (9.4%)	12 (20.0%)	5 (4.2%)	0.071
	Urban	67 (37.2%)	23 (38.3%)	44 (36.7%)	

*Significance at p≤ 0.05

Figure 4.1: Governorate distribution among cases and controls

Figure 4.2: Place of residency distruibution among cases and controls
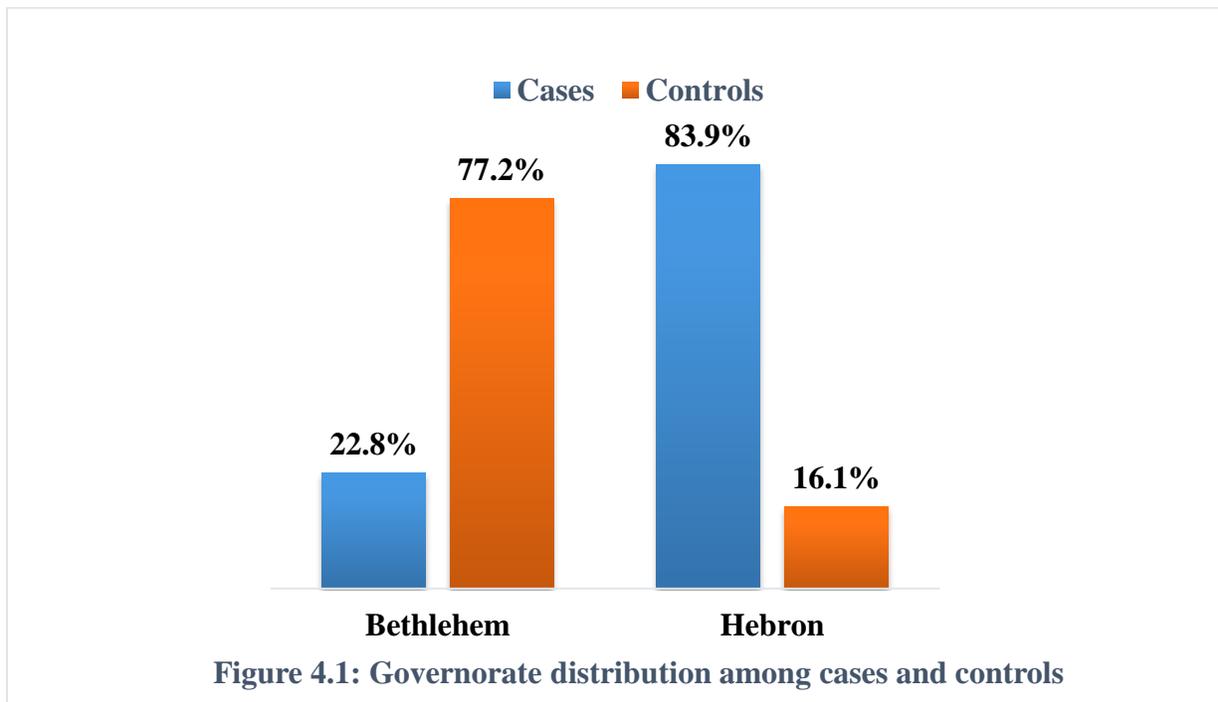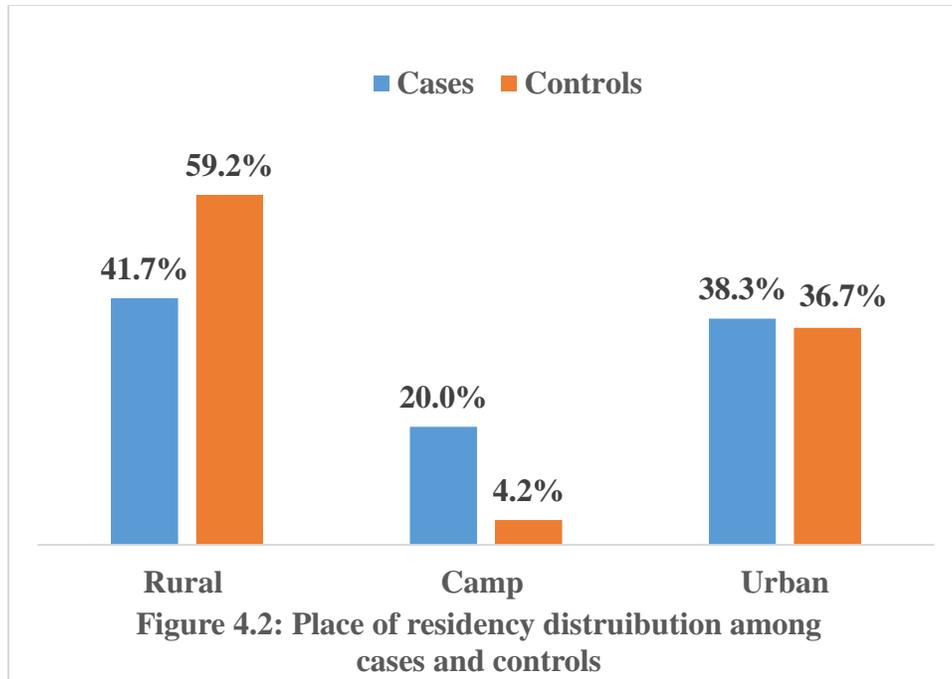
4.3.4 Description and differences between study participants regarding the anthropometric measurements

The average height of study participants was 162 cm (minimum height = 150 cm, maximum height = 170 cm). Moreover, the average weight of women before pregnancy was 67.6 kg (minimum weight = 43 kg, maximum weight= 130 kg), and their current weight, 74.6 kg (minimum current weight = 54 kg, maximum current weight= 134 kg). The average increase in weight was 7 kg (Before to after being pregnant) (table 4.4) and (figure 4.3).

The distribution of pre-pregnancy BMI index shows that 3.3% of pregnant women were underweight, 40.0% were normal weight, 40.0% were overweight, and 16.7% were obese (table 4.5) and (figure 4.4).

Table 4.4: Distribution of study participants according to anthropometric measurements.

Number	Variables	Total (180)		Cases (60)		Controls (120)		Independent sample t test
		Mean	SD	Mean	SD	Mean	SD	P value
1.	**Height (cm)**	1.6	0.0	1.62	.05	1.62	.03	0.454
2.	**Weight before pregnancy (kg)**	67.6	15.0	76.3	19.2	63.2	9.9	**0.000***
3.	**Current Weight (kg)**	74.7	14.5	83.9	17.7	70.0	9.7	**0.000***
4.	**Gestational Weight Gain (GWG) (kg)**	8.1	6.8	9.5	7.9	6.1	4.9	**0.049***

*Significance at p≤ 0.05

Table 4.5: The difference between pre-pregnancy BMI among cases and controls.

Number	Variable	Total (180) %	Cases (60) %	Controls (120) %	Chi-Square P value
1.	**Pre-pregnancy BMI categories**				
Underweight	< 18.5 kg/m^2	3.3%	10.0%	0.0%	
Normal weight	18.5 – 24.9 kg/m^2	40.0%	15.0%	52.5%	
Overweight	25.0 – 29.9 kg/m^2	40.0%	33.3%	43.3%	**0.000***
Obese	≥ 30 kg/m^2	16.7%	41.7%	4.2%	

*Significance at p≤ 0.05

Figure 4.3: Weight (kg) before pregnancy among cases and controls

Figure 4.4: Pre-pregnancy BMI distribution among cases and controls
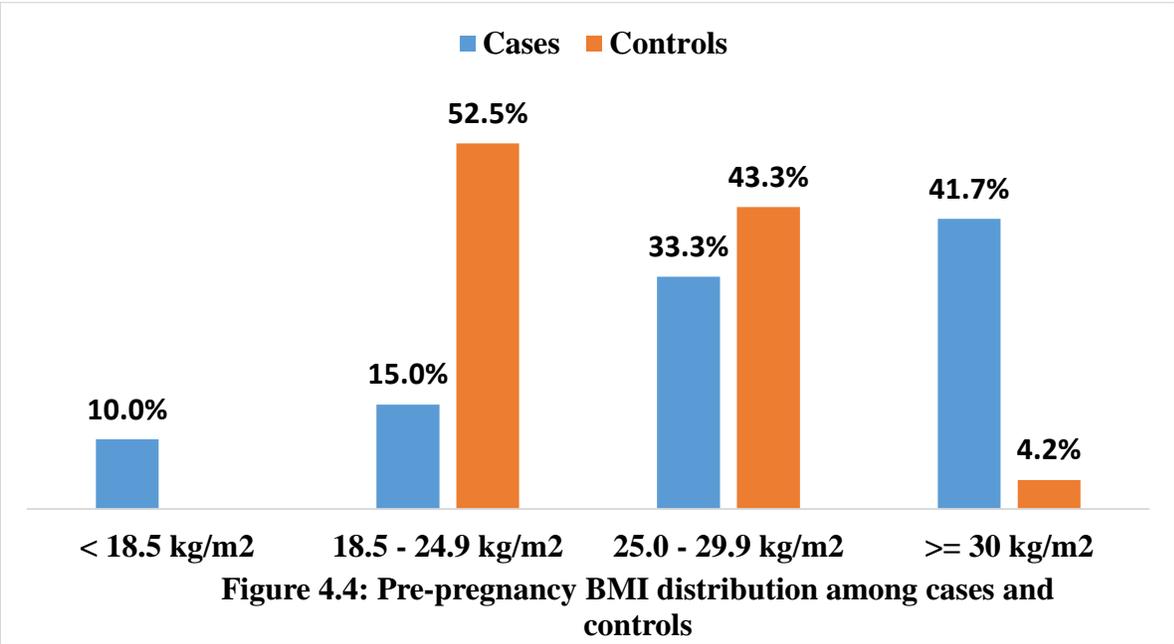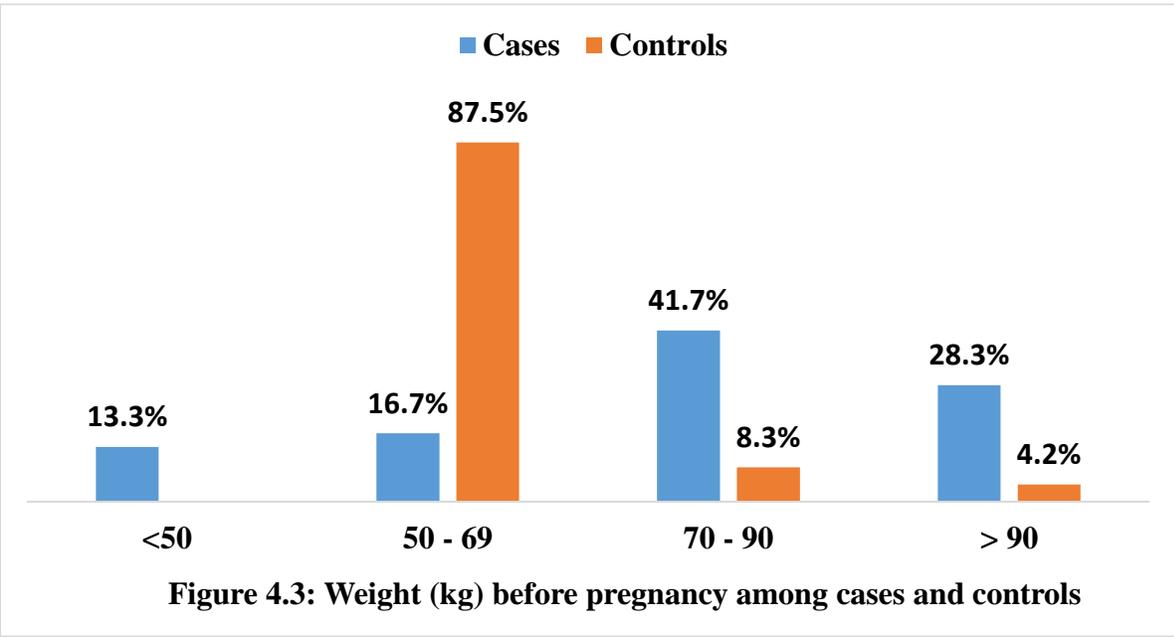
4.3.5 Description and differences between study participants regarding the socio-economic variables

35.0% of study participants had secondary education, 24.4% had diploma, 22.2% had bachelor, 10.6% were uneducated, and 7.8% got primary education. In line with this, 5.0% were employees in organizations, 11.1% had their private job, 11.1% were still students, and a majority of 72.8% were housewives. Results revealed that 32.2% of participant their household income was 1500 NIS or less, 51.1% have an income of 1500 to 3000 NIS, 11.1% between 3001 and 4000 NIS, and 5.6% their household income was more than 4000 NIS.

There are differences of statistical significance at the rate of $\alpha = 0.05$ between cases and controls attributed to the level of education, and monthly income (see table 4.6).

Table 4.6 a: Distribution of study participants according to socio-demographic variables.

| Number	Variable	Total (180) N (%)	Cases (60) N (%)	Controls(120) N (%)	Chi-square P value
1.	**Education level**				
	Uneducated	19 (10.6%)	16 (26.7%)	3 (2.5%)	
	Primary	14 (7.8%)	3 (5.0%)	11 (9.2%)	
	Secondary	63 (35.0%)	33 (55.0%)	30 (25.0%)	**0.000***
	Diploma/College	44 (24.4%)	8 (13.3%)	36 (30.0%)	
	Bachelor	40 (22.2%)	0 (0.0%)	40 (33.3%)	
	Postgraduate	0 (0.0%)	0 (0.0%)	0 (0.0%)	
2.	**Current job**				
	Employee	9 (5.0%)	2 (3.3%)	7 (5.8%)	0.073
	Private job	20 (11.1%)	0 (0.0%)	20 (16.7%)	

Table 4.6 b: Distribution of study participants according to socio-demographic variables.

Number	Variable	Total (180) N (%)	Cases (60) N (%)	Controls(120) N (%)	Chi-square P value
	Student	20 (11.1%)	0 (0.0%)	20 (16.7%)	
	Housewife	131 (72.8%)	58 (96.7%)	73 (60.8%)	
3.	**Monthly income (NIS)**				
	< 1500	58 (32.2%)	33 (55.0%)	25 (20.9%)	
	1500 - 3000	92 (51.1%)	17 (28.3%)	75 (62.5%)	**0.000***
	3001 - 4000	20 (11.1%)	7 (11.7%)	13 (10.8%)	
	> 4000	10 (5.6)	3 (5.0%)	7 (5.8)	
4.	**Gestational Age (Weeks)**				
	Mean ± SD	25.9 ± 0.1	26.5 ± 0.3	25.4 ± 0.5	0.061

*Significance at p≤ 0.05

Figure 4.5: Level of education among cases and controls
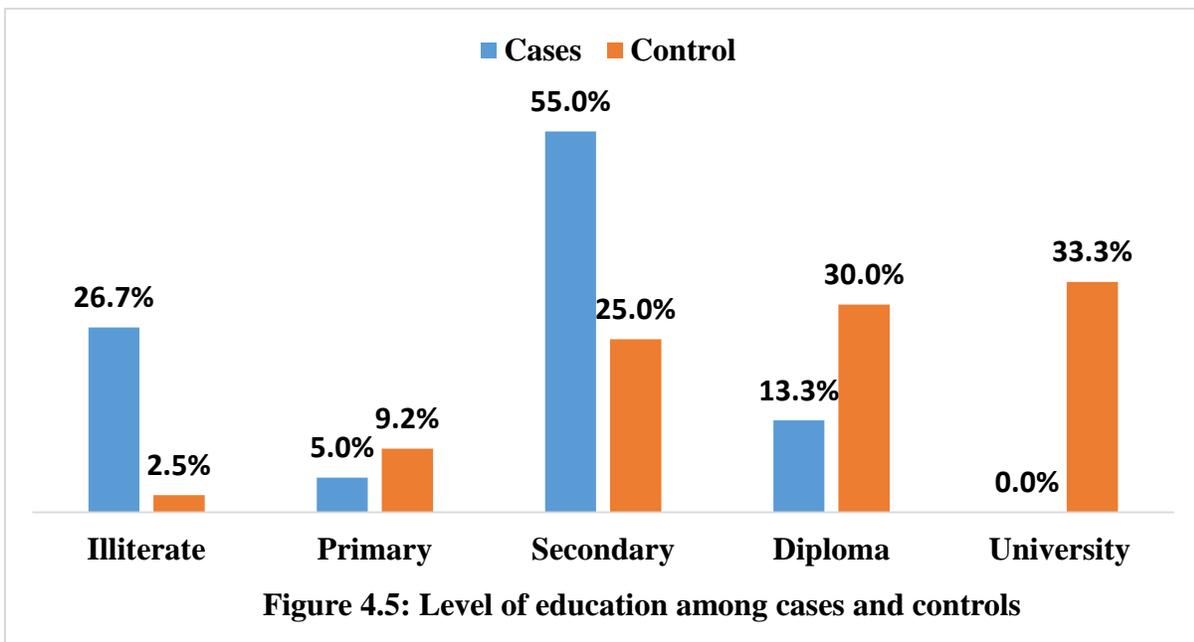
4.3.6 Description and differences between study participants regarding the maternal obstetric variables

As shown in table 4.3, 8.3% of both cases and controls reported having more than 3 babies. A majority of 75% never had an abortion, 18.3% they had it once, and 1.1% had abortions 3 times or more (table 4.7).

Table 4.7: Distribution of study participants according to maternal obstetric variables.

Number	Variable	Total (180) N (%)	Cases (60) N (%)	Controls (120) N (%)	Chi-square P value
1.	**Number of children**				
	0	36 (20.0%)	16 (26.7%)	20 (16.7%)	
	1	49 (27.2%)	19 (15.0%)	40 (33.3%)	
	2	36 (20.0%)	16 (26.7%)	20 (16.7%)	0.61
	3	44 (24.4%)	14 (23.3%)	30 (25.0%)	
	More than 3	15 (8.3%)	5 (8.3%)	10 (8.3%)	
2.	**Number of abortions**				
	0	135 (75.0%)	29 (48.3%)	106 (88.3%)	
	1	33 (18.3%)	19 (31.7%)	14 (11.7%)	
	2	8 (4.4%)	8 (13.3%)	0 (0.0%)	.053
	3	2 (1.1%)	2 (3.3%)	0 (0.0%)	
	More than 3	2 (1.1%)	2 (3.3%)	0 (0.0%)	

*Significance at $p \leq 0.05$

4.3.7 Description and differences between study participants regarding the medical history variables

Only 7.2% of participants suffered from chronic diseases. 8.3% have suffered from GDM in previous pregnancies, and 17.2% have a family history of type 2 diabetes mellitus (table 4.8).

Table 4.8: Distribution of study participants according to medical history variables.

Question	Cases (60)		Controls (120)		P value
	Yes **N (%)**	**No** **N (%)**	**Yes** **N (%)**	**No** **N (%)**	
Have you suffered from gestational diabetes in previous pregnancies?	10 (16.7%)	50 (83.3%)	5 (4.2%)	115 (95.8%)	**0.004***
Is there a family history of type 2 diabetes?	16 (26.7%)	44 (73.3%)	15 (12.5%)	105 (87.5%)	**0.018***
Do you have chronic diseases such as high blood pressure, liver disease, blood diseases, and thyroid disorder?	3 (5.0%)	57 (95.0%)	10 (8.3%)	110 (91.7%)	0.415

*Significance at p≤ 0.05

Chapter Five

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Discussion

5.1 Introduction

The overall aim of this study was to assess dietary patterns and physical activity level of pregnant with and without GDM. This study provides a baseline data for Mother and Child (MCH) clinics in maternal lifestyle during pregnancy to enhance appropriate weight gain, physical activity, and consumption of a variety of foods to reduce the risk of GDM.

5.2 Description of study sample

A sample of 180 pregnant women was included in the study (60 cases and 120 controls) matched by age and gestational age. Results showed that the average age of participants was 27.4, with a maximum age of 44, and a minimum age of 18 years. Ages, when they got married, were distributed as follows: 9.4% of them got married when they were 18 years old or less, 90.0% got married when they were 19 to 35 years old, and only one participant got married when she was older than 35 years. 82.8% of participants were from Bethlehem governorate, and 17.2% were from Hebron governorate. Of which, 53.3% were living in rural areas, 9.4% were living in refugee camps, and 37.2% were living in urban areas. The distribution of pre-pregnancy BMI shows that 3.3% of pregnant women were underweight, 40.0% were normal, 40.0% were overweight, and 16.7% were obese.

5.3 First Hypothesis (Dietary patterns)

The study showed that GDM participants ate more animal protein, milk and dairy products, oils and fats, and sweets. The controls showed a higher intake of grains and starchy vegetables, high intake of fruits and vegetables. Findings of the study suggest that there is a significant difference between dietary patterns of the two groups.

The observational literature supports the results found in our study between dietary patterns and risk of developing GDM. Results from different studies showed that high consumption of refined grains, fat, added sugars, low intake of fruits and vegetables (Shin et al., 2015), high total dietary protein intake (Pang et al., 2017), high saturated fat (Bo et al., 2001), high processed red meat and high glycemic index foods (Zhang et al., 2006) were associated with higher risk for GDM.

In a prospective cohort study that was done in the US between 1991 and 2001. The study findings showed that pre-pregnancy adherence to healthful dietary patterns is significantly associated with a lower risk of GDM (Tobias et al., 2012).

Another prospective cohort study was done by Zhang and his colleagues in the US between 1992 and 1998 to examine whether dietary patterns are related to the risk of GDM. The study results suggest that pregnancy dietary patterns affect women's risk of developing GDM (Zhang et al., 2006)

In summary, pregnant women with GDM did not receive proper nutrition advice to help them in control their diabetes. This is due to the fact that nutrition counseling is offered after the women being diagnosed with GDM not from the beginning of their pregnancy. So, it's very important to visit nutritionist from as early as possible to emphasize the key components of a health-promoting lifestyle during pregnancy.

5.4 Second Hypothesis (Physical activity)

The present study showed that controls have higher levels of physical activity than cases. Evidence is emerging which suggests that physical activity both before (Zhang et al., 2006) and during pregnancy (Avery & Walker, 2001; Brankston et al., 2004; Clarke et al., 2004; Garcia-Patterson et al., 2001) has a positive effect on GDM. Some studies have reported that women who consistently engage in physical activity during pregnancy reduce their risk for GDM compared to inactive women (Dempsey et al., 2005).

The highest mean was for household activities for both cases and controls (217 and 282.1 MET-hr. / week) respectively because women spend more time on household and family care tasks and, less time on leisure or conditioning activities (Masse et al., 1998).

Thus, it appears that approximately 30 min/day of moderate-intensity physical activity performed during pregnancy may be sufficient to decrease the risk of GDM (ACOG, 2015).

5.5 Third hypothesis (Demographic variables)

In this study, the comparison of two groups revealed no statistically significant difference between them in terms of demographic variables with risk of developing GDM including age, age at marriage, governorate, and place of residence.

5.6 Fourth hypothesis (Anthropometric measurements)

Average weight before pregnancy for cases was 76.3 kg with an average height 1.62 m, which means the cases tended to be overweight before becoming pregnant. According to pre-pregnancy BMI, 33.3% of cases were overweight, and 41.7% of them were obese. This supports that marked obesity before pregnancy is the most commonly investigated modifiable risk factor with the most predictable findings.

In Poland, a case-control study by Ogonowski and his partners (2009) examined the association between GDM and pre-pregnancy BMI. The study investigated 1121 women with GDM who were referred to the outpatient clinic for diabetic pregnant women between the years 2001 and 2005. Controls were 1011 healthy pregnant women. The cut point for pre-pregnancy BMI as a risk indicator for GDM was 22.9 kg/m^2. For all, except underweight women group, a significant relationship between pre-pregnancy BMI and GDM was found (Ogonowski et al., 2009).

Similarly, a retrospective cohort study was done in the USA between 2004 – 2011 using the Pregnancy Risk Assessment Monitoring System (PRAMS) records to examine if pre-pregnancy BMI is a risk factor for GDM. The study findings showed that obese women with pre-pregnancy BMI (≥30 kg/m^2) had an increased odds ratio for GDM (OR 2.78; CI 2.60-2.96) (Shin & Song, 2015).

Another retrospective cohort study was done in Nairobi County by Adoyo and his colleagues (2016). The study findings showed that weight before pregnancy was high with a mean of 74.04 kg (95% C.I: 70.82-77.30) among mothers with GDM compared to a mean of 60.27 kg (95% C.I:58.59-61.96) among Non-GDM mothers (Adoyo et al., 2016).

5.7 Fifth hypothesis (Socioeconomic factors)

Monthly income and level of education were significantly associated with the risk of developing GDM. These findings support the idea of Folkehelse that health and lifestyle habits such as diet and physical activity are connected to living conditions and environment, and these background factors can influence decisions and habits that can promote health or increase risk of disease (Folkehelse, 2014).

A study that supports the study findings was done in Australia with a large sample size (nearly 1 million births over 11 years between 1995 and 2005). It found that the Association was confirmed between socioeconomic factors and the occurrence of GDM. Women living in the

three lowest socioeconomic quartiles had higher adjusted ORs for GDM relative to women in the highest quartile (Anna et al., 2008).

5.8 Seventh hypothesis (Medical history)

Family history of T2DM and personal history of GDM were significantly associated with the risk of developing GDM.

A similar study was done in Nairobi County by Adoyo and his colleagues (2016). The study findings showed that mothers with diabetic history in the family had twice the risk of developing GDM (OR=2.27; 95% C.I: 1.23-4.17) compared to those who did not have diabetic history in the family (Adoyo et al., 2016).

Another study that supports the present study was done in Australia in 2007 to review the risk profiles of women with GDM. The findings showed that the strongest independent risk factor for GDM was a past history of GDM (OR = 10.7; 95% CI: 5.4–21.1) (Teh et al., 2011).

Chapter Six

Conclusions and Recommendations

6.1 Conclusions

In conclusion, it was found that women with multiple positive modifiable risk factors including marked obesity before pregnancy, excessive gestational weight gain, bad dietary patterns, and physical inactivity during pregnancy have a significantly higher risk of developing GDM. The study results support the hypothesis that modifiable factors during pregnancy are associated with the risk of GDM.

In this study, the results indicated that the dietary intake might not be met by recommendations in the majority of the food groups, the study participants ate below the standard servings/day. The findings from this study suggest that higher intake of dietary animal protein, milk and dairy products, fats and sweets during pregnancy is associated with a higher risk of developing GDM.

It was found that marked obesity before pregnancy is a major risk factor for developing GDM, this has been manifested by the finding that an increment of 1 kg/m^2 in pre-pregnancy BMI increases the probability of women having GDM by 6%.

The study observed associations with physical activity are consistent with the findings of prior studies that the majority of the pregnant women failed to meet the daily recommendations for physical activity. Higher levels of physical activity during pregnancy are associated with a significantly lower risk of developing GDM, while household chores and childcare constitute a significant proportion of physical activity during pregnancy among Palestinian pregnant women.

Both physical activity and medical nutrition therapy are key components in decreasing the risk of developing GDM.

The results of this study suggest that health care personnel particularly midwife can provide enough information on physical activities during pre-pregnancy and prenatal visits. It is possible to prevent gestational diabetes by appropriate counseling and making pregnant women aware of having an appropriate and healthy lifestyle during pregnancy and any intervention that might improve it.

6.2 Recommendations

6.2.1 Recommendations for Pregnant Women

- Improving diet before pregnancy is essential to reduce the risk of GDM.

- It is recommended for women who plan to get pregnant to keep their body weight within its normal limits and to avoid overweight and obesity.

- It is recommended for obese pregnant women to avoid excess calorie intake and to gain the recommended weight during pregnancy.

6.2.2 Recommendations for Decision Makers

- Awareness raising campaign should be conducted among married women for the risk of obesity and overweight and healthy life style.

- Hiring nutritionist in each maternity unit to provide dietary program for obese pregnant women.

- Appropriate counseling and raising awareness among pregnant women to have a proper and healthy lifestyle during pregnancy including eating patterns and level of physical activity.

- Personalized educational interventions can improve dietary behavior and physical activity levels in pregnant women.

6.2.3 Recommendations for Future Research

- Prospective and cohort studies are needed to further evaluate and monitor changes in dietary patterns and physical activity during pregnancy and its effect on the risk for GDM.

- Detailed analysis of food components using 3 days record.

6.3 Limitations

1. Although PPAQ is validated in other countries, it has not been validated in Palestine.

2. Lack of research in Palestine regarding dietary patterns and physical activity and their relation in the reduction of GDM risk.

3. The research should have been conducting in MOH HRP clinics, but there was a small number of cases because they are referred to the specialized diabetic clinic in HFH so the study has been transferred there.

4. Limited time for data collection.

5. Lack of fund to do blood tests to confirm diagnosis or check for glycemic control.

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Appendix (1)

State of Palestine

Ministry of Health - Nablus

General Directorate of Education in Health

دولة فلسطين

وزارة الصحة – نابلس

الإدارة العامة للتعليم الصحي

Ref.: ....

Date: ....

الرقـم: ١٢٤ /٨ /٢٢ ١٠/٢ .C

التاريخ: ٢٥/٢/١٨ ١٠. C

الأخ مدير عام الادارة العامة للرعاية الصحية الأولية المحترم،،،

تحية واحتراماً،،،

<u>الموضوع: تسهيل مهمة طلاب</u>

يرجى تسهيل مهمة الطالبة: غدير حنا نصري سعد – ماجستير السياسات والادارة الصحية– جامعة

القدس، في عمل مشروع بحثي بعنوان: " A comparative Study on Dietary Habits and

Physical Activity Level of Pregnant Women with and without Gestational

Diabetes in Bethlehem District، لذا يرجى تسهيل مهمتها في الحصول على معلومات

احصائية عن مواقع مراكز الامومة والطفولة في محافظة بيت لحم وبيانات عن عدد النساء الحوامل

اللاتي يراجعن في هذه المراكز من ضمنها عيادات الحمل الخطر.

ـ ذلك في مديرية صحة بيت لحم.

علماً بأنه سيتم الالتزام بمعايير البحث العلمي والحفاظ على سرية المعلومات. كما يرجى العلم ان

مشرف البحث: د. معتصم حمدان.

مع الاحترام،،،،،

مدير عام التعليم الصحي

نسخة: عميد كلية الصحة العامة المحترم/ جامعة القدس

P.O .Box: 14

TelFax: 09-2333901

ص.ب: 14

تلفاكس: 09-2333901

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Appendix (2)

State of Palestine

Ministry of Health - Nablus

General Directorate of Education in Health

دولة فلسطين

وزارة الصحة– نابلس

الإدارة العامة للتعليم الصحي

Ref.: ....
Date:................

الرقـم:٥٦ـ٦٦/١٧٤٤/٢٠١٨

التاريخ: ..../....../٢٠١٨

الأخ مدير عام الادارة العامة للرعاية الصحية الأولية المحترم،،،

تحية واحترام،،،

<u>الموضوع: تسهيل مهمة طلاب</u>

يرجى تسهيل مهمة الطالبة: غدير حنا نصري سعد– ماجستير الصحة العامة– جامعة القدس، في

عمل رسالة الماجستير بعنوان: " Determinants of Gestational Diabetes Mellitus in

Southern Area of West Bank: A case-control Study"، لذا يرجى تسهيل مهمتها في

الحصول على معلومات احصائية عن مواقع مراكز الامومة والطفولة في محافظة بيت لحم وبيانات عن

عدد النساء الحوامل اللاتي يراجعن في هذه المراكز من ضمنها عيادات الحمل الخطر، وذلك في:

- مديرية صحة الخليل.

علما بأنه سيتم الالتزام بمعايير البحث العلمي والحفاظ على سرية المعلومات. كما يرجى العلم ان

مشرف البحث: د. معتصم حمدان.

مع الاحترام،،،

د. أمل أبو عوض

المدير عام التعليم الصحي

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Appendix (3)

Al-Quds University

Jerusalem

School of Public Health

جـامـعـة الـقـدس

القدس

كلية الصحة العامة

التاريخ: 2018/3/28

حضرة الدكتور سابا ابو فرحة المحترم

المدير الطبي لمستشفى العائلة المقدسة/ بيت لحم

<u>الموضوع:</u> تسهيل مهمة الطالبة غدير حنا نصري سعد

تحية طيبة وبعد،،،

تقوم الطالبة غدير حنا نصري سعد برنامج ماجستير الصحة العامة/ جامعة القدس بإجراء بحث الرسالة <u>بعنوان:</u>

"A comparative study on dietary habits and physical activity level of pregnant women with and without gestational diabetes in Bethlehem district".

وهي بحاجة الى تزويدها بمعلومات وبيانات عن عدد النساء الحوامل اللواتي يراجعن في عيادة المشفى الخاصة بالحوامل ، نرجو من حضرتكم مساعدة الطالبة في الحصول على المعلومات اللازمة لإنهاء متطلبات البحث. علما بأن الدراسة ستكون لأغراض البحث العلمي فقط.

شاكرين لكم حسن تعاونكم،،،

أ.د. معتصم حمدان

عميد كلية الصحة العامة

Faculty of Public Health

نسخة: الملف

Appendix (4)

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جامعة القدس

كلية الصحة العامة

برنامج الصحة العامة / الوبائيات

استبانة دراسة

سيداتي الأفاضل:

تقوم الباحثة غدير سعد بإجراء دراسة لتقييم العوامل المؤثرة على سكري الحمل في العيادات الخارجية في مستشفى العائلة المقدسة في محافظة بيت لحم من الضفة الغربية, وذلك لإتمام متطلبات برنامج الماجستير في الصحة العامة جامعة القدس.

لقد تم اختيار ملفك عشوائيا من ضمن الملفات الموجودة في العيادات الخارجية. لذا ندعوك للمشاركة في الدراسة والتكرم بالإجابة على أسئلة هذه الاستبانة بدقة وموضوعية لما في ذلك من أهمية في إنجاح هذه الدراسة والتوصل إلى توصيات هادفة إن شاء الله.

إن المعلومات الواردة في الدراسة سوف تستخدم لأغراض البحث العلمي فقط وسوف تراعى السرية التامة في التعامل معها ولك حق الانسحاب في أي وقت تشائين من الدراسة.

وتفضلوا بقبول فائق التقدير والإحترام

</div>

2018

ضعي علامة (✗) عند الإجابة التي تعبر عن وضعك الصحي:

الحالة	نعم	لا
1. هل قمتِ بتغيير نمطك الغذائي خلال الحمل؟		
2. هل عانيتِ في حالات الحمل السابقة من سكري الحمل ؟		
3. هل يوجد تاريخ عائلي لمرض السكري النوع الثاني ؟		
4. هل يوجد لديكِ تاريخ من العقم أو تشخيص متلازمة تكيس المبيض ؟		
5. هل قمتِ بولادة طفل أكثر من 4 كغم في حالات الحمل السابقة ؟		
6. هل انت حامل بتوأم ؟		
7. هل قمتِ بولادة جنين ميت في حالات الحمل السابقة ؟		
8. هل يوجد لديكِ أمراض مزمنة مثل ضغط الدم، أمراض في الكلى، أمراض في الكبد، أمراض الدم، واضطراب في الغدة الدرقية؟		

	(A) المعلومات الشخصية:

A2. رقم الملف:ـــــــــــــــــــ.	A1. الأسم:ـــــــــــــــــــــ.

A5. مقابلة / إتصال تلفوني	A4. الجنسية:ـــــــــ.	A3. تاريخ الميلاد:ـــــــــــــ.

	(B) الوضع الديمغرافي:

أكثر من 35	18 – 35	أقل من 18	B1. ما هو عمرك عند الزواج؟
أكثر من 3	3	2	1	صفر	B2. كم طفل لديك؟
الخليل		بيت لحم		B3. اسم المحافظة؟
مدينة		مخيم	الريف/قرية	B4. مكان الإقامة؟

	(C) المستوى الإقتصادي والإجتماعي:

دراسات عليا	جامعية	دبلوم / كلية	ثانوي	ابتدائي	غير متعلمة	C1. مستوى تعليمك؟
غير ذلك, حدديـــــــ.	ربة منزل	طالبة	عمل خاص	موظفة		C2. عملك الحالي؟
أكثر من 4000		3001 – 4000	1500 – 3000	أقل من 1500		C3. الدخل الشهري للأسرة بالشيكل؟

			(D) التاريخ الطبي للنساء الحوامل:
لا أدري	لا	نعم	D1. هل تعانين في حملك هذا من سكري الحمل؟
لا أدري	لا	نعم	D2. هل عانت أي من أمك أو أختك من سكري الحمل؟

			(E) المتغيرات الإنجابية:
أكثر من 3	3	2	1	صفر	E1. عدد الإجهاضات؟

أكثر من 28	28 – 24	أقل من 24	E2. عمر الحمل الحالي بالأسبوع؟

(F) قياسات الجسم:

F3. وزنك الحالي؟ ____كغم.	F2. وزنك قبل الحمل؟ ____كغم.	F1. ما هو طولك؟____سم.

(G) نتائج فحوصات السكر (هذا الجزء تتم تعبئته من الملف):

	Normal Ranges		
=>110	110 – 95	95>	G1. فحص السكر صياماً FBS
=>140	140 – 136	136>	G2. فحص تحدي السكر50 غمGCT
140>	155>	180>	95>	G3. فحص تحمل السكر 100 غم OGTT
=>6.5		6.5>	G4. فحص السكري التراكمي HbA1c

(H) يرجى تقدير متوسط الاستهلاك الغذائي خلال فترة الحمل, و إذا كنتي مصابة بسكري الحمل الرجاء الإجابة ما قبل التشخيص, ويرجى الإجابة عن كل سؤال بوضع علامة (✗) عند كل سطر.

النوع	أبداً أو أقل من مرة واحدة في الشهر	1 – 3 في الشهر	مرة في الأسبوع	2 – 4 في الأسبوع	5-6 في الأسبوع	مرة في اليوم	2– 3 في اليوم	4 – 5 في اليوم	6 مرات وأكثر في اليوم حصة/اليوم
الإستهلاك اليومي	0	0.07	0.14	0.43	0.7	1	2.5	4.5	6
1. النشويات (الحبوب و منتجاتها)									
H1. خبز أبيض (1/2 رغيف)									
H2. خبز أسمر(قمح كامل) (1/2 رغيف)									
H3. الأرز مطبوخ / المعكرونة / الحبوب (البرغل, الفريكة, الذرة,القمح, مفتول,شوفان) (1/2 كوب)									
H4. بطاطا (مسلوقة, مشوية,مهروسة) (1/2 كوب)									

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									2. البروتين الحيواني (اللحوم و الأسماك)
										H5. البيض (1 بيضة)
										H6. لحم عجل / لحم خروف / دجاج / سمك طازج/مقلي/مشوي/مسلوق (120 غم) بحجم وسماكة 4 علب كبريت صغيرة
										H7. سمك السردين / التونا (60غم) / 2 علبة صغيرة
									3. البروتين النباتي (البقوليات)	
										H8. فاصولياء / بازيلاء / حمص / فول / عدس (1 كوب)
حصة/ اليوم	6 مرات وأكثر في اليوم	4 – 5 في اليوم	2– 3 في اليوم	مرة في اليوم	5-6 في الأسبوع	2 – 4 في الأسبوع	مرة في الأسبوع	1 – 3 في الشهر	أبداً أو أقل من مرة واحدة في الشهر	النوع
	6	4.5	2.5	1	0.7	0.43	0.14	0.07	0	الإستهلاك اليومي

									4. الفاكهة
									H9. فواكه طازجة (التفاح/إجاص/موز/برتقال) حبة حجم كف اليد
									H10. فواكه مجففة(زبيب/ خوخ) (1/4 كوب)
									H11. عصير الفوكه الطبيعي (3/4 الكوب)
									5. الخضار
									H12. سبانخ/ملوخية ورقية/ الخس/ الجرجير (1 كوب)
									H13. ملفوف/زهر/بروكلي (1 كوب)
									H14. خيار/بندورة/فلفل حلو (1 كوب)
									H15. الكوسى/ الباذنجان (1 كوب)
									6. الحليب ومنتجات الألبان
									H16. حليب قليل الدسم (1 كوب / 240 مل)
									H17. حليب عالي الدسم (1 كوب / 240 مل)

										H18. حليب مجفف قليل الدسم (1/3 كوب)
										H19. حليب مجفف كامل الدسم (1/3 كوب)
										H20. لبن رايب قليل الدسم (3/4 كوب)
										H21. لبن رايب عالي الدسم (3/4 كوب)
										H22. جبنة بيضاء نعاج (1 قطعة)
										H23. جبنة صفراء (1 قطعة)
										7. الزيوت و الدهون
										H24. زيت (الذرة,عباد الشمس,الصويا ,الزيتون, الفول السوداني) (1 ملعقة طعام)
										H25. زيتون (أسود,أخضر) (8 حبة كبيرة)
										H26. سمن نباتي(مرغرين) (1 ملعقة طعام)
										H27. زبدة صلبة (1 ملعقة طعام)

										H28. طحينة (حبوب السمسم) (1 ملعقة طعام)
										8. الحلويات و السكريات
										H29. شكولاتة (قطعة واحدة متوسطة)
										H30. الكعك/ البسكويت (1 قطعة متوسطة)
										H31. الكرواسون / فطيرة حلوة (1 حبة)
										H32. عسل / مربّى (1 ملعقة صغيرة)

(ا) ضعي درجة نشاطك البدني خلال فترة الحمل.

متوسط نفقات الطاقة الأسبوعية	3 ساعات و أكثر يومياً (≤ 3)	2 ساعة الى أقل من 3 ساعات في اليوم (2– >3)	1 ساعة الى أقل من 2 ساعة في اليوم (1– >2)	½ الى أقل من 1 ساعة في اليوم (½– >1)	أقل من نصف ساعة في اليوم (> ½)	لا شيء	مكافئ الأيض	
	3.0	2.5	1.5	0.75	0.25	0.0		درجة المدة
عندما لا تكونين في العمل,وخلال تواجدك في المنزل, كم من الوقت تقضينه في:								
							2.5	l1. إعداد وجبات الطعام LH
							2.0	l2. العناية بالأطفال جلوساً LH
							3.0	l3. العناية بالأطفال وقوفاً MH
							2.7	l4.اللعب مع الأطفال جلوساً او قوفاً LH
							4.0	l5. اللعب مع الأطفال مشياً او ركضاً MH
							3.0	l6. حمل الأطفال MH
							4.0	l7. رعاية كبار السن MH
							1.8	l8. استخدام جهاز الكمبيوتر S
							3.2	l9.اللعب مع الحيوانات الأليفة

								M
							2.3	I10. تنظيف خفيف للمنزل (ترتيب/الغسيل/الكوي) LH
							2.3	I11. التسوق LH
							2.8	I12. تنظيف ثقيل للمنزل (مكنسة الكهرباء/تنظيف الزجاج/المسح) LH
							2.8	I13. العناية بحديقة المنزل من خلال ركوب ماكنة مخصصة للعمل LH
							4.4	I4. العناية بحديقة المنزل مشياً MH
الذهاب الى الأماكن (كم من الوقت تقضينه في :)								
							2.5	I15. المشي ببطء (الى محطة الباص, الى العمل, زيارة) L
							4.0	I16. المشي السريع (الى محطة الباص, الى العمل, زيارة) M
							1.5	I17. قيادة السيارة أو ركوب الباص S
للمتعة أو ممارسة الرياضة (كم من الوقت تقضينه في :)								
							3.2	I18. المشي ببطء MSp

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						4.6	I19. المشي السريع MSp
						6.5	I20. المشي بسرعة الى أعلى التلال VSp
						7.0	I21. الركض VSp
						3.5	I22. ممارسة تمارين رياضية خاصة بالولادة MSp
						6.0	I23. السباحة MSp
						4.5	I24. الرقص MSp
							هل تقومين بأشياء أخرى للمتعة أو ممارسة الرياضة؟ ما هي ؟
							I25.اسم التمرين:Sp
							I26.اسم التمرين:Sp
						1.0	I27. مشاهدة التلفاز S
						1.1	I28. الجلوس/القراءة/التحدث/ على الهاتف S
							أثناء العمل (أذا كنتي تعملين الرجاء تعبئة هذا القسم)
						1.6	I29. فترة الجلوس خلال العمل SO
						3.0	I30. الوقوف أو المشي الخفيف خلال العمل مع حمل أشياء MO
						2.2	I31. الوقوف أو المشي الخفيف خلال العمل بدون حمل أشياء MO

							4.0	I32. المشي السريع خلال العمل مع حمل أشياء MO
							3.3	I33. المشي السريع خلال العمل بدون حمل أشياء MO

<div align="center">أنتهت الإستمارة.</div>

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UMASS.

Pregnancy Physical Activity Questionnaire

Instructions:
Please use an ordinary No. 2 pencil. *Fill in the circles completely. The Question will be read by a machine so if you need to change your answer, erase the incorrect mark **completely**. If you have comments, please write them on the back of the questionnaire.*

Example: During this trimester, when you are NOT at work, how much time do you usually spend:

If you take care of your mom for 2 hours each day, then your answer should look like this... →

E1. **Taking care of an older adult**

○ None
○ Less than 1/2 hour per day
○ 1/2 to almost 1 hour per day
○ 1 to almost 2 hours per day
● 2 to almost 3 hours per day
○ 3 or more hours per day

It is very important you tell us about yourself honestly. There are no right or wrong answers. We just want to know about the things you are doing during this trimester.

1. Today's Date: ☐☐ / ☐☐ / ☐☐☐☐
   Month   Day   Year

2. What was the first day of your last period? ☐☐ / ☐☐ / ☐☐☐☐   ○ I don't know
   Month   Day   Year

3. When is your baby due? ☐☐ / ☐☐ / ☐☐☐☐   ○ I don't know
   Month   Day   Year

During this trimester, when you are NOT at work, how much time do you usually spend:

4. **Preparing meals (cook, set table, wash dishes)**

   ○ None
   ○ Less than 1/2 hour per day
   ○ 1/2 to almost 1 hour per day
   ○ 1 to almost 2 hours per day
   ○ 2 to almost 3 hours per day
   ○ 3 or more hours per day

5. **Dressing, bathing, feeding children while you are <u>sitting</u>**

   ○ None
   ○ Less than 1/2 hour per day
   ○ 1/2 to almost 1 hour per day
   ○ 1 to almost 2 hours per day
   ○ 2 to almost 3 hours per day
   ○ 3 or more hours per day

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UMASS.

During this trimester, when you are NOT at work, how much time do you usually spend:

6. **Dressing, bathing, feeding children while you are standing**
   ○ None
   ○ Less than 1/2 hour per day
   ○ 1/2 to almost 1 hour per day
   ○ 1 to almost 2 hours per day
   ○ 2 to almost 3 hours per day
   ○ 3 or more hours per day

7. **Playing with children while you are sitting or standing**
   ○ None
   ○ Less than 1/2 hour per day
   ○ 1/2 to almost 1 hour per day
   ○ 1 to almost 2 hours per day
   ○ 2 to almost 3 hours per day
   ○ 3 or more hours per day

8. **Playing with children while you are walking or running**
   ○ None
   ○ Less than 1/2 hour per day
   ○ 1/2 to almost 1 hour per day
   ○ 1 to almost 2 hours per day
   ○ 2 to almost 3 hours per day
   ○ 3 or more hours per day

9. **Carrying children**
   ○ None
   ○ Less than 1/2 hour per day
   ○ 1/2 to almost 1 hour per day
   ○ 1 to almost 2 hours per day
   ○ 2 to almost 3 hours per day
   ○ 3 or more hours per day

10. **Taking care of an older adult**
    ○ None
    ○ Less than 1/2 hour per day
    ○ 1/2 to almost 1 hour per day
    ○ 1 to almost 2 hours per day
    ○ 2 to almost 3 hours per day
    ○ 3 or more hours per day

11. **Sitting and using a computer or writing, while not at work**
    ○ None
    ○ Less than 1/2 hour per day
    ○ 1/2 to almost 1 hour per day
    ○ 1 to almost 2 hours per day
    ○ 2 to almost 3 hours per day
    ○ 3 or more hours per day

12. **Watching TV or a video**
    ○ None
    ○ Less than 1/2 hour per day
    ○ 1/2 to almost 2 hours per day
    ○ 2 to almost 4 hours per day
    ○ 4 to almost 6 hours per day
    ○ 6 or more hours per day

13. **Sitting and reading, talking, or on the phone, while not at work**
    ○ None
    ○ Less than 1/2 hour per day
    ○ 1/2 to almost 2 hours per day
    ○ 2 to almost 4 hours per day
    ○ 4 to almost 6 hours per day
    ○ 6 or more hours per day

14. **Playing with pets**
    ○ None
    ○ Less than 1/2 hour per day
    ○ 1/2 to almost 1 hour per day
    ○ 1 to almost 2 hours per day
    ○ 2 to almost 3 hours per day
    ○ 3 or more hours per day

15. **Light cleaning (make beds, laundry, iron, put things away)**
    ○ None
    ○ Less than 1/2 hour per day
    ○ 1/2 to almost 1 hour per day
    ○ 1 to almost 2 hours per day
    ○ 2 to almost 3 hours per day
    ○ 3 or more hours per day

16. **Shopping (for food, clothes, or other items)**
    ○ None
    ○ Less than 1/2 hour per day
    ○ 1/2 to almost 1 hour per day
    ○ 1 to almost 2 hours per day
    ○ 2 to almost 3 hours per day
    ○ 3 or more hours per day

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During this trimester, when you are NOT at work, how much time do you usually spend:

17. **Heavier cleaning (vacuum. mop, sweep, wash windows)**
   - ○ None
   - ○ Less than 1/2 hour per week
   - ○ 1/2 to almost 1 hour per week
   - ○ 1 to almost 2 hours per week
   - ○ 2 to almost 3 hours per week
   - ○ 3 or more hours per week

18. **Mowing lawn while on a riding mower**
   - ○ None
   - ○ Less than 1/2 hour per week
   - ○ 1/2 to almost 1 hour per week
   - ○ 1 to almost 2 hours per week
   - ○ 2 to almost 3 hours per week
   - ○ 3 or more hours per week

19. **Mowing lawn using a walking mower, raking, gardening**
   - ○ None
   - ○ Less than 1/2 hour per week
   - ○ 1/2 to almost 1 hour per week
   - ○ 1 to almost 2 hours per week
   - ○ 2 to almost 3 hours per week
   - ○ 3 or more hours per week

Going Places...

During this trimester, how much time do you usually spend:

20. **Walking slowly to go places (such as to the bus, work, visiting)**
   Not for fun or exercise
   - ○ None
   - ○ Less than 1/2 hour per day
   - ○ 1/2 to almost 1 hour per day
   - ○ 1 to almost 2 hours per day
   - ○ 2 to almost 3 hours per day
   - ○ 3 or more hours per day

21. **Walking quickly to go places (such as to the bus, work, or school)**
   Not for fun or exercise
   - ○ None
   - ○ Less than 1/2 hour per day
   - ○ 1/2 to almost 1 hour per day
   - ○ 1 to almost 2 hours per day
   - ○ 2 to almost 3 hours per day
   - ○ 3 or more hours per day

22. **Driving or riding in a car or bus**
   - ○ None
   - ○ Less than 1/2 hour per day
   - ○ 1/2 to almost 1 hour per day
   - ○ 1 to almost 2 hours per day
   - ○ 2 to almost 3 hours per day
   - ○ 3 or more hours per day

For Fun or Exercise...

During this trimester, how much time do you usually spend:

23. **Walking slowly for fun or exercise**
   - ○ None
   - ○ Less than 1/2 hour per week
   - ○ 1/2 to almost 1 hour per week
   - ○ 1 to almost 2 hours per week
   - ○ 2 to almost 3 hours per week
   - ○ 3 or more hours per week

24. **Walking more quickly for fun or exercise**
   - ○ None
   - ○ Less than 1/2 hour per week
   - ○ 1/2 to almost 1 hour per week
   - ○ 1 to almost 2 hours per week
   - ○ 2 to almost 3 hours per week
   - ○ 3 or more hours per week

25. **Walking quickly up hills for fun or exercise**
   - ○ None
   - ○ Less than 1/2 hour per week
   - ○ 1/2 to almost 1 hour per week
   - ○ 1 to almost 2 hours per week
   - ○ 2 to almost 3 hours per week
   - ○ 3 or more hours per week

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During this trimester, how much time do you usually spend:

26. Jogging

○ None
○ Less than 1/2 hour per week
○ 1/2 to almost 1 hour per week
○ 1 to almost 2 hours per week
○ 2 to almost 3 hours per week
○ 3 or more hours per week

27. Prenatal exercise class

○ None
○ Less than 1/2 hour per week
○ 1/2 to almost 1 hour per week
○ 1 to almost 2 hours per week
○ 2 to almost 3 hours per week
○ 3 or more hours per week

28. Swimming

○ None
○ Less than 1/2 hour per week
○ 1/2 to almost 1 hour per week
○ 1 to almost 2 hours per week
○ 2 to almost 3 hours per week
○ 3 or more hours per week

29. Dancing

○ None
○ Less than 1/2 hour per week
○ 1/2 to almost 1 hour per week
○ 1 to almost 2 hours per week
○ 2 to almost 3 hours per week
○ 3 or more hours per week

Doing other things for fun or exercise? Please tell us what they are.

30. _____
Name of Activity

○ None
○ Less than 1/2 hour per week
○ 1/2 to almost 1 hour per week
○ 1 to almost 2 hours per week
○ 2 to almost 3 hours per week
○ 3 or more. hours per week

31. _____
Name of Activity

○ None
○ Less than 1/2 hour per week
○ 1/2 to almost 1 hour per week
○ 1 to almost 2 hours per week
○ 2 to almost 3 hours per week
○ 3 or more hours per week

Please fill out the next section if you work for wages, as a volunteer, or if you are a student. If you are a homemaker, out of work, or unable to work, you do not need to complete this last section.

At Work...

During this trimester, how much time do you usually spend:

32. Sitting at working or in class

○ None
○ Less than 1/2 hours per day
○ 1/2 to almost 2 hours per day
○ 2 to almost 4 hours per day
○ 4 to almost 6 hours per day
○ 6 or more hours per day

33. Standing or slowly walking at work while carrying things (heavier than a 1 gallon milk jug)

○ None
○ Less than 1/2 hour per day
○ 1/2 to almost 2 hours per day
○ 2 to almost 4 hours per day
○ 4 to almost 6 hours per day
○ 6 or more hours per day

34. Standing or _slowly_ walking at work _not_ carrying anything

○ None
○ Less than 1/2 hours per day
○ 1/2 to almost 2 hours per day
○ 2 to almost 4 hours per day
○ 4 to almost 6 hours per day
○ 6 or more hours per day

35. Walking _quickly_ at work while _carrying_ things (heavier than a 1 gallon milk jug)

○ None
○ Less than 1/2 hour per day
○ 1/2 to almost 2 hours per day
○ 2 to almost 4 hours per day
○ 4 to almost 6 hours per day
○ 6 or more hours per day

36. Walking _quickly_ at work _not_ carrying anything

○ None
○ Less than 1/2 hour per day
○ 1/2 to almost 2 hours per day
○ 2 to almost 4 hours per day
○ 4 to almost 6 hours per day
○ 6 or more hours per day

Thank You