An-Najah National University

**Proposal Title:**

**Adverse Pregnancy Outcomes related to Pre‑pregnancy Overweight & Obesity: A Single Center Study in Palestine**

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**Introduction:**

**Background:**

Adverse pregnancy outcomes either maternal or neonatal are very serious. According to the Palestinian Health Annual Report of 2018([1](#_ENREF_1)), we have an increasing maternal mortality ratio from 5.9/100,000 in 2017 to 16.7/100,000 live birth in 2018, a significant number of near miss cases (from 56 cases in 2017 to 91 cases in 2018) mostly due to pre-eclampsia and hemorrhage, more than 4.5/1000 stillbirths and 7/1000 early neonatal deaths (0-6 days old) which occurs mostly due to prenatal conditions.

Adverse pregnancy outcomes are health problems that involve the mother’s health, the baby’s health or both. Maternal complications include Gestational hypertension (Blood pressure ≥140/90 after 20 weeks gestation), Preeclampsia which is gestational hypertension plus proteinuria, Gestational diabetes, delivery by cesarean section (C/S), postpartum hemorrhage which is ≥1000 ml blood loss and admission to intensive care unit (ICU). Neonatal complications include preterm delivery <37 weeks, low birth weight neonates <2500, high birth weight neonates ≥4000, Apgar score at 5 min <7, Admission to neonatal intensive care unit (NICU) and congenital malformation confirmed at 20 weeks gestation.

It is very important for women to receive health care before and during pregnancy to decrease the risk of pregnancy complications.([2](#_ENREF_2)) Overweight and obesity is one of the most important avoidable risk factors of adverse pregnancy outcomes. The percentage of overweight adults aged 15-64 years in Palestine is 57.8% and 26.8% are obese.([3](#_ENREF_3)) Unfortunately**,** this trend of higher overweight and obesity has involved women of reproductive-age (15-49 years) who constitute almost 25% of the population. Several studies addressed the negative influence of maternal pre-pregnancy weight on pregnancy outcome; both for the woman and her offspring including gestational diabetes, gestational hypertension and preeclampsia, post-partum hemorrhage, high birth weight ([4-6](#_ENREF_4)) and preterm delivery.([7](#_ENREF_7), [8](#_ENREF_8)) Palestinian Health Annual Report of the year 2018([1](#_ENREF_1)) showed that almost 3% of live newborns weigh > 4000 grams and 6.3% of live newborns weigh <2500 grams.([9](#_ENREF_9)) Fetuses of obese mothers are at increased risk of stillbirth ([7](#_ENREF_7), [8](#_ENREF_8), [10](#_ENREF_10)) Furthermore, intra-partum care, normal and operative deliveries, cesarean section, anesthetic and operative interventions in obese women demand extra care and extra costs.([4](#_ENREF_4), [6](#_ENREF_6))

A cohort study was done in Italy in 2019 focused the attention on the importance of maternal weight loss in preventing pathological outcomes and offered a quantitative estimation of negative impact of pre-pregnancy obesity on the most common pregnancy and perinatal complications.([11](#_ENREF_11)) Another cross sectional study was done in 2017 at Oshkatai, Namibia shows that the risk of adverse pregnancy outcomes is four times more in obese patients (aOR 4.89, 95% CI: 1.38 to 17.37, p=0.014) ([12](#_ENREF_12)) A population based cohort study was conducted in 2015 from pregnancies in British Columbia (Canada) concluded that a 10% difference in prepregnancy BMI was associated with at least a 10% lower risk of adverse pregnancy outcomes. ([13](#_ENREF_13))

In addition to maternal pre-pregnancy weight, many other factors have been shown to be associated with adverse pregnancy outcomes like antenatal care, Birth space, weight gain during pregnancy, parity, consanguineous marriage, smoking, low socioeconomic status, etc.

Antenatal care (ANC) is critical through timely and appropriate evidence-based actions related to health promotion, disease prevention, screening, and treatment([14](#_ENREF_14)) Almost 47% of pregnant women register in the primary health care centers of Ministry of Health in West Bank/Palestine with an average of 4.5 visits during pregnancy. The maternal and child health handbook is distributed for each pregnant woman at their first ANC visit. It is a comprehensive home-based booklet designed to provide relevant health information and include integrated mother and child health records.([9](#_ENREF_9)) Based on WHO guidelines; Women should have at least eight ANC contacts during her pregnancy([14](#_ENREF_14)) and also recommends a birth space of a minimum of two years between a woman’s previous delivery and her subsequent conception.([15](#_ENREF_15)) Short (<18 months) and long (>59 months) birth space is associated with increased risks of adverse pregnancy outcomes.([16-20](#_ENREF_16)) In addition, The Institute of Medicine recommends a specific weight gain during pregnancy according to BMI.([21](#_ENREF_21)) In singleton pregnancy, normal weight women (BMI 18.5-24.9) are recommended to gain 11.5 to 16 kg, overweight women (BMI 25 – 29.9) are recommended to gain from 7 to 11.5 Kg and obese women (BMI ≥ 30) are recommended to gain from 5 to 9 Kg.

First cousin consanguineous marriage which account for 30% of all marriages in Palestine([22](#_ENREF_22)) is proposed to increase the risk of congenital malformations and stillbirth. Smoking cigarettes represents the first major environmental risk of the mother and unborn. Fetuses of mothers who Smoke during pregnancy are at increased risk of small-for-gestational age (SGA), intra-uterine growth restriction and preterm birth.([23](#_ENREF_23)) As low socio-economic factors is associated with more adverse pregnancy outcomes, approximately 30% of Palestinians in 2017 suffered from poverty.([24](#_ENREF_24)) In addition, 8.4% of Palestinians aged ≥ 15 years didn't complete any stage of education. ([24](#_ENREF_24))

**Justification statement:**

As Sustainable Development Goals (SDG) efforts to address promotion of maternal health and reduction of child mortality becomes intensified, A Palestinian Coherent theoretical framework need to be developed that can explain and analyze the possible causal relationships of factors that have potential risk to the pregnant mother and the birth outcome.

Infant mortality (<365 days) is 11.7 per 1000 live birth mostly due to conditions in the prenatal period. We are still having significant numbers of near miss cases and maternal mortality ratio as well. These are still a public health concern in the Palestinian society.

We need more studies that take more potential confounding factors into account. We need to clarify the observed associations between pre-pregnancy overweight and obesity with maternal and infant outcomes. The National Institute of Health (NIH) advises that a 10% reduction (achievable in 6 months of therapy) in body weight is associated with significant health benefits, in non-pregnant obese individuals([25](#_ENREF_25)). Until now, the potential benefits of pre-pregnancy weight reduction on maternal and perinatal outcomes have not been studied properly.

There is a need to develop an evidence base for effective interventions to put recommendations on pre-pregnancy weight reduction into practice, gaining weight during pregnancy, to advice on birth spacing and we need more control over ANC visits.

**Aim of the study:**

To study various risk factors and their relation to adverse pregnancy outcomes including Pre-pregnancy overweight and obesity, smoking, parity, gaining weight more than or below recommended according to BMI, Birth space and the number of antenatal care visits (ANC) in patients who gave birth in Hebron Hospital (Alia) Obstetric department.

**Study objectives:**

1. To assess the relationship of pre-pregnancy BMI on pregnancy outcomes.
2. To assess the relationship of weight gain in pregnancy according to BMI on pregnancy outcomes
3. To assess the relationship of birth space on pregnancy outcomes
4. To assess the relationship of smoking status of pregnant women on pregnancy outcomes.
5. To assess the relationship of parity on pregnancy outcomes.
6. To assess the relationship of the number of ANC contacts on pregnancy outcomes.

**Study questions:**

1. Do overweight and obese pregnant women have adverse pregnancy outcomes compared to normal weight pregnant women?
2. Do pregnant women who gain weight during pregnancy more or less than the recommended according to BMI have more adverse pregnancy outcomes compared to pregnant women who gain weight according to recommended?
3. Do women with less than the recommended birth space (<18 months) or more than the recommended birth (>59 months) have adverse pregnancy outcomes compared to women who have a minimum of 18 months birth space?
4. Does smoking during pregnancy have adverse pregnancy outcomes compared to non smokers?
5. Do Primigravidas and grand multiparous ≥5 have adverse pregnancy outcomes compared to women who have two to four child births?
6. Do women with less ANC contacts <8 have adverse pregnancy outcomes compared with women with more ANC contacts (≥ 8)?

**Methodology:**

**Study design:**

A case control study is going to be conducted on pregnant women giving birth to a singleton baby in Princess Alia Governmental Hospital. It is the main governmental hospital in Hebron of the West Bank/ Palestine with a capacity of 239 beds and serves 800 thousand people. ([9](#_ENREF_9))

During the year 2017, the highest occupancy rate was recorded at Hebron Hospital (Alia), which reached 155% ([9](#_ENREF_9), [26](#_ENREF_26), [27](#_ENREF_27)). The Hospital has the highest maternal near miss cases compared with other Palestinian hospitals.([9](#_ENREF_9)) In 2017, the number of births reported in Palestine (West Bank and Gaza Strip) was 136,349 of which 78,046 were born in West Bank; 20% of them were born in Hebron. A total of 6148 deliveries occurred in 2017 in Hebron Hospital with an average of 130 deliveries per week.

Data on births reported that 99.9% of births occurred at qualified health facilities in Palestine by specialized and/or trained medical personnel. More than half (54.0%) were carried out in MOH hospitals due to the availability of governmental health insurance for the majority of the Palestinian population, which provides full financial coverage of childbirth, making the hospitals of MOH the most appropriate option.([9](#_ENREF_9))

Cases are pregnant women who are going to be admitted for giving birth in Hebron Hospital with adverse pregnancy outcomes: Gestational Hypertension, Preeclampsia, Gestational diabetes, cesarean section, postpartum hemorrhage, Admission to ICU, Preterm delivery, low birth weight neonates, high birth weight neonates, Apgar at 5 min <7, Admission to NICU, congenital malformation.

Controls are pregnant women who are going to be admitted for giving birth in Hebron Hospital with no adverse pregnancy outcomes.

One control for one case is going to be selected and matched for age (±2.5 years).

**Study Setting and time:**

Pregnant women giving birth in obstetric department of Hebron Hospital during the study data collection period of two months (1/May/2019 and 30/June/ 2019) will be included.

Postpartum women completed a questionnaire during a face to face interview in the obstetric department. Data from hospital charts were extracted and interview responses were correlated with data in the “Mother and Child Health Handbook”, which is completed during antenatal care visits.

Women post normal vaginal delivery should be admitted for 24 hours unless discharged against medical advice. Women post cesarean section should be admitted for 48 hours post Cesarean Section unless discharged against medical advice.

**Study Population:**

The study population comprised of all reproductive women aged (15-49years) with previous history of one or more pregnancies and residing in the study area during the survey. All women with single pregnancies who gave birth between 24 weeks + 1 and 42 + 0 weeks of gestational age will be included.

Pregnant women with their weight is not measured at first antenatal visit or whose pre-pregnancy BMI is < 18.5 kg/m2 will be excluded. Pregnancies that are complicated by pre-existing diabetes, hypertension or puerperium fever will also be excluded.

BMI will be calculated from self-reported pre-pregnancy weight and will be correlated with the pregnant weight obtained by a health care provider at the first antenatal visit. Self-reported weight is valid according to Brunner Huber (46) and Masturzo (47)

All women are going to be categorized according to pre-pregnancy BMI following WHO guidelines: normal weight women (BMI 18.5–24.99 kg/m2), overweight women (BMI 25.00–29.99 kg/m2), obese women (BMI ≥ 30 kg/ m2).([28](#_ENREF_28)) Overweight and obese women will be compared with normal weight women for all considered outcomes. Maternal and neonatal complications during pregnancy and delivery are classified according to the International Classification of Diseases 10th Revision (Inter class diseases) ([29](#_ENREF_29)).

**Sample size:**

The minimum sample size is 298 women as calculated by Open Epicalculator as follows:

Ninety five is the two sided confidence level (1-alpha). Power (% chance of detecting) is 90. Ratio of controls to cases is one. Hypothetical proportion of controls with exposure is 26.7

Hypothetical proportion of cases with exposure is 44.49

Least extreme odds ratio to be detected is 2.2 ([12](#_ENREF_12))

Sample size for cases is 149 and Sample size for controls is 149. Total sample size is 298.

Sampling method is a convenient sampling. Age will be matched for age in a range of ± 2.5 years.

**Study Variables:**

**The main outcome variables are classified as maternal and neonatal outcomes:**

**Maternal outcomes** are gestational hypertension, pre-eclampsia, gestational diabetes mellitus, postpartum hemorrhage, delivery by C/S and admission to ICU. They are defined according to the American Association of Obstetrics and Gynecology (ACOG) as the following: Gestational hypertension is sustained BP of ≥140/90 mmHg after 20 weeks’ gestation in a previously normotensive patient without proteinuria. Preeclampsia (PE): HTN as defined above associated with proteinuria. Gestational diabetes mellitus (GDM): is diabetes diagnosed in the second or third trimester of pregnancy that was not overt diabetes prior to gestation. Post-partum hemorrhage (PPH): cumulative blood loss equal to 1000 mL or more regardless of route of delivery.

**Neonatal outcomes** that will be considered are preterm delivery, High and low birth weight, Apgar five minutes’ score <7, congenital malformations at 20 weeks and admission to NICU.

Gestational age at delivery (weeks) is calculated based on the last menstrual period (LMP). When LMP based gestational age is unknown, ultrasonography measures are relined on. Pre-term delivery (PTD) is a delivery < 37 weeks (259 days). Neonatal weight (Grams) are classified as normal, Low birth weight defined as birth-weight <2500 grams and high birth weight defined as birth-weight ≥4000 grams. Apgar five minutes’ score is performed by examining the baby's breathing effort, heart rate, muscle tone, reflexes and skin color. Reassuring status if 5-minute Apgar score is 7 to 10 as defined by the Neonatal Encephalopathy and Neurologic Outcome report.([30](#_ENREF_30)) Neonatal distress is defined as Apgar score < 7 at 5 min after birth and Stillbirth is defined as an Apgar score = 0 five min after birth.

**The main background variables** are maternal age at delivery, residence, first cousin Consanguinity marriage, maternal education, Job, income level, Smoking status during pregnancy.

**Independent variables** include prepregnancy BMI, weight gain during pregnancy, Birth space, number of ANC contacts, being primigravida, Parity and abortions.

BMI is calculated from Pre-pregnancy weight (Kg) and height (m). Weight gain during pregnancy is calculated from women’s weight post delivery in hospital minus her weight pre-pregnancy. It will be classified in three groups as inadequate, adequate and excessive weight gain. Birth space is defined as the interpregnancy interval between a woman’s previous delivery and her subsequent conception. It will be divided into three groups; less than 18 months, 18 months till 59 months, and greater than 59 months. Women with an interpregnancy interval of 18 to 59 months will be chosen to be the reference group. Primigravida is defined as first time pregnant. **Parity** is defined as the number of times that woman has given birth to a fetus with a gestational age of 24 weeks or more, regardless of whether the child was born alive or was stillborn. Grand multiparous is a woman who has already delivered five or more infants. Abortion is defined by WHO as pregnancy termination prior to 20 weeks' gestation or a fetus born weighing less than 500 grams.

**Measurement tool**

A questionnaire (Appendix I) is constructed and pretested to record study variables. It includes three sections. Section A includes demographic characteristics of the pregnant mother: Age, educational level, income level, employment status, residential area, first degree consanguinity marriage and smoking status during pregnancy. Section B addressed potential risk factors: gravidity (number of pregnancies occurred), parity (number of pregnancies reached ≥ 24 weeks), BMI, weight gain during pregnancy, Number of antenatal care contacts, Last interpregnancy interval. Section C focused on patient outcomes: Gestational Hypertension, Preeclampsia, Gestational diabetes, cesarean section, postpartum hemorrhage, Admission to ICU, Preterm delivery, low birth weight, high birth weight, APGAR’5 <7, Admission to NICU, congenital malformation.

**Validity and reliability:**

A pretested questionnaire is designed by the researcher to collect all the variables by a face to face interview with postpartum women in obstetric department. Data will also be extracted and correlated with the women’s documentation about antenatal care visits as “Mother and Child health Handbook” and Hospital charts.

BMI will be calculated from self-reported pre-pregnancy weight. Pre-pregnancy weight will be correlated with the woman’s weight measured by a health care provider at her first ANC visit. Self-reported weight is valid according to Brunner Huber ([31](#_ENREF_31)) and Masturzo([11](#_ENREF_11)).

**Statistics:**

Statistical analyses were performed using SPSS-20. Descriptive analysis for baseline characteristics, outcomes and other determinants were performed. Baseline characteristics were presented and compared. Outcomes and independent determinants were analyzed by a chi-square and t-test as appropriate. Odds ratio was used to compare between variables and P value <0.05 will be considered significant throughout the analysis. Logistic regression was used to control for confounders.

**Ethical approval**

Ethical Approval will be obtained from the Institutional Review Board (IRB) at An-Najah University. Additionally, an official permission will be obtained from the Palestinian MOH to conduct the study in Hebron Hospital (Alia) obstetric department. Data will be collected after informed verbal consent is obtained (Appendix II) and after the women are stabilized and ready to be discharged. All data will be treated as confidential.

**Results**

A total of 300 participants, 150 cases and 150 controls matched for age were included in the study. Table 1 shows the demographic characteristics of the participants: The mean age of the mothers is 26.4 ± 5.5 years. Majority (81%) is from Hebron villages and 19% is from Hebron city. More than half (59%) have a school education, 7% has a college education and 34% has a university education, and most (94%) are not employed. No significant difference was observed between cases and controls for background variables (Table 1).

Cases have more first cousin consanguineous marriage than controls; 27% of cases compared to 23% of controls, but there is no significant difference (p value is 0.42). Smoking was found to be minimal among the participating mothers; almost 3% of mothers smoked during pregnancy even for at least one puff. 4% of cases smoke compared to 2.7% of controls and with no significant difference (p value is 0.75) (Table 1).

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| Table 1: Demographic characteristics of the study participants (n=300) | | | | | |
| ***Demographic factors*** | ***Total*** | ***Case*** | ***Control*** | | ***P-value*** |
| **Maternal Age at delivery** *Mean±SD* | 26.4± 5.5 | 26.6 ± 5.7 | 26.18±5.3 | | 0.52# |
| **Residence** |  |  |  | |  |
| City | 57 (19%) | 28 (18.7%) | 29 (19.3%) | | 1.0\* |
| Village | 243 (81%) | 122 (81.3%) | 121 (80.7%) | |
| **Education** |  |  |  |  |  |
| School | 176 (58.7%) | 86 (57.3%) | 90(60%) | | 0.7\* |
| College | 22 (7.3%) | 10 (6.7%) | 12(8%) | |
| University | 102 (34%) | 54 (36%) | 48(32%) | |
| **Employment** |  |  |  |  |  |
| Yes | 18 (6%) | 11 (7.3%) | 7(4.7%) | | 0.47\* |
| No | 282 (94%) | 139 (92.7%) | 143(95.3%) | |
| **Household Income** (NIS) |  |  |  |  |  |
| <2500 | 132 (44%) | 69 (46%) | 63 (42%) | | 0.76\* |
| 2500-5000 | 159 (53%) | 77 (51.3%) | 82 (54.7) | |
| >5000 | 9 (3%) | 4 (2.7%) | 5 (3.3%) | |
| **Consanguinity** |  |  |  |  |  |
| Yes | 75 (25%) | 41 (27.3) | 34 (22.7) | | 0.42\* |
| No | 225 (75%) | 109 (72.7) | 116 (77.3) | |
| **Smoking** |  |  |  |  |  |
| Yes | 10 (3.3%) | 6 (4%) | 4 (2.7%) | | 0.75\* |
| No | 290 (96.7%) | 144 (96%) | 146 (97.3) | |

\*Chi-sqaure test # Independent T-test

Table 2 shows the type and frequency of adverse pregnancy outcomes among cases. The most common complication is Caesarean section (C/S); 56% of cases had either an emergency or an elective C/S. forty five percent of cases had a Newborn with either a low birth weight or a high birth weight and 31% had a preterm delivery. Seventeen percent of cases had their newborn admitted to NICU, and 10% and 9% of cases had postpartum hemorrhage and preeclampsia, respectively.

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| **Table 2**: The type and frequency of adverse pregnancy outcomes are as follows (n=150) | |
| **Complication** | **Frequency (percentage)** |
| Caesarean section  Emergency  Elective | **85 (56.6%)**  56 (37.3%)  29 (19.3%) |
| Low and High birth weight  Low birth weight  High birth weight | **67 (45%)**  46 (30.9%)  21 (14.1%) |
| Preterm delivery | **47(31.3%)** |
| Admitted to NICU | **26 (17.3%)** |
| Postpartum hemorrhage | **15 (10%)** |
| Preclampsia | **14 (9.3%)** |
| Congenital malformation | **10 (6.7%)** |
| Apgar score <7 \* | **7 (4.7%)** |
| Admission to ICU | **5 (3.3%)** |
| Gestational Hypertension | **5 (3.3%)** |
| Gestational Diabetes | **4 (2.7%)** |
| \*Including stillbirth |  |

Table 3 shows the association of Clinical and obstetrical risk factors for adverse pregnancy outcomes among participants. Majority (76%) are multigravida and a quarter (24%) are Primigravida of which 31% are cases and 18% are controls with a significant difference (p value is 0.011). Grand multiparous (≥5) have significantly increased risk for adverse pregnancy outcomes with a p value of 0.007.

Historically, Majority (84%) of multigravida reported that they have had a delivery as the preceding birth and 16% reported that they have had an abortion. There is no significant difference (P value = 0.58) on adverse pregnancy outcome between having the preceding birth as an abortion or a delivery.

Controls are slightly taller than cases, the mean height of cases is 1.58± 0.1 and of controls’ is 1.6± 0.1 with no significant difference (p value is 0.4)

The frequency of prepregnancy overweight and/or obesity was significantly higher among cases (47.3%) compared to control (34.7%). This difference is found to be significant (p value is 0.01)

Almost 70% of multigravida who has the preceding pregnancy as an abortion has a birth space of less than six months. Birth space shows insignificant differences on adverse pregnancy outcomes between cases and controls (P-value is 0.7).

More than half of multigravida (53.4%) with the preceding birth as a delivery has either a short birth space <18 months or a long birth space of more than 59 months. Birth space shows insignificant difference between cases and controls (P value is 0.45).

For the BMI, 65% of mothers had either inadequate or adequate weight gain and 35% had excessive weight gain with no significant difference (p value is 0.46). It was noticed that overweight and obese mothers tend to gain excessive weight during their pregnancy than normal weight mothers.

Majority (70%) of mothers had at least eight ANC visits with no significant difference when compared to mothers with less than ANC visits (P value is 0.9).

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| Table 3: Clinical and obstetrical risk factors for adverse pregnancy outcomes among participants (n=300) | | | | | | | | | | |
| **Clinical factors** | **Total** | | **Cases** | | | | **Controls** | | **P- Value** | |
|  |
| **Gravidity**  =1 | 73 (24.3%) | | 46(30.7%) | | | | 27(18%) | | 0.011\* | |
| >1 | 227(75.7%) | | 104(69.3%) | | | | 123 (82%) | |
| **Parity**  1  2-4  ≥5 | 83 (27.7%)  157 (52.3%)  60 (20%) | | 48 (32%)  65 (43.3%)  37 (24.7%) | | | | 35 (23.3%)  92 (61.3)  23 (15.3%) | | 0.007\* | |
| **preceding birth** |  | |  | | | |  | |  | |
| Delivery | 191 (84.1%) | | 86 (82.7%) | | | | 105 (85.4%) | | 0.58\* | |
| Abortion | 36 (15.9%) | | 18 (17.3%) | | | | 18 (14.6%) | |  | |
| **Maternal Height** *(mean±SD)* | 1.6 ± 0.1 | | 1.58 ± 0.1 | | | | 1.6± 0.1 | | 0.4# | |
| **Prepregnancy BMI** |  | |  | | | |  | |  | |
| Obese and overweight | 123 (41%) | | 71 (47.3%) | | | | 52 (34.7%) | | 0.01\* | |
| Normal | 177 (59%) | | 79 (52.7%) | | | | 98 (65.3%) | |
| **Birth Space for preceding abortion** | | | |  | |  | |  | |  | |
| <6 months | | 25(69.4%) | | | 12(66.7%) | | 13(72.2%) | | | 0.7\* | |
| ≥6 months | | 11(30.6%) | | | 6(33.3%) | | 5(27.8%) | | |  | |
| **Birth space for preceding delivery** | | | | | | | | | | | |
| Short <18 | | 92(48.2%) | | | 38(44.2%) | | 54(51.4%) | | | 0.45\* | |
| Normal interval | | 89(46.6%) | | | 42(48.8%) | | 47(44.8%) | | |  | |
| Long >59 | | 10(5.2%) | | | 6(7%) | | 4(3.8%) | | |  | |
| **Weight gain during pregnancy** | | | | | | | | | | | |
| inadequate  adequate | | 96(32%)  98 (32.7%) | | | 51(34%)  44(29.3%) | | 45(30%)  54 (36%) | | | 0.46\* | |
| excessive | | 106(35.3%) | | | 55 (36.7%) | | 51(34%) | | |  | |
| **ANC visits**  <8  ≥8 | | 91 (30.3%)  209 (69.7%) | | | 46 (30.7%)  104 (69.3%) | | 45 (30%)  105 (70%) | | | 0.9\* | |

\*Chi-sqaure test # Independent T-test

The multivariate logistic regression model was performed to control for confounders. It included all variables found to be significant in the univariate analysis; gravidity, parity and pre-pregnancy BMI. Controlling for these variable, Logistic-Regression Model revealed that adverse pregnancy outcomes is predicted by pre-pregnancy BMI [adjusted OR= 1.8, P value= 0.019], gravidity [adjusted OR= 8.2, P value= 0.012], and parity (≥5) [adjusted OR= 6.1, P value= 0.031]. (Table 4)

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| **Table 4:** Multivariate analysis for the adverse pregnancy outcomes | | | | |
| ***Clinical factors*** | **SE** | **P value** | **Adjusted OR** | **95%CI** |
| **Pre-pregnancy BMI** |  |  |  |  |
| Normal**1**  Obese and overweight | 0.254 | 0.019 | 1.8 | **1.1-3.0** |
| **Parity** |  |  |  |  |
| One**1**  Two-Four  ≥Five | 1  0.81  0.84 | 0.67  0.031 | 3.1  6.1 | 0.63-15.2  1.8- 31.6 |
| **Gravidity** |  |  |  |  |
| One  >One**1** | 0.84 | 0.012 | 8.3 | 1.6-42.5 |
| ***1****Reference group,****SE=*** *Standard Error ,* ***OR****=Odds Ratio,* ***CI****=confidence Interval* | | | | |

**Discussion**

Most of the sample are non smokers from Hebron Villages with 25% first cousin consanguineous marriage, have an income level of less than 5000 NIS, have school education and are unemployed. There is no significant difference in demographic characteristics between cases and controls. Delivery by cesarean section and having either a low or a high birth weight newborn are the most frequent adverse pregnancy outcomes followed by preterm delivery and admission to NICU.

In this study, Twenty five percent of the sample had first cousin consanguineous marriage. This is not surprising, as it is a long-standing socially accepted practice among Palestinian population. The prevalence of first cousin consanguineous marriages in rural Palestinian community according to Farid Ghrayeb represents 34.8% of all marriages([22](#_ENREF_22)). Only 3.3% of the participants confessed smoking; 4% are cases compared to 2.7% of controls with no significant difference. Generally smoking is low among Palestinian women, as 20% of Palestinian adults (15-64 years) smoke according to Stepwise survey, 37.6% are males and 2.6% are females.([3](#_ENREF_3)) No significant difference is found between cases and controls in relation to Demographic factors, as shown in table 1.

Among cases it is noticed that the most frequent adverse pregnancy outcome was caesarean section (56.6%) followed by low and high birth weight, preterm birth and admission to NICU. Having C/S as the most frequent adverse pregnancy outcome is consistent with other studies done in Namibia, UK, Australia and Italy ([11](#_ENREF_11), [12](#_ENREF_12), [32](#_ENREF_32), [33](#_ENREF_33)), where C/S percentage was 32.6% in Namibia, 31.9% in UK, 27% in Australia and 37.2% in Italy. According to PHIC 2018, the percentage of C/S in Hebron Governmental Hospital is 19%([1](#_ENREF_1)) a little bit higher than the 10% to 15% recommended by WHO ([34](#_ENREF_34)) and this percent is of the lowest among the Palestinian Hospitals 25% ([1](#_ENREF_1)). In addition, 81% of the sample is from Hebron villages where there are safe Normal delivery centers that refer high risk pregnant women that need C/S to Hebron Hospital.

In order to decrease the frequency of adverse pregnancy outcomes, we studied various obstetrical and clinical risk factors including pre-pregnancy overweight and obesity, gaining weight more than or below recommended according to BMI, Parity, Birth space and the number of ANC visits. Increasing pre-pregnancy BMI, primigravidity and grand multiparity played significant roles in adverse pregnancy outcomes.

The finding that maternal BMI is significantly associated with adverse pregnancy outcomes have been observed in several other studies ([11-13](#_ENREF_11), [35-37](#_ENREF_35)). Specifically, increasing pre-pregnancy BMI have been shown to increase the risk of C/S, adversely affects birth weight and induces preterm delivery. ([32](#_ENREF_32)) The potential mechanism that elevates the risk of overweight and obese women to fail normal vaginal delivery is that the presence of excess intra-abdominal adipose tissue could mechanically obstruct the progression of labor. This could overtime, compromises feto-placental circulation, causes fetal distress and necessitates C/S. ([38](#_ENREF_38)) The relation between maternal obesity and spontaneous preterm birth may be caused by premature rupture of membranes([39](#_ENREF_39)) or by higher levels of pro-inflammatory cytokine and inflammatory regulation in obese mothers during pregnancy([40](#_ENREF_40))

In addition, gaining excessive weight in pregnancy above IOM recommendations is found to be associated with being overweight and obese and this is consistent with other studies ([41](#_ENREF_41)).

Primigravidity (p is 0.01) is found to be significantly associated with adverse pregnancy outcomes and these findings are consistent with other studies, too ([42](#_ENREF_42), [43](#_ENREF_43)). Intrapartum risk is based mainly on the past obstetric history which is lacking in all primigravidas. Only active labor is the most important determinant of normal vaginal delivery. In addition, there are fundamental differences in what constitutes normal labor in a primigravida and multigravida. Primigravida women had the longest and most gradual labor curve when compared with multigravida women.([44](#_ENREF_44))

Grand multiparity is also found to be significantly associated with adverse pregnancy outcomes (p is 0.03). A study done in Tanzania([45](#_ENREF_45)) explained that with repeated deliveries of grand multipara, the uterine wall becomes weak resulting in inability to adequately contract. There is also a possible existence of heightened risk for placental pathologies among women of extreme parity. ([46](#_ENREF_46), [47](#_ENREF_47))

Birth space haven’t shown to be a risk factor for adverse pregnancy outcomes as short birth space is associated with increased risk of beginning a subsequent pregnancy obese.([48](#_ENREF_48))

The direct association of short birth space intervals on adverse pregnancy outcomes could be confounded by other factors including young maternal age, lower socioeconomic status and lower utilization of health services.([49](#_ENREF_49)) One of the most frequent hypothesis that has been proposed to explain the association between short birth intervals and adverse pregnancy outcomes is maternal nutritional depletion phenomenon. Short birth space doesn’t allow mothers sufficient time to restore nutritional reserves needed to support fetal growth and development during the subsequent pregnancy. ([19](#_ENREF_19), [50](#_ENREF_50))  In this study, we excluded women of pre-pregnancy BMI <18.5 kg/m2 who may have problems with nutrition and all sample has attended PHC clinics with an average of 9 ANC visits both in PHC and private sector, 70% of them attended ≥8 ANC visits. Antenatal care attendance increases awareness of potential complications, identifies risk factors, plans for complications that may arise, encourage emergency preparedness and planning. In addition, Women offered folic acid 5 mg preconception and for the first three months of pregnancy. They are given multivitamins, Calcium and Iron in her second and thirds trimester. Women are given one high dose capsule Vitamin A directly observed in PHC clinics in the first week of delivery and she is given iron supplements for the 6 weeks postnatal. All this care is free in PHC of MOH and doesn’t need health insurance, which means that is accessible to low socioeconomic class.

Concerning long birth space intervals, only 5% of the sample (10 participants) had long birth space interval and it is impossible to correctly interpret the results.

**Strengths and limitations:**

One of the major strengths of this study is including various risk factors for adverse pregnancy outcomes while adjusted for age. Categorizing women’s BMI and weight gain according to WHO classifications.

On the other hand, the results of this study should be interpreted in light of several limitations; the sample is small and in one center; this can affect generalizability of the results.

Prepregnancy BMI was obtained from maternal recall and correlated with first ANC visit. Although most reproductive-aged women report weight and height accurately, some over and underestimation of pre-pregnancy weight is expected ([31](#_ENREF_31)) and thus may be subject to misclassification.

**Conclusion and Recommendations**

Overweight and obesity is a risk factor for adverse pregnancy outcomes; it increases the likelihood of failing normal delivery and this takes considerable toll on healthcare costs.

Closer observation for overweight and obese women, primigravidas and grand multiparas than regular patients during labor and delivery may improve population-level perinatal outcomes. We need an unlimited access not only to appropriate contraceptives but also to prenatal care, skillful medical practitioners and adequate facilities to safe delivery.

All this calls for a need to increase community awareness on these risks. We need to apply healthy dietary promotion programs and exercise for reproductive age women in the community, to consider overweight and obese women “at risk” according to local policy and national guidelines and address weight management in pre-pregnancy counseling.

Further studies are recommended to evaluate the effectiveness of dietary and lifestyle interventions among women with elevated pre-pregnancy BMI in reducing adverse pregnancy outcomes.

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**Appendix I: Questionaire for singleton pregnancy**

|  |  |
| --- | --- |
| Maternal Age |  |
| Place of residence: | CityVillageRefugee camp |
| Maternal education | School College University |
| Work | Employed Unemployed |
| 1st  cousin consanguineous marriage | Yes No |
| Income level of family | <2500 NIS 2500🡪5000 NIS >5000 NIS |
| Smoking in pregnancy | Yes No |
| Gravidity |  |
| Parity |  |
| Abortions |  |
| Number of live children |  |
| Outcome of last pregnancy | Abortion stillbirth neonatal death  twins live birth |
| Date of birth of last pregnancy |  |
| LMP |  |
| EDD |  |
| Height (m) |  |
| **Pre-preg weight (Kg)** |  |
| Weight at **1st** ANC visit |  |
| Weight at **end** of pregnancy |  |
| # of ANC contacts in **PHC unit** |  |
| # of contacts **Outside** PHC |  |
| Neonate Gender | Male Female Unknown |
| Neonatal weight (g) |  |
| Date of birth |  |
| APGAR score 5’ min |  |
| Gestational DM | Yes No |
| Gestational HTN | Yes No |
| Preeclampsia | Yes No |
| Mode of delivery | Vaginal Emergency C/S Elective C/S |
| Post-partum hemorrhage | Yes No |
| Admission to ICU | Yes No |
| Shoulder dystocia | Yes No |
| Admission to NICU | Yes No |
| Congenital anomalies | Yes No |

**Appendix II:**

**Consent Form:**

اتفاقية المشاركة في الدراسة

هذه الدراسة تبحث في ايجاد العلاقة بين وزن المرأة قبل الحمل مع المضاعفات التي ممكن ان تواجهها السيدة والجنين خلال حملها وبعد الولادة.

سنحافظ على سرية المعلومات الخاصة بك وبطفلك.

الام : اوافق على المشاركة في الدراسة

وموافقة ولي الامر للأم الاصغر عمرا من 18 عاما