

# The Pattern of Changes in Body Mass Index Before and During Pregnancy. The Maternal and Neonatal Outcome

Gamal Sayed, Husam Salama, Lina Abdulla, Sawsan Al-Obaidly, Mai Al.Qubasi, Ashraf Mansour

## Abstract:

**Background:** Obesity compromises the health of a woman's pregnancy and her newborn.

**Aim:** To describe weight-gaining changes throughout pregnancy and evaluate outcomes for the mother and the baby.

**Methods:** A retrospective review of women who delivered singletons using a Large perinatal registry was undertaken. Based on their body mass index (BMI), patients were categorized into four categories: underweight, normal, overweight, and obese. Mode of delivery, gestational diabetes, hypertensive disorders, obstetric cholestasis, and postpartum hemorrhage (PPH) were the main maternal outcome measures. The newborn outcome indicators were birth weight, neonatal intensive care unit (NICU) hospitalization, premature birth, and stillbirth.

**Results:** The study sample included 2,352 natives (25.0%) and 7,058 expatriates (75.0%). Most of the sample (4,726) were aged 20-29; 43.6% were aged 30-39; 2.1% were aged 19; and 3.9% were aged 40 years. The incidence of hypertension, obstetric cholestasis, diabetes, postpartum hemorrhage, and cesarean section varied among the sample. In the underweight group, the incidence of cesarean section (C.S.) was 15.7%; in the normal weight group, 24.9%; in the overweight group, 31.3%; and in the obese group, 41.0%.

Hypertensive disorders were three times more prevalent in obese women than in normal-weight women (2,0%), and 5.3% of obese women had PPH compared to 5.6% of women of normal weight. The underweight group gained the most weight during pregnancy, whereas the obese group gained the least.

**Conclusions:** A significant proportion of pregnant women in our sample will become obese by delivery. Obesity during pregnancy is associated with adverse maternal and fetal outcomes.

**Keywords:** BMI, maternal outcome, neonatal outcome, Obesity, Qatar, pregnancy.

## List of Abbreviations:

BMI	Body Mass Index
EMR	Electronic Medical Record
GDM	Gestational Diabetes Mellitus
HMC	Hamad Medical Corporation
NICU	Neonatal Intensive Care Unit
PPH	Postpartum Hemorrhage

## Introduction:

Obesity has reached an alarming proportion around the world. This has been described as a "global epidemic" and a "major public health issue" by the World Health Organization (1). The expansion may be related to the evolving cultural, social, and economic

forces affecting numerous nations. Obesity has been more common in the general population since the 1990s, affecting both the general public and women of reproductive age, particularly pregnant women (2,3). Obesity during pregnancy increases the risks to both the mother and the newborn (4). Furthermore, it places pregnant women and their infants at risk for unfavorable pregnancy outcomes, including postpartum weight retention, which increases the potential for long-term obesity (5).

**"Obesity has been more common in the general population since the 1990s, affecting both the general public and women of reproductive age, particularly pregnant women (2,3). Obesity during pregnancy increases the risks to both the mother and the newborn (4). Furthermore, it places pregnant women and their infants at risk for unfavorable pregnancy outcomes, including postpartum weight retention, which increases the potential for long-term obesity (5)."**

Obesity is also an issue for healthcare workers. It has become one of the most severe healthcare complications for pregnant women in the last decade, putting an additional strain on healthcare systems, and there is a strong relationship between Body Mass Index (BMI) and healthcare spending (6).

**"The obesity pandemic has also been prevalent in Qatar, a country with a population of 2.6 million, of which only 12.0% are natives. This country is rapidly modernizing, quickly becoming one of the world's largest liquid gas exporters, ranking in the top ten countries in per capita GDP (7-9)."**

The obesity pandemic has also been prevalent in Qatar, a country with a population of 2.6 million, of which only 12.0% are natives. This country is rapidly modernizing, quickly becoming one of the world's largest liquid gas exporters, ranking in the top ten countries in per capita GDP (7-9). Women constitute around 25% of the country's population (10, 11). Rapid modernization, a diverse

population, increased availability of various varieties of food and fast food, a high intake of processed foods, and a lack of physical activity, among other things, have all been linked to an increase in the number of obese persons (7). According to the Qatar National Health Strategy, 70.1% of adults (including ex-pats and indigenous) residing in Qatar are either overweight (28.7%) or obese (41.4%) (9). This research aims to discover how BMI is distributed and changing among pregnant women in Qatar and how it affects pregnancy outcomes and other health consequences.

#### **Study Methods:**

This study used data from the Qatar Pearl-Peristat Registry funded by The Qatar National Research Fund. The registry is a retrospective study focusing on maternal and newborn medical records from four government-run hospitals in the country, with information on the perinatal and postpartum periods. The private sector has been omitted from the registry because it accounts for less than 15.0% of all births in Qatar and does not use the same electronic health record system. Most of the registry data came from Cerner™ shared electronic medical records connecting all four government hospitals.

---

***“This study used data from the Qatar Pearl-Peristat Registry funded by The Qatar National Research Fund. The registry is a retrospective study focusing on maternal and newborn medical records from four government-run hospitals in the country, with information on the perinatal and postpartum periods.”***

---

In addition, a post-delivery social data questionnaire was used to collect socioeconomic and demographic health information about the parturient women’s social status. Under the guidance of a full-time, qualified research associate, the registry research team comprises 12 research assistants who collect patient data directly from the family (social data) or through the electronic clinical data, Cerner™. The collected data was assessed and saved in software developed specifically for the Dendrite® database system, and it was analyzed with both Dendrite® and Statistical Package for the Social Sciences (SPSS®) version 21. The Medical Research Center of Hamad Medical Corporation granted ethical approval from the Pearl-Peristat Registry. For participants, no written consent was required. Before getting social data, participants provided verbal agreement and were handed patient information pamphlets.

The current study looked at the BMI of singleton babies at the four main state-run hospitals where women were delivered. The BMI was measured before pregnancy (or early in the first trimester), during the antenatal clinic visits, and at the time of birth.

#### **Body Mass Index Calculation and Classification:**

In this study, pregnant women were categorized based on their Body Mass Index (BMI) into four groups as in non-pregnant women: underweight (BMI < 18.5), normal weight (BMI 18.5–24.9),

overweight (BMI 25–29.9), and obese (BMI ≥ 30) (12). The pre-pregnancy, booking, and delivery BMIs were calculated using hospital weight and height data. The BMI of everyone was computed by dividing their weight (in kilograms) by their height (in centimeters). For the analysis, the pre-pregnancy BMI variable was determined. The pre-pregnancy BMI is the BMI before pregnancy or the BMI during the first trimester of pregnancy. Moribund obesity has been combined with the “obesity” category to allow for more meaningful comparisons, referred to as obesity in this study. The following BMI categories were statistically compared: (1) “underweight,” (2) “normal weight,” (3) “overweight,” and (4) “obesity.”

#### **Outcome metrics:**

Maternal variables include maternal age, gravidity, parity, mode of delivery, gestational diabetes mellitus (GDM), hypertension, cholestasis, and postpartum hemorrhage (PPH). Neonatal variables included low birth weight (less than 2500 grams), gestational age less than 37 weeks, live births or stillbirths, and postnatal ward or neonatal intensive care (NICU) admission.

---

***“Maternal variables include maternal age, gravidity, parity, mode of delivery, gestational diabetes mellitus (GDM), hypertension, cholestasis, and postpartum hemorrhage (PPH). Neonatal variables included low birth weight (less than 2500 grams), gestational age less than 37 weeks, live births or stillbirths, and postnatal ward or neonatal intensive care (NICU) admission.”***

---

#### **Statistics for analysis:**

Descriptive statistics were generated using IBM SPSS 21 statistical software to understand the distribution of the variables. A two-sided P value of 0.05 was used to assess statistical significance. Both univariate and multivariate analyses were used in the modeling technique. We used univariate and multivariate logistic regression to evaluate the association between BMI and research findings. The univariate method was used to investigate the basic (unadjusted) association. A multivariable analysis was performed to investigate the relationship between BMI and pregnancy outcomes, considering the influence of other relevant confounding variables.

---

***“A multivariable analysis was performed to investigate the relationship between BMI and pregnancy outcomes, considering the influence of other relevant confounding variables.”***

---

**“The study comprised 2960 single pregnant women who had their pre-pregnancy or early pregnancy BMI calculated. Underweight women accounted for 83, normal-weight women for 1053, overweight women accounted for 937, and obese women accounted for 887 (Table 1).”**

**Results:**

The study comprised 2960 single pregnant women who had their pre-pregnancy or early pregnancy BMI calculated. Underweight women accounted for 83, normal-weight women for 1053, overweight women accounted for 937, and obese women accounted for 887 (Table 1).

was 15.7% in the underweight group, 24.9% in the normal weight group, 31.3% in the overweight group, and 41% in the obese group. GDM was diagnosed in 37.5 percent of obese women, 31.8 percent of overweight women, 23 percent of normal-weight women, and 16.7 percent of underweight women. Hypertensive conditions were three times as common in obese women than in normal-weight women. Women who were overweight or obese did not have an increased risk of postpartum hemorrhage; 5.3% of obese women versus 5.6% of normal-weight women experienced PPH (Table 2). The proportion of overweight and Obesity among Qatari women was 32% and 37%, compared to 31% and 28% in non-Qatari women, respectively. Throughout pregnancy, the rate of obesity and overweight was noted to increase significantly; where only 29% of the sample size was labeled as obese in the pre-pregnancy period, the rate increased to 56% at delivery. In other words, the underweight group gained the most weight during pregnancy, whereas the obese group gained the least. The mean weight gain in underweight was 13 (±9 kg), 11(±6) in normal weight, kg 9 (kg ±6) in overweight, and 6.8 (±7 kg.) in obese women with a total weight gain of 9 (±7 kg) in all age groups (Figure 2).

**Table 1: Distribution according to measured pre-pregnancy BMI category (2960 Women)**

Variables	Underweight N= 83 (2.8%)	Normal N=1053 (35.0%)	Overweight N=937 (31.6%)	Obese N=887 (30.0%)	P*
<b>Maternal age</b>					<.0001
**≤19 years	0 (0)	29 (2.8)	15 (1.6)	10 (1.1)	
20-29 years	65 (78.3)	609 (57.8)	447 (47.7)	308 (34.7)	
30-39 years	15 (18.1)	397 (37.7)	440 (47)	503 (56.7)	
≥40 years	3 (3.6)	18 (1.7)	35 (3.7)	66 (7.4)	
<b>Gravidity</b>					<0.0001
1	37 (44.6)	362 (34.4)	199 (21.2)	115 (13)	
2-4	41 (49.4)	573 (54.4)	551 (58.8)	484 (54.6)	
≥5	5 (6)	118 (11.2)	187 (20)	288 (32.5)	
<b>Parity</b>					<0.0001
Nulliparous	42 (50.6)	433 (41.1)	246 (26.3)	144 (16.2)	
Multiparous ≥1	41 (49.4)	620 (58.9)	691 (73.7)	743 (83.8)	
<b>Nationality</b>					<0.0001
Qatari	18 (21.7)	182 (17.3)	212 (22.6)	242 (27.3)	
Non-Qatari	65 (78.3)	870 (82.7)	725 (77.4)	645 (72.7)	

\*Chi-square tests for association pre-gestation BMI and maternal age, gravidity, parity, and nationality. \*\* 19-year group had no underweight.

Obesity risk increased linearly as maternal age increased. Obesity was found in 19% of women younger than 20 years old, 22% of 20- to 29-year-old women, 37% of 30- to 39-year-old women, and 54% of women over 40 years old (Figure 1). The pre-pregnancy BMI was calculated to be 2,960. 2.8% (83) of women were underweight, 35.6% (1105) were normal weight, 31.6% (937) were overweight, and 30% (887) were obese, according to their pre-pregnancy BMI (Table, Figure 1).

Increased BMI increases the risk of cesarean section, gestational diabetes (GDM), and hypertension. The incidence of C.S.

**“The pre-pregnancy BMI was calculated to be 2,960. 2.8% (83) of women were underweight, 35.6% (1105) were normal weight, 31.6% (937) were overweight, and 30% (887) were obese, according to their pre-pregnancy BMI (Table, Figure 1). ”**

**Table 2: Comparison of Maternal outcomes between underweight, Normal, Overweight, and Obese**

	Under	Normal	Over	Obese	Over vs Normal		Obese vs Normal	
	(83) N (%)	(1053) N (%)	(937) N (%)	(887) N (%)	aOR* (95% CI)	p-value	aOR* (95% CI)	p-value
Cesarean	13 (15.7)	262 (25.0)	293 (31.0)	364 (41.0)	1.29 (1.05–1.57)	0.014	1.82 (1.48–2.22)	0.000
PPH	6 (7.2)	59 (5.6)	48 (5.1)	47 (5.3)	1.05 (.70–1.56)	0.814	1.21 (.79–1.84)	0.366
GDM	14 (16.7)	242 (23.0)	298 (31.8)	333 (37.5)	1.51 (1.23–1.85)	0.000	1.87 (1.52–2.29)	0.000
Hypertension	2 (2.4)	21 (2.0)	38 (4.1)	54 (6.1)	2.37 (1.36–4.13)	0.002	3.68 (2.13– 6.36)	0.000
All types of D.M.	15 (18)	266 (25.4)	337 (36.1)	394 (44.6)	1.66 (1.37–2.01)	0.001	2.36 (1.95–2.86)	0.0001

\*Adjusted for maternal age, parity, and nationality. Underweight excluded from the analysis.

**Table 3: BMI and Neonatal outcomes**

	Underweight	Normal	Overweight	Obese	Overweight vs Normal		Obese vs Normal	
	(83) N (%)	(1053) N (%)	(937) N (%)	(887) N (%)	aOR* (95% C.I.)	p-value	aOR* (95% C.I.)	p-value
NICU**	12 (14.5)	118 (11.3)	116 (12.5)	128 (14)	1.21 (0.92 - 1.59)	0.18	1.50 (1.13 - 2.0)	0.005
Stillborn	0 (0.0)	7 (0.7)	5 (0.5)	10 (1.1)	0.74 (0.23 - 2.35)	0.61	1.55 (0.56 - 4.27)	0.394
Preterm**	9 (10.8)	61 (5.8)	75 (8.0)	88 (9.9)	1.59 (1.09 - 2.29)	0.014	1.84 (1.26 - 2.68)	0.001
≤ 2499g**	11 (13.3)	75 (7.1)	54 (5.8)	66 (7.4)	0.90 (0.61 - 1.32)	0.595	1.13 (0.77- 1.66)	0.543
≥ 4000g**	1 (1.2)	32 (3.0)	63 (6.7)	62 (7.0)	2.12 (1.37 - 3.29)	0.001	2.09 (1.33 - 3.28)	0.001
Died in DR/OT§	0 (0.0)	2 (.2)	1 (0.1)	2 (0.2)	0.56 (0.01 -6.20)	0.41	1.19 (0.17- 8.5)	0.17

\*aOR: odds ratio adjusted for maternal age, parity, and nationality. Underweight excluded from the analysis.

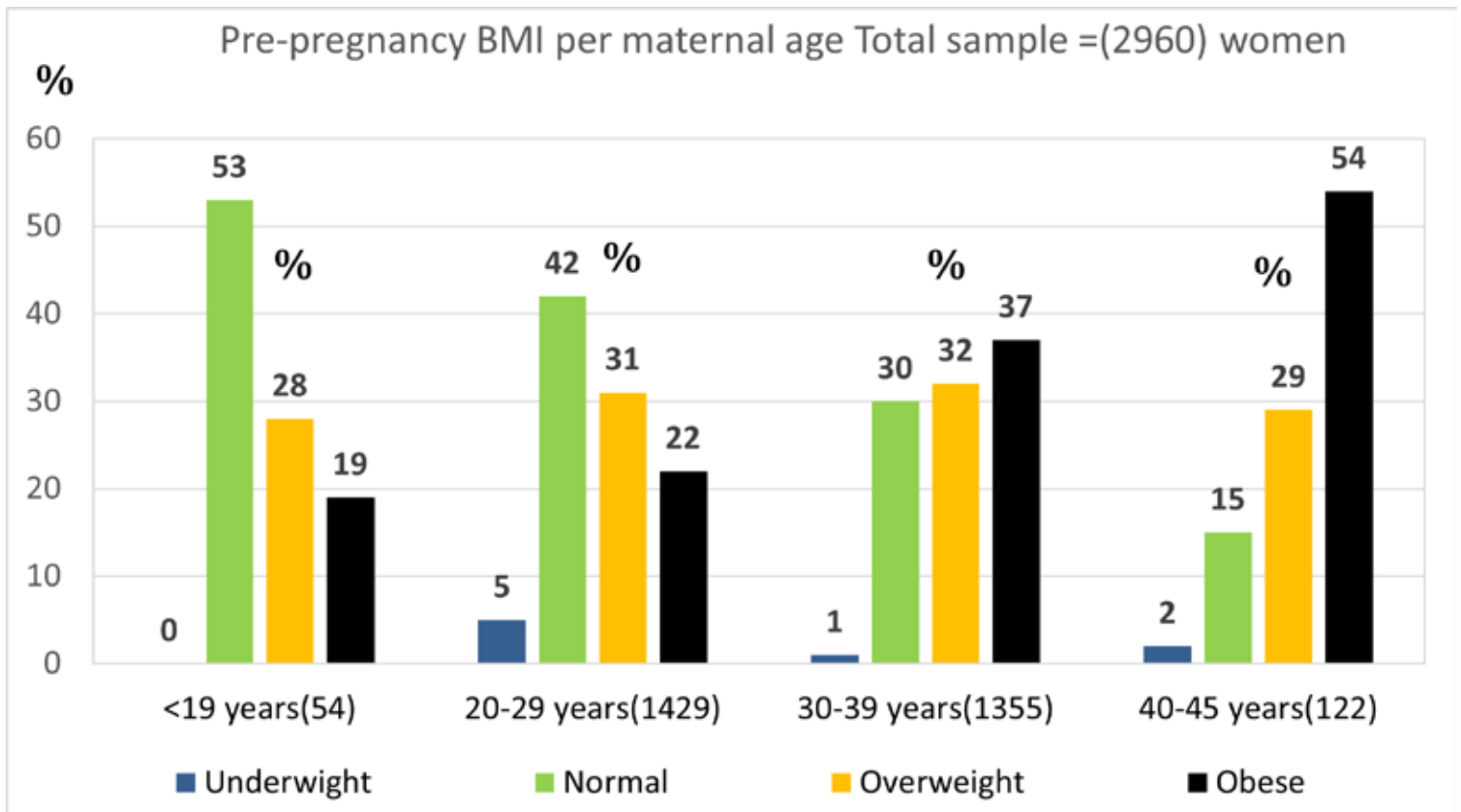
\*\*Live-born only. § DR/OT= delivery room or Operating theater

The percentage of babies admitted to the neonatal intensive care unit (NICU) in the pre-pregnancy BMI-tested sample was higher for obese mothers than for women with a normal BMI. 14.6% of babies born to obese mothers were admitted to the NICU, compared to 11.3% of newborns born to normal-weight mothers. The probability of stillbirth in the obese group was not significantly high in the obese group. Preterm births were more common in the underweight (11.8%) and obese (9.9%) groups than in the normal

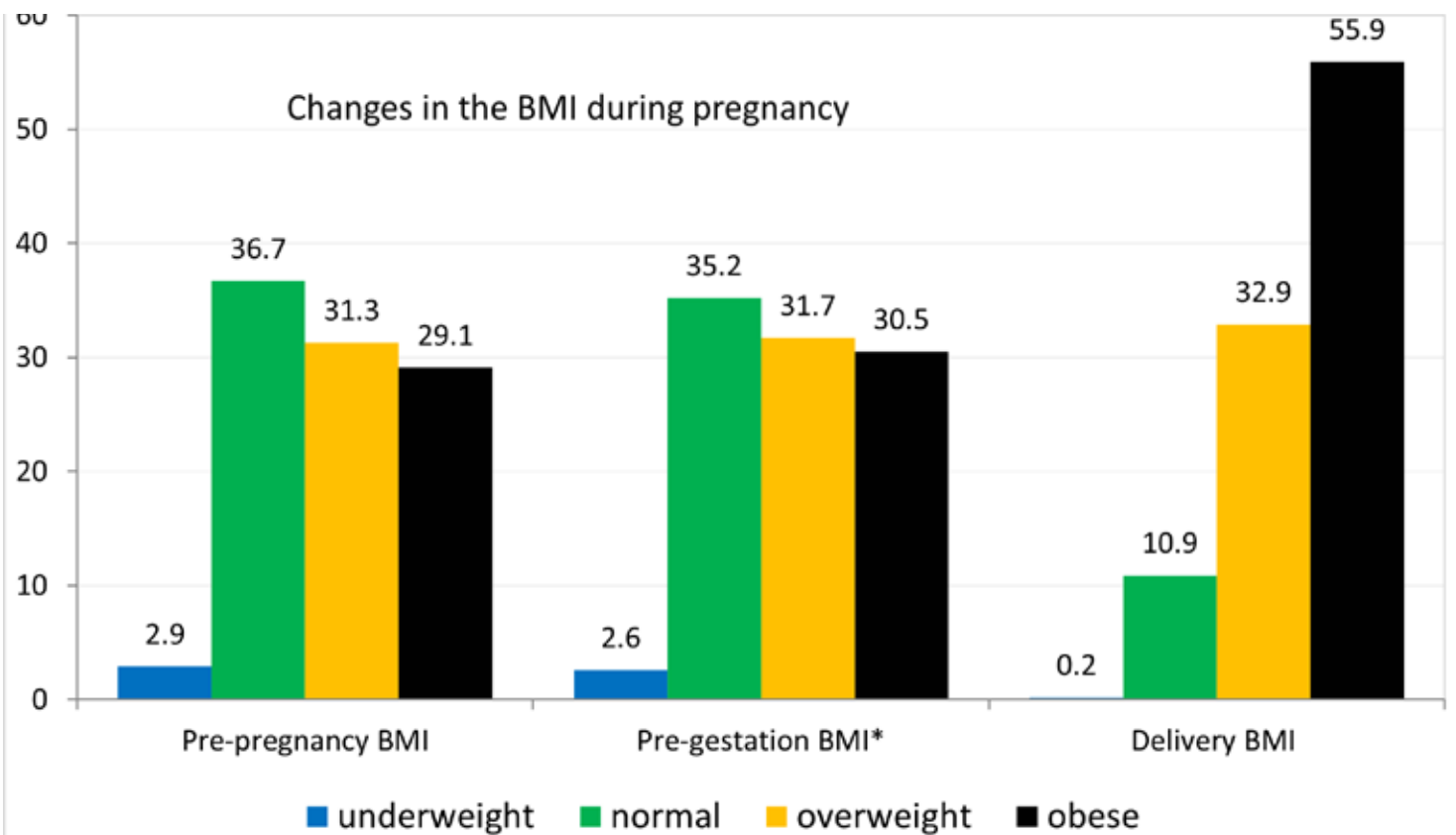
BMI (4.9%) group. It was typical for babies born to overweight or obese mothers to weigh more than 4000 grams. Just 7% of obese women had newborns weighing more than 4000 grams, compared to 3% of women with a normal BMI (Table 3).

**Results of Logistic Regression:**

There was no link between overweight or obese and stillbirth or low birth weight. An above-normal BMI, on the other hand, was



**Figure 1:** Pre-pregnancy BMI and maternal age. Older women are more likely to become obese.



**Figure 2:** During the first four weeks of pregnancy, there is no significant difference from the period before conception. However, at delivery, there was a noticeable change. A large percentage of pregnant women considered healthy, or underweight before their pregnancies will be classified as obese after giving birth.



linked to a 1.5-fold greater risk of preterm birth, macrosomia, and NICU hospitalization (see Table 3). Overweight women were 1.3 times more likely than normal-weight women to have a cesarean section, 1.5 times more likely to develop GDM, and two times more likely to have hypertensive issues. Obese women's traits were enhanced. They were twice as likely to have a cesarean birth, gestational diabetes, and hypertensive issues throughout pregnancy (Table 2).

---

***“Overweight women were 1.3 times more likely than normal-weight women to have a cesarean section, 1.5 times more likely to develop GDM, and two times more likely to have hypertensive issues. Obese women’s traits were enhanced. They were twice as likely to have a cesarean birth, gestational diabetes, and hypertensive issues throughout pregnancy (Table 2).”***

---

#### **Discussion:**

The Maternal and Neonatal Registry data were used in this hospital-based study to learn more about the association between BMI and various perinatal outcomes in our population. Pregnant women with a high BMI were more likely to have a cesarean section, develop gestational diabetes, and develop hypertension in our study. For overweight and obese mothers, however, there was no increase in postpartum hemorrhage (PPH). PPH was found in 5.3% of obese women and 5.6% of average-weight women (Table 2). Various research studies have disputed the precise effect of Obesity on PPH. Our findings do support that weight is not a significant risk factor for postpartum hemorrhage, consistent with the previous research findings (13). However, another study encountered a positive relationship between obesity and postpartum hemorrhage, implying that as obesity levels rise, so will the incidence of atonic postpartum hemorrhage (14). Inconsistencies in definitions, variations in practices and health care systems, racial compositions, and study participant variability are all possible causes of the rise in PPH in various studies (13,14). One of the study's strengths is that it was carried out at a single institution with slight changes in some confounding variables found in other research.

---

***“The risk of gestational diabetes (GDM) grows linearly with obesity. GDM was diagnosed in 37.5% of obese women, 31.8% of overweight women, 23% of normal-weight women, and 16.7% of underweight women.”***

---

The risk of gestational diabetes (GDM) grows linearly with obesity. GDM was diagnosed in 37.5% of obese women, 31.8% of overweight women, 23% of normal-weight women, and 16.7% of underweight women. This finding is consistent with previous research that shows that the higher the BMI, the higher the incidence of GDM (15). Obesity prevalence increased linearly with maternal age. Obese women increased from 19% in the 19–40 age group to 54% in the >40 age group. Obesity was more prevalent among natives than foreigners (Figure 1), and it is an essential factor to consider when counseling women of various ages. Basic health care and weight-loss programs should be emphasized more strongly in older age groups considering childbearing. Obesity is linked to aging, which raises the risk of insulin resistance and metabolic syndrome (16).

---

***“Some of our study’s participants may have gained more weight than necessary, putting them at risk of retaining extra weight after the pregnancy and reaping no legitimate advantage. In one study, 47% of pregnant women gained more weight than the Institute of Medicine (IOM) recommendations, implying an increased risk of adverse maternal and infant outcomes (19).”***

---

In our study, mothers with a low BMI at the start of their pregnancy gained more weight than mothers with a higher BMI (Figure 2). This observation is worth debating. The allowable weight gain parameters during pregnancy are a source of significant debate. Weight gain ranges are not provided in the U.K. recommendations (16). The North American Institute of Medicine (IOM) recommends that underweight women gain up to 18 kg and obese women gain up to 9 kg. (18) Our findings can help with prenatal counseling and tailoring the optimal weight gain during pregnancy conversation. Some of our study's participants may have gained more weight than necessary, putting them at risk of retaining extra weight after the pregnancy and reaping no legitimate advantage. In one study, 47% of pregnant women gained more weight than the Institute of Medicine (IOM) recommendations, implying an increased risk of adverse maternal and infant outcomes (19). Given our findings and that Qatar is a cultural melting pot, fully adhering to IOM norms may not be prudent.

Six parameters were used in this study to examine the influence of greater BMI on neonatal outcomes (Table 3). The neonatal intensive care unit (NICU) admission was chosen as the criterion for measuring the physical status at birth and as an indicator of the effect of the mother's BMI on the baby's health. Underweight and obese mothers had a higher percentage of babies admitted to the NICU when compared to women with a normal BMI. Babies delivered to obese mothers were admitted to the NICU at a rate of 14.6%, compared to 11.3% of children born to normal-weight mothers ( $p=0.005$ ). This finding is consistent with previous research that indicated an increased likelihood of newborn critical

care admission for infants born to obese mothers (20-22). In a study of 3,388 women, there were no differences in NICU admissions between obese and normal mothers (23). The disparity in findings may be due to differences in identifying and prioritizing infants who can benefit from NICU treatment among institutions.

Using birth weight as a proxy for intrauterine growth, researchers observed that the probability of delivering a baby weighing more than 4,000 grams rose as maternal BMI before conception increased. 7% of obese women had newborns weighing more than 4000 grams, compared to 3% of women with a normal BMI ( $p=0.001$ ). This discovery adds to previous studies that found a 1.5–2.3% increase in the likelihood of obese mothers giving birth to large-for-gestational-age infants. Obesity in the mother is a well-known risk factor for rapid intrauterine growth, with fetal macrosomia consistently associated with a higher maternal body mass index (24). Obesity is significantly linked to the delivery of newborns in the 90th percentile (24).

Few researchers raised concerns regarding an association between obesity and an increased risk of stillbirth (26). In our report, the incidence of stillbirth was 1.1% in the obese group versus 0.7% in the normal BMI group with low significance (Table 3). In contrast, there were no stillbirths in the underweight group, confirming previous studies that found a reduction in stillbirths among mothers with a low BMI (27). There are several unresolved questions about the specific role of obesity on stillbirth.

---

***“ In our report, the incidence of stillbirth was 1.1% in the obese group versus 0.7% in the normal BMI group with low significance (Table 3). In contrast, there were no stillbirths in the underweight group, confirming previous studies that found a reduction in stillbirths among mothers with a low BMI (27). There are several unresolved questions about the specific role of obesity on stillbirth.”***

---

#### **Conclusion:**

Obesity and stillbirth are both challenging issues with multiple complicating factors. These risk factors for increased obesity may also place the baby at risk for stillbirth. As such, increasing BMI is a significant proxy to validate an increased risk for stillbirth. (27) Furthermore, because our study is based on a single institution with a diverse population, numerous confounding factors observed in earlier studies may not apply to this study. Based on our findings and previous reported data, we believe that encouraging weight loss programs before pregnancy can help reduce stillbirth rates in subsequent pregnancies in our demographic as well, in addition to the many benefits of weight loss. As well as following a more nutritional program during pregnancy to avoid unnecessary excessive weight gain by the end of pregnancy.

#### **Weakness, Strengths, and Limitations:**

The prospective cohort nature of this study is a major strength of our investigation. Because of the large cohort size, a phenotype may be chosen to investigate the effects of high BMI on maternal and infant outcomes. Several confounding variables associated with diverse healthcare systems or practices are avoided by conducting the study in a single institution (Hamad Medical Corporation) that follows the same clinical protocols and shares the same rotating medical and nursing staff with a reasonably large sample size. Furthermore, our findings can be applied to a broader range of populations because the study population and sample are distinct.

#### **References:**

- 1 Obesity: preventing and managing the global epidemic. Report of a WHO consultation. World Health Organ Tech Rep Ser. 2000;894:i-xii, 1-253. PMID: 11234459.
- 2 Office for National Statistics. NHS. Statistics on Obesity, Physical Activity and Diet: England, January 2008. London, 2008.
- 3 Chen C, Xu X, Yan Y. Estimated global overweight and Obesity burden in pregnant women based on panel data model. PLoS One 2018;13(8):e0202183. Published 2018 Aug 9. doi:10.1371/journal.pone.0202183
- 4 Fitzsimons KJ, Modder J; Centre for Maternal and Child Enquires. Setting maternity care standards for women with obesity in pregnancy. Semin Fetal Neonatal Med 2010;15(2):100-107. doi:10.1016/j.siny.2009.09.004
- 5 Shaikh H, Robinson S, Teoh TG. Management of maternal Obesity prior to and during pregnancy. Semin Fetal Neonatal Med 2010;15(2):77-82. doi:10.1016/j.siny.2009.10.003
- 6 Morgan KL, Rahman MA, Macey S, et al. Obesity in pregnancy: a retrospective prevalence-based study on health service utilisation and costs on the NHS. BMJ Open 2014;4(2):e003983. Published 2014 Feb 27. doi:10.1136/bmjopen-2013-003983
- 7 Taheri S, Al-Thani M. Obesity in Qatar: current and future strategies. Lancet Diabetes Endocrinol 2021;9(9):561-562. doi:10.1016/S2213-8587(21)00209-6
- 8 World Bank, World development indicators. (2022). GDP per capita – Qatar. <https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=QA>
- 9 Qatar National Health Strategy (2018-2022). <https://www.moph.gov.qa/english/strategies/National-Health-Strategy-2018-2022/Pages/default.aspx>
- 10 World Bank, World development indicator. (2022). Population, female (% of total population) – Qatar. <https://data.worldbank.org/indicator/SP.POP.TOTL.FE.ZS?locations=QA>
- 11 Woman and Man in the State of Qatar: a Statistical Portrait (2018). [https://www.psa.gov.qa/en/statistics/Statistical%20Releases/Social/GenrealSocialStatistics/MenWomenProfile/2018/Woman\\_Man\\_2018\\_EN.pdf](https://www.psa.gov.qa/en/statistics/Statistical%20Releases/Social/GenrealSocialStatistics/MenWomenProfile/2018/Woman_Man_2018_EN.pdf)
- 12 Simko M, Totka A, Vondrova D, Samohyl M, Jurkovicova J, Trnka M, Cibulkova A, Stofko J, Argalasova L. Maternal Body Mass Index and Gestational Weight Gain and Their Asso-

- ciation with Pregnancy Complications and Perinatal Conditions. *Int J Environ Res Public Health*. 2019;16(10):1751. doi: 10.3390/ijerph16101751.
- 13 Butwick AJ, Abreo A, Bateman BT, et al. Effect of Maternal Body Mass Index on Postpartum Hemorrhage. *Anesthesiology* 2018;128(4):774-783. doi:10.1097/ALN.0000000000002082
  - 14 Blomberg M. Maternal obesity and risk of postpartum hemorrhage. *Obstet Gynecol*. 2011;118(3):561-568. doi:10.1097/AOG.0b013e31822a6c59
  - 15 Catalano PM. The impact of gestational diabetes and maternal obesity on the mother and her offspring. *J Dev Orig Health Dis* 2010;1(4):208-215. doi:10.1017/S2040174410000115
  - 16 National Institute for Health and Care Excellence (NICE). Weight management before, during and after pregnancy. Public health guideline [PH27]. London: NICE; 2010
  - 17 Rasmussen KM, Yaktine AL, Institute of Medicine (U.S.) and National Research Council (U.S.) Committee to Reexamine IOM Pregnancy Weight Guidelines, eds. *Weight Gain During Pregnancy: Reexamining the Guidelines*. Washington (D.C.): National Academies Press (U.S.); 2009.
  - 18 Goldstein RF, Abell SK, Ranasinha S, et al. Association of Gestational Weight Gain With Maternal and Infant Outcomes: A Systematic Review and Meta-analysis. *JAMA* 2017;317(21):2207-2225. doi:10.1001/jama.2017.3635
  - 19 Usha Kiran TS, Hemmadi S, Bethel J, Evans J. Outcome of pregnancy in a woman with an increased body mass index. *BJOG* 2005;112(6):768-772. doi:10.1111/j.1471-0528.2004.00546.x
  - 20 Callaway LK, Prins JB, Chang AM, McIntyre HD. The prevalence and impact of overweight and obesity in an Australian obstetric population. *Med J Aust* 2006;184(2):56-59. doi:10.5694/j.1326-5377.2006.tb00115.x
  - 21 Kalk P, Guthmann F, Krause K, et al. Impact of maternal body mass index on neonatal outcome. *Eur J Med Res* 2009;14(5):216-222. doi:10.1186/2047-783x-14-5-216
  - 22 Vinturache AE, McDonald S, Slater D, Tough S. Perinatal outcomes of maternal overweight and obesity in term infants: a population-based cohort study in Canada. *Sci Rep* 2015;5:9334. Published 2015 Mar 20. doi:10.1038/srep09334
  - 23 Yao R, Ananth CV, Park BY, Pereira L, Plante LA; Perinatal Research Consortium. Obesity and the risk of stillbirth: a population-based cohort study. *Am J Obstet Gynecol* 2014;210(5):457.e1-457.e4579. doi:10.1016/j.ajog.2014.01.044
  - 24 Leddy MA, Power ML, Schulkin J. The impact of maternal obesity on maternal and fetal health. *Rev Obstet Gynecol* 2008;1(4):170-178.
  - 25 Sebire NJ, Jolly M, Harris JP, et al. Maternal obesity and pregnancy outcome: a study of 287,213 pregnancies in London. *Int J Obes Relat Metab Disord* 2001;25(8):1175-1182. doi:10.1038/sj.ijo.0801670
  - 26 Jura M, Kozak LP. Obesity and related consequences to aging. *Age (Dordr)* 2016;38(1):23. doi:10.1007/s11357-016-9884-3
  - 27 Gardosi J, Madurasinghe V, Williams M, Malik A, Francis A. Maternal and fetal risk factors for stillbirth: population based study. *BMJ* 2013;346:f108. Published 2013 Jan 24. doi:10.1136/bmj.f108

**Acknowledgments:** *The data in this publication was retrieved from The Pear-PeriSat maternal-neonatal registry funded by the Qatar National Research Fund. The authors support the publication of this study.*

**Conflicts of Interest:** *Each author declares that he or she has no commercial associations (e.g., consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.*

**Author Contribution:** *S.G. wrote the initial copies of the manuscript, SH is the primary principal investigator of the Pear-Peristat study, formulated the final copy of the manuscript, contributed to the conceptualization of the study, investigation, data curation, performed formal analysis, software, and review and editing the manuscript's drafts as well as the journal submission process. A.L. carries out drafting the original manuscript. AM, G.S., AS, and AM review and edit the manuscript's draft. All authors approved the final version of the manuscript.*

**NT**







*Gamal Sayed*  
 Department of Obstetrics and Gynecology. Women's wellness and research Centre Hamad Medical corporation (Qatar)  
 Clinical Department, College of Medicine, QU Health, Qatar University, Doha, Qatar  
 Email: [Gahmed5@hamad.qa](mailto:Gahmed5@hamad.qa)



*Sawsan Al-Obaidly*  
 Department of Obstetrics and Gynecology. Women's wellness and research Centre Hamad Medical corporation (Qatar)  
 Email: [Salobaidly@hamad.qa](mailto:Salobaidly@hamad.qa)

*Corresponding Author*



*Husam Salama*  
 Department of Neonatology, Women's wellness and research Centre Hamad Medical corporation (Qatar)  
 NICU-Hamad Medical City. 3050,  
 Phone: 097440261411 & 097455262159  
 E-mail: [hsalama1@hamad.qa](mailto:hsalama1@hamad.qa)



*Mai Al-Qubaisi*  
 Department of Neonatology, Women's wellness and research Centre Hamad Medical corporation (Qatar)  
 Email: [MALQUBAISI@hamad.qa](mailto:MALQUBAISI@hamad.qa)



*Lina Abdullah*  
 Department of Neonatology, Women's wellness and research Centre Hamad Medical corporation (Qatar)  
 Email: [LAbdullah1@hamad.qa](mailto:LAbdullah1@hamad.qa)



*Ashraf Mansour*  
 Department of Neonatology, Women's wellness and research Centre Hamad Medical corporation (Qatar)  
 Email: [amansour2@hmc.org.qa](mailto:amansour2@hmc.org.qa)