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Original Article

Pregnancy outcomes in a population with high prevalence of obesity: How bad is it?

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ABSTRACT

Introduction: The prevalence of obesity and overweight in United Arab Emirates (UAE) reaches 39.9% among females and the WHO estimates that obesity prevalence will reach 44.6% among females by the year 2015.

Objective: To evaluate the effect of varying degrees of maternal obesity on perinatal outcomes.

Methods: Retrospective study of 1985 women grouped into 5 groups according to the body mass index (BMI) measurements in early pregnancy. Group 1 – BMI 18.5–24.9 (normal weight), Group 2 – BMI 25–29.9 (overweight), Group 3 – BMI 30–34.9 (obesity class I), Group 4 – BMI 35–39.9 (obesity class II), Group 5 – BMI 40 or more (obesity class III). The obstetric and perinatal outcomes were compared by creating multiple logistic regression models.

Results: Morbidly obese women were about 5 times more likely to develop hypertensive disorders of pregnancy (OR = 4.97, 95% CI, 1.35–18.33, $p = 0.016$), 4 times more likely to develop gestational diabetes (OR 3.75, 95% CI, 1.83–7.69, $p = 0.001$), 3 times more likely to deliver post-term (OR 2.99, 95% CI 1.35–6.65, $p = 0.007$), 3 times more at risk of delivering by caesarean section (OR 2.73, 95% CI, 1.61–4.65, $p = 0.0001$) and at a very high risk of delivering big babies, OR 17.30 (95% CI, 15.48–54.62, $p = 0.001$).

Conclusion: Maternal obesity especially morbid obesity in early pregnancy is strongly associated with a number of obstetrical and perinatal complications. Pregnancies in obese women should be managed as high risk pregnancies with strategies for prevention, early detection and management of complications arising from obesity.

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1. Introduction

Obesity has become a worldwide epidemic.¹ World Health Organization (WHO) reports in 2005 indicate that approximately 1.6 billion adults were overweight and at least 400 million adults were obese. The WHO and the National

Institute of Health define underweight as a body mass index (BMI) of 18.5 or less, normal weight as a BMI of 18.5–24.9, overweight as a BMI of 25–29.9 and obesity as a BMI of 30 or greater. Obesity is further classified by BMI into class I (BMI of 30–34.9), class II (BMI of 35–39.9) and class III (BMI of 40 or more).¹ The prevalence of obesity and overweight in United

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Arab Emirates (UAE) reaches 39.9% among females and WHO estimates that prevalence will reach 44.6% among females by the year 2015.²

Obesity during pregnancy has been reported in various studies to increase morbidity, specifically hypertension,^{3–5} diabetes,^{3–5} gestational diabetes,^{4,6,7} preeclampsia^{3,5,7} and postpartum hemorrhage.^{8,9} Higher rates of induction of labor,^{7,10} caesarean deliveries^{3,4,6,11–17} and dystocia resulting from macrosomia^{4,6} are reported in obese women. Some studies also report increase in the risk of preterm delivery in obese women.¹¹ UK Confidential Enquiry into Maternal Deaths has highlighted obesity as a factor in increasing the maternal mortality in the United Kingdom.^{18,19}

Most of the studies reporting the effect of obesity on pregnancy outcomes are from developed countries but there is paucity of data from developing countries.

2. Objective

The main objective of this study was to confirm the hypothesis that obese pregnant women are more prone for adverse pregnancy outcomes, and to quantify that risk after adjusting for conceivable confounders.

3. Material and methods

This retrospective observational study evaluating 1985 women with singleton pregnancies was carried out at Mafraq Hospital which is a tertiary care government referral hospital in Abu Dhabi. The duration of the study was from December 2010 to October 2011.

Approval for the study was obtained from the hospital's Research & Ethics Committee.

Data was retrieved from the maternity register and computer based information system.

The study sample consisted of all the women who delivered during the study period with the following exclusion criteria.

1. Underweight women with BMI less than 18.5
2. Multiple pregnancies
3. Women with pre-existing hypertension
4. Women with pre-existing diabetes
5. Women for whom first trimester BMI was unavailable.

The women were grouped according to the BMI measurement recorded in early pregnancy.

BMI 18.5–24.9 = normal weight. i.e. control.

BMI 25–29.9 = overweight.

BMI 30–34.9 = obesity class I.

BMI 35–39.9 = obesity class II.

BMI 40 or more = obesity class III).

Maternal outcome variables analyzed were – hypertensive disorders of pregnancy, gestational diabetes mellitus, placental abruption, placenta previa, intrauterine growth restriction, need for induction of labor, mode of delivery,

caesarean section rate, operative vaginal delivery, preterm delivery at less than 32 weeks gestation, preterm delivery at less than 37 weeks gestation and delivery beyond 41 completed weeks.

Neonatal outcome variables analyzed were- birth weight less than 2.5 kg, birth weight more than 4 kg, Apgar score less than 7 at 5 min, congenital anomalies, admission to neonatal intensive care unit and stillbirth beyond 28 weeks gestation.

These outcome variables in overweight and obese women were compared with those of women with normal BMI. Within the obese women group further comparison was done across different BMI groups to analyze the trends in the occurrence of outcome variables.

In univariate analysis frequency distributions were generated for each variable separately. Categorical variables were summarized in percentages and continuous variables in terms of mean and standard deviation. A standard case-control analysis strategy was followed due to retrospective nature of the study design. Women with normal BMI were considered as 'Controls' and overweight or obese women constituted the 'Cases' for comparison purposes. In bivariate analyses, differences in percentages between the comparison groups were tested by Chi-square test and the differences in means were tested by t-test.

Crude estimates of Odds ratio (OR) were calculated to quantify association between an exposure and an outcome. Estimates of standard errors and 95% Confidence intervals (CI) were calculated by Cornfield method and Fisher's exact method. In multivariate analyses, unconditional, multiple logistic regression models were used to obtain estimates of ORs accounting for the role of confounders. e.g. age, parity, hypertension and diabetes. Attributable Risk Proportion (ARP) and Population Attributable Risk Proportion (PARP) were also calculated as measures of health impact. A *p* value less than 0.05 was considered statistically significant. Statistical analyses were carried out in STATA software version 10.1, 2009, and Epi Info version 7.1.0.6, 2012.

4. Results

A total cohort of 1985 women was included in the study sample constituting the five groups with their respective sample sizes and proportions as follows: Overweight, *n* = 635 (31.9%); Obese class I, *n* = 520 (26.2%); Obese class II, *n* = 280 (14.1%); Obese class III, *n* = 130 (6.5%) and control group, *n* = 420 (21.1%).

Maternal characteristics of study and control population are shown in Table 1. Distribution of age and parity across different groups is shown in Tables 2 and 3 respectively. Obese class II & III women were slightly older in age and a significant number in these two groups were grand multiparous (parity 5–9).

Comparison of antenatal complications among Cases and Controls is presented in Table 4.

The risk of gestational diabetes mellitus showed a statistically highly significant increase in all groups of obesity in comparison to women with normal BMI. The increment in the risk estimates suggests an increasing trend across the obesity groups. Risk almost doubled for obese class I (OR 2.05, 95% CI,

Table 1 – Summary statistics on baseline maternal characteristics of study sample by BMI groups.

BMI groups	Statistic	Gravidity	Parity	Miscarriages	Maternal age (years)	BMI	Gestational age (weeks)	Baby weight (kg)
Control Group n = 420	Mean	2 ^a	1 ^a	0 ^a	26.26	22.78	39 ^a	2.94
	SD	2.13	1.86	0.74	5.47	1.46	2.35	0.53
	Min	1	0	0	16	20.01	23	0.5
	Max	13	10	8	52	24.99	44	4.1
Overweight n = 635	Mean	3 ^a	2 ^a	0 ^a	27.83	27.60	40 ^a	3.10
	SD	2.85	2.46	0.89	6.04	1.40	2.44	0.53
	Min	1	0	0	15	25	22	0.5
	Max	14	13	6	46	29.96	44	4.4
Obese class I n = 520	Mean	4 ^a	2 ^a	0 ^a	29.00	32.16	40 ^a	3.20
	SD	2.87	2.49	0.96	6.22	1.38	2.32	0.57
	Min	1	0	0	16	30	23	0.5
	Max	13	11	6	51	34.2	44	4.8
Obese class II n = 280	Mean	4 ^a	2 ^a	0 ^a	30.18	37.00	39 ^a	3.20
	SD	2.89	2.61	0.77	6.77	1.35	2.34	0.60
	Min	1	0	0	17	35.17	25	0.7
	Max	13	10	4	47	39.95	42	4.8
Obese class III n = 130	Mean	5 ^a	3 ^a	0 ^a	30.36	43.60	40 ^a	3.37
	SD	2.82	2.49	0.99	5.96	3.61	2.09	0.63
	Min	1	0	0	18	40.01	27	0.8
	Max	13	11	6	45	52.6	42	4.8

a Indicates median values for some discrete variables.

1.15–3.66, $p = 0.016$), tripled for obese class II (OR 3.13, 95% CI, 1.69–5.77, $p = 0.001$) and almost quadrupled for obese class III (OR 3.75, 95% CI, 1.83–7.69, $p = 0.001$) women.

A positive, very strong and significant association was observed between obesity and hypertensive disorders of pregnancy only for morbidly obese group, i.e. obese class III women. These subjects were almost 5 times at higher risk of development of hypertensive disorders of pregnancy as compared to controls (OR = 4.97, 95% CI, 1.35–18.33, $p = 0.016$). Increase in risk of this complication was not statistically significant in other study groups.

There was a decreased risk of intrauterine growth restriction in overweight and obese class I women. This reduced risk was two third in comparison to controls.

Placenta previa, placental abruption and antenatal still-birth occurred equally frequently among study and control groups.

Obese women were more likely to deliver by caesarean section. The risk estimates suggest an increasing trend across

the obesity groups. The risk was one and a half times more in obese class I (OR 1.51, 95% CI, 1.05–2.19, $p = 0.028$), double in obese class II (OR 2.09, 95% CI, 1.38–3.17, $p = 0.001$) and almost triple in obese class III (OR 2.73, 95% CI, 1.61–4.65, $p = 0.0001$) women in comparison to control group. The increase in caesarean section was significantly more for elective as compared to emergency indications. Commonest indications for elective caesarean section being post-term pregnancy and macrosomia. Although no significant association was observed between emergency caesarean section rates and lower classes of obesity, the Obese class III women carried almost two-times higher risk of delivering by emergency caesarean section (OR 1.99, 95% CI, 1.05–3.79, $p = 0.035$) as compared to controls (Table 5).

Compared to controls, obese class III women were 3 times more likely to deliver beyond 41 weeks, (OR 2.99, 95% CI, 1.35–6.65, $p = 0.007$). Proportion of preterm delivery at less than 37 weeks gestation was lower in obese class III women but was not statistically significant after adjusting for

Table 2 – Age distribution of study subjects by BMI groups.

Maternal age (years)	Control group n = 420		Overweight n = 635		Obese class I n = 520		Obese class II n = 280		Obese class III n = 130		Total n = 1985	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
15–19	31	7.38	32	5.04	18	3.46	10	3.57	2	1.54	93	4.69
20–24	151	35.95	182	28.66	115	22.12	52	18.57	19	14.62	519	26.15
25–29	122	29.05	206	32.44	167	32.12	78	27.86	43	33.08	616	31.03
30–34	83	19.76	125	19.69	114	21.92	69	24.64	31	23.85	422	21.26
35–39	25	5.95	58	9.13	74	14.23	40	14.29	26	20	223	11.23
40–44	6	1.43	30	4.72	27	5.19	26	9.29	8	6.15	97	4.89
45–49	1	0.24	2	0.31	3	0.58	5	1.79	1	0.77	12	0.6
50 or more	1	0.24	0	0	2	0.38	0	0	0	0	3	0.15

Table 3 – Parity-wise distribution of study subjects by BMI groups.

Parity groups	Control group n = 420		Overweight n = 635		Obese class I n = 520		Obese class II n = 280		Obese class III n = 130		Total n = 1985	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Nullipara	127	30.24	168	26.46	85	16.35	49	17.50	19	14.62	448	22.57
Para 1	111	26.43	136	21.42	101	19.42	55	19.64	12	9.23	415	20.91
Para 2–4	148	35.24	218	34.33	226	43.46	110	39.29	49	37.69	751	37.83
Para 5–9	33	7.86	105	16.54	98	18.85	63	22.50	49	37.69	348	17.53
Para 10 or more	1	0.24	8	1.26	10	1.92	3	1.07	1	0.77	23	1.16

confounders. Need for induction of labor showed an upward trend in obese women but did not reach statistical significance after adjusting for confounders. Postpartum hemorrhage and instrumental vaginal delivery rates were similar in obese and control group.

Data on neonatal outcome among the Cases and Controls is presented in Table 6.

Women in all study groups were significantly more likely to deliver babies with birth weight more than 4 kg had 5 times increased risk (OR 5.13, 95% CI, 1.74–15.12, $p = 0.003$ and OR 5.12, 95% CI, 1.63–16.04, $p = 0.005$ respectively). Obese class III women had a tremendous increase, being 17 times more likely to deliver big babies, OR 17.30 (95% CI, 15.48–54.62, $p = 0.001$). Overweight and obese women were less likely to deliver low birth weight babies weighing less than 2.5 kg however it was statistically significant only in obese class II women after adjustment for confounders. The women in this group were found to have 90% reduced risk of delivering low birth weight babies in comparison to controls, OR- 0.10 (95% CI, 0.03–0.39, $p = 0.001$). Need for admission to neonatal intensive care unit (NICU) showed an increasing trend, the risk being about 4 times increased in overweight and obese class I while obese class II and class III showed the highest risk, OR for these two groups respectively being 28.16 (95% CI, 5.88–134.40, $p = 0.001$) and 39.73 (95% CI, 7.61–207.32, $p = 0.0001$).

Obese class III women were more prone for the complication of shoulder dystocia, adjusted OR 13.12 (95% CI, 40–123.19, $p = 0.024$).

Owing to the very small number of subjects having fetal congenital anomalies which limited the calculation of risk estimate, we cannot comment about association between obesity and congenital anomalies, however the p values (0.01 in obese class I and 0.03 in obese class III) suggest that statistically significant differences might exist among obese and control subjects with respect to this outcome.

Attributable Risk Proportions (ARP) and Population Attributable Risk Proportions (PARP) for important outcome measures are presented in Table 7. It is evident that, except for shoulder dystocia, obesity does contribute in part to important adverse pregnancy outcomes, both in overweight and obese women.

5. Discussion

Obesity and overweight is no longer a public health problem limited to the populations of developed countries. Prevalence

of obesity is increasing in UAE population and more so in reproductive age group women. There are many studies in literature pointing association of maternal obesity with obstetrical complications. However most of these studies are from developed countries. Results of these studies may not be applicable to the UAE population because of cultural, social, dietary and lifestyle variations.

Maternal obesity has been shown to be associated with hyperlipidemia and hyperinsulinemia. Hyperlipidemia reduces prostacyclin secretion and enhances peroxidase production resulting in vasoconstriction and platelet aggregation and thus increasing the risk of preeclampsia.^{20,21} Earlier studies have shown a strong association between morbid obesity and hypertensive disorders of pregnancy.^{4,13,22,23} A meta-analysis of association of maternal BMI with the risk of preeclampsia has shown that with every 5–7 kg/m² increase in BMI, risk of preeclampsia doubles.²⁴ Bhattacharya et al in a large retrospective cohort study conducted in Aberdeen found a 3 times increased risk of preeclampsia in obese primigravid women with BMI 30–39.9 and a 7 times increased risk in morbidly obese primigravid women with BMI more than 40.²⁵ The results of our study are in agreement of this observation and show 7 times higher risk of hypertensive disorders in morbidly obese women.

Our results are similar to some other studies in terms of risk of gestational diabetes,^{4,7,22,23} and show an increasing trend in gestational diabetes with increasing BMI, Odds ratio in morbidly obese women being 3 times more than the control group. Many of these gestational diabetic women may be representative of women who develop frank diabetes in later part of life which is so prevalent in UAE. ARP analysis suggests that obesity may partly be an attributing factor in 60% of cases of gestational diabetes in obese women and about 6% of all gestational diabetes cases may be attributable in part to obesity in women population (Table 7).

Many studies have shown an increased risk of postpartum hemorrhage in obese women.^{7,25} However our results agree with the study of Bianco who also found no difference in the incidence of postpartum hemorrhage in obese women.

Incidence of caesarean delivery has consistently been found to be increased in many studies^{7,13,22,23,25} and our results agree with these studies. Morbidly obese women were significantly more likely to deliver by caesarean section, rate for these patients being 28% compared to 15% in control group. This increase was significantly more for elective sections and included indications of predicted macrosomia, prolonged pregnancy and maternal request. Increase in

Table 4 – Antenatal complications among Cases (overweight and obese women) and Controls.

Antenatal complications	Controls n = 420 [No. (%)]	Overweight n = 635 [No. (%)]	OR (95% CI)	p Value	Obese class I n = 520 [No. (%)]	OR (95% CI)	p Value	Obese class II n = 280 [No. (%)]	OR (95% CI)	p Value	Obese class III n = 130 [No. (%)]	OR (95% CI)	p Value
Hypertensive disorders	5 (1.1)	7 (1.1)	0.77 (0.23–2.5)	0.67	10 (1.9)	1.93 (0.63–5.9)	0.24	9 (3.2)	1.53 (0.44–5.3)	0.49	6 (4.6)	4.97 (1.35–18.3)	0.01
Gestational diabetes	17 (4.0)	36 (5.6)	1.27 (0.70–2.3)	0.43	53 (10.1)	2.05 (1.15–3.66)	0.01	42 (1)	3.13 (1.69–5.77)	0.001	23 (17.6)	3.75 (1.83–7.69)	0.001
Abruption	4 (0.9)	4 (0.6)	0.58 (0.14–2.4)	0.46	7 (1.3)	1.26 (0.35–4.63)	0.72	4 (1.4)	1.53 (0.36–6.50)	0.56	4 (0.7)	1.20 (0.12–11.85)	0.87
Placenta praevia	0 (0)	4 (0.6)	2.66 (1.04–6.7)	0.04	0 (0)	–	–	2 (0.7)	1.18 (0.31–4.51)	0.80	1 (0.7)	1.46 (0.17–13.41)	0.71
Stillbirth after 28 weeks gestation	1 (0.2)	0 (0)	0.81 (0.06–11.14)	0.87	0 (0)	0.81 (0.06–11.14)	0.87	0 (0)	0.81 (0.06–11.14)	0.87	0 (0)	0.81 (0.06–11.14)	0.87
Intrauterine growth restriction	18 (4.2)	10 (1.5)	0.35 (0.15–0.80)	0.01	9 (1.7)	0.35 (0.15–0.83)	0.01	9 (3.2)	0.31 (0.28–1.68)	0.40	2 (1.5)	0.18 (0.03–1.04)	0.05

Table 5 – Labor and delivery complications among Cases (overweight and obese women) and Controls.

Labor and delivery complications	Controls n = 420 [No. (%)]	Overweight n = 635 [No. (%)]	OR (95% CI)	p Value	Obese class I n = 520 [No. (%)]	OR (95% CI)	p Value	Obese class II n = 280 [No. (%)]	OR (95% CI)	p Value	Obese class III n = 130 [No. (%)]	OR (95% CI)	p Value
Caesarean delivery	65 (15.4)	103 (16.2)	1.07 (0.76–1.52)	0.69	103 (19.8)	1.51 (1.05–2.19)	0.02	73 (26.0)	2.09 (1.38–3.17)	0.001	37 (28.4)	2.73 (1.61–4.65)	0.0001
Elective caesarean section	20 (4.7)	32 (5.0)	1.06 (0.59–1.89)	0.84	40 (7.6)	1.8 (1.01–3.19)	0.04	33 (11.7)	3.43 (1.89–6.31)	0.001	16 (12.3)	3.22 (1.50–6.91)	0.003
Emergency caesarean section	45 (10.7)	71 (11.1)	1.06 (0.70–1.61)	0.76	63 (12.1)	1.26 (0.81–1.96)	0.31	40 (14.2)	1.24 (0.74–2.08)	0.41	21 (16.1)	1.99 (1.05–3.79)	0.035
Operative vaginal delivery	12 (2.8)	20 (3.1)	1.08 (0.51–2.26)	0.84	4 (0.7)	0.33 (0.10–1.10)	0.07	10 (3.5)	1.31 (0.51–3.33)	0.57	3 (2.3)	0.82 (0.20–3.39)	0.78
Induction of labor	14 (3.3)	26 (4.0)	1.03 (0.50–2.11)	0.94	21 (4.0)	1.13 (0.52–2.43)	0.75	15 (5.3)	1.01 (0.40–2.50)	0.98	10 (7.6)	1.76 (0.63–4.91)	0.28
Preterm delivery at less than 32 weeks	12 (2.8)	15 (2.3)	0.80 (0.37–1.74)	0.57	13 (2.5)	1.10 (0.48–2.52)	0.82	8 (2.8)	1.09 (0.42–2.79)	0.85	2 (1.5)	0.95 (0.20–4.48)	0.95
Preterm delivery at less than 37 weeks	28 (6.6)	39 (6.1)	0.94 (0.56–1.55)	0.79	34 (6.5)	1.29 (0.75–2.22)	0.35	17 (6.0)	1.03 (0.54–1.96)	0.93	2 (1.5)	0.40 (0.09–1.74)	0.22
Delivery after 41 weeks	20 (4.7)	48 (7.5)	1.54 (0.89–2.65)	0.12	43 (8.2)	1.69 (0.96–2.98)	0.06	24 (8.5)	1.78 (0.93–3.42)	0.08	12 (9.2)	2.99 (1.35–6.65)	0.007
Postpartum hemorrhage	8 (1.9)	25 (3.9)	2.16 (0.92–5.06)	0.07	15 (2.8)	1.65 (0.67–4.08)	0.28	6 (2.1)	0.82 (0.24–2.82)	0.75	5 (3.8)	3.69 (0.98–13.93)	0.05

Table 6 – Neonatal outcomes among Cases (overweight and obese women) and Controls.

Neonatal outcomes	Controls n = 420 [No. (%)]	Overweight n = 635 [No. (%)]	Obese class I n = 520 [No. (%)]	OR (95% CI)	p Value	Obese class II n = 280 [No. (%)]	OR (95% CI)	p Value	Obese class III n = 130 [No. (%)]	OR (95% CI)	p Value
Birth weight > 4 kg	4 (0.9)	19 (2.9)	31 (5.9)	1.53 (0.92–8.24)	0.07	18 (6.4)	5.12 (1.63–15.12)	0.003	24 (18.4)	17.30 (15.48–54.62)	0.001
Birth weight < 2.5 kg	53 (12.6)	47 (7.4)	36 (6.9)	0.65 (0.38–1.10)	0.11	15 (5.3)	0.10 (0.03–0.39)	0.001	6 (4.6)	0.38 (0.11–1.24)	0.10
Shoulder dystocia	2 (0.4)	3 (0.4)	1 (0.1)	1.15 (0.18–7.10)	0.88	3 (1.0)	5.09 (0.74–35.04)	0.09	2 (1.1)	13.12 (1.40–123.19)	0.02
Congenital anomalies	0 (0)	4 (0.6)	4 (0.7)	–	0.11	3 (1.0)	–	0.10	3 (2.3)	–	0.03
Apgar score < 7 at 5 min	6 (1.4)	10 (1.5)	16 (1.3)	0.85 (0.18–3.98)	0.83	4 (1.4)	2.36 (0.28–19.65)	0.42	2 (1.5)	7.89 (0.37–167.49)	0.85
Neonatal intensive care unit admission	15 (3.5)	35 (5.5)	29 (5.5)	4.18 (1.56–11.16)	0.004	27 (9.6)	28.16 (5.88–134.40)	0.03	12 (9.2)	39.73 (7.61–207.32)	0.0001

emergency section rates was mainly for the indication of non progress of labor which partly may have been because of cephalopelvic disproportion due to macrosomic babies, excessive fat deposition in the soft tissues of the pelvis or because of abnormal uterine action. The increased caesarean section rate is relevant in obese women because of associated anesthetic risks, wound infections and thrombo-embolic events. However we could not calculate the risk for the occurrence of these complications because of inadequate data collection for these complications.

Some of the studies have shown increased association of induction of labor with maternal obesity.^{7,13,25} In our study we found an increasing trend for induction of labor however it did not reach statistical significance.

Massive obesity seems to be protective in terms of risk of placenta previa¹³ and placental abruption.⁷ In our study there was no difference in the occurrence of placenta previa and our result agrees with Bhattacharya et al.²⁵ Placental abruption similarly was seen with equal frequencies in study and control group agreeing with the result of Marie I. in Sweden.¹³

There are variable results in literature about the risk of preterm delivery, with some studies reporting obesity as protective^{4,7} while others report increased risk in some subgroups only²⁵ and there are some studies which suggest an independent increase in preterm delivery in association with maternal obesity. Our results showed no statistically significant differences in the risk of preterm delivery.

Our results of increased risk of delivery beyond 41 weeks are in agreement with some studies,^{7,13,25} however this increased incidence was not reflected in the incidence of induction of labor. This can be explained by an increased number of women who delivered by elective cesarean section for the indication of post-term pregnancy or macrosomic baby.

Incidence of macrosomia has consistently been reported to be high in obese women.^{4,7,13,25} In our study, we found an astonishingly high incidence of macrosomia in morbidly obese women.

The combination of increased energy influx to the fetus along with fetal hyperinsulinemia associated with obesity may explain the increased frequency of macrosomic babies seen in obese non diabetic women in this study. ARP analysis suggests that obesity may contribute in part to about 84% of cases of macrosomia in babies of obese pregnant women. About 5% of all cases of macrosomia may be attributed in part to obesity in women population as per the PARP analysis.

Many studies,¹³ corroborate that rapid fetal growth because of maternal hyperinsulinemia and placental insufficiency may result in antepartum stillbirth in obese women. However in our study it is difficult to comment on this risk because of small number of women with morbid obesity.

Most of these risk factors show an increasing trend with increasing BMI suggesting even a moderate pre-pregnancy weight loss can be protective against development of some of these complications.

It is prudent to consider BMI of the pregnant women rather than weight while assessing her risk for development of pregnancy complications as it is a more sensitive indicator in predicting a woman's obstetrical risks.

Table 7 – Attributable Risk Proportions (ARP) and Population Attributable Risk Proportions (PARP) for important outcome measures.

Outcomes	ARP (%)	95% CI for ARP (%)	PARP (%)	95% CI for PARP (%)
Hypertensive disorders	42.28	1.34–67.13	0.87	0.02–1.74
Gestational diabetes	61.35	48.13–71.27	6.04	4.24–7.83
Caesarean delivery	27.63	13.28–39.60	5.58	2.54–8.62
Delivery after 41 weeks	43.39	24.44–57.58	1.79	1.33–2.42
Postpartum hemorrhage	42.36	9.83–63.15	1.70	1.07–2.72
Birth weight > 4 kg	84.6	73.70–90.99	4.974	3.72–6.23
Shoulder dystocia	17.28	0.0–68.16	0.10	0.0–0.60
NICU admission	47.43	27.16–62.06	3.12	1.57–4.68

6. Conclusion

This study shows a strong association between morbid obesity and many obstetrical complications even after adjusting for confounders. Some of the identified risk factors are modifiable. Lifestyle is a major contributor to obesity. There is a need for widespread education about obesity and its attendant complications and role of diet and exercise. Considering such a high prevalence of obesity in females of reproductive age group in UAE, this study emphasizes a strong need for pre-pregnancy advice about weight loss in these women before conception as even a small weight loss can lead to better perinatal outcomes.

Pregnancies in obese women in UAE should be managed as high risk pregnancies with strategies for prevention, early detection and management of complications arising from obesity.

Conflicts of interest

All authors have none to declare.

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