

Effect of obesity of pregnant women on the maternal outcomes: a retrospective cohort from Baghdad

Raghad Ezzat Abdul Razaq¹, Yousif Abdul Raheem², Lujain Kadhim Al-Dabbagh³

ABSTRACT

INTRODUCTION: Obesity has become a serious global public health problem, and it is prevalent among pregnant women as well as general population. Evidence has shown that obesity has many detrimental effect on maternal and fetal outcome.

OBJECTIVE: To identify the effect of obesity on maternal outcomes in pregnancies comparing them to that of normal weight pregnant women and to measure the effect of some demographic factors on these outcomes.

METHODS: A retrospective cohort conducted at four family teaching centres in Baghdad from 2 May - 31 August 2016. Pregnant women who have completed records during 2015 were included in this study. Women were divided into two groups, obese and normal weight, according to BMI. Gestational hypertension, preeclampsia, premature labour, gestational diabetes, abortions, anaemia, and the need for caesarean section were measured and compared in both groups. Associations between pregnancy outcomes and maternal obesity were estimated as relative risk and 95% confidence intervals using a logistic regression model

RESULTS: This cohort included 429 normal weight and 429 obese pregnant women. Obese pregnant women had 1.2 unfavourable maternal outcomes which included: Gestational hypertension (RR=4.28), preeclampsia (RR=2.27), premature labour (RR=3.4), gestational diabetes (RR=1.95), abortions (RR=1.40), anaemia (RR=1.32), caesarean section (RR=1.23), maternal age >35 years (RR=1.5), 18-35 years (RR=1.39), multiparous (RR=1.23), and illiterate and primary educational level (RR=2.10, RR=1.2 respectively). Logistic regression analysis showed that obese pregnant women had 2.99 times the risk and those with lower educational level had 1.68 times the risk.

CONCLUSION: Obese pregnant women have a higher risk for having unfavourable maternal outcomes in comparison to normal weight pregnant women. These outcomes include gestational hypertension, preeclampsia, gestational diabetes mellitus, anaemia, abortion and the need for caesarean section.

Key words: Pregnant, Maternal outcome, Obesity.

Iraqi New Medical Journal July 2019;5(10)

INTRODUCTION

The alarming increase in the prevalence of obesity worldwide is currently the commonest metabolic disease. It has led the WHO to consider obesity as one of the most serious global health problems of 21st century.¹ Obesity is defined as excessive body fat to an extent that is highly likely to impair health and increase morbidity and mortality.¹ The causes of obesity are still unknown, about 30-40% are genetic in origin and the remaining 60-70% are environmental as the high energy foods and sedentary lifestyle.² Body mass index is the most frequently applied indicator of obesity, and the classification es-

tablished by WHO in 1997 and published in 2000 provide the values.³

The prevalence of obesity has increased during the last three decades, and it affects both developed and developing countries.⁴ It appears to be more prominent in women. Over half of the women of childbearing age in most developed countries are either overweight (BMI 25-29.9 kg/m²) or obese (≥ 30 kg/m²).⁵ A previous review has reported that the prevalence of obesity in pregnant women varying between 1.8% and 25.3%, depending on the country.⁶ In Iraq the prevalence of obesity in female 18 years and more, increases from 28.3% in 2008



¹ MBChB, FABCM. Community Physician, The National Centre for Training and Human Development, Ministry of Health, Baghdad, Iraq.

² FICMS. Professor of Community Medicine, Al-Kindy Medical College, Baghdad, Iraq.

³ FICMS, Family Physician. Primary Health Care Department, Public Health Directorate, Ministry of Health, Baghdad, Iraq

Corresponding Author: Raghad Ezzat Abdul Razaq, The National Centre for Training and Human Development, Ministry of Health, Baghdad, Iraq. Email: dddddd_1978@yahoo.com

to 32.1% in 2015.

Obesity is an increasing problem in Iraqi population especially in females of childbearing age from 32.1% to 42.6%^{7, 8} making it a common condition during pregnancy. Worldwide, the obesity among pregnant women has become one of the most crucial public health concerns.⁹

Maternal obesity is associated with a number of pregnancy related complications for both mother and fetus. Risks for the mother include gestational diabetes, hypertension, pre-eclampsia, postpartum haemorrhage, caesarean delivery, and wound infection. Risks for the fetus include prematurity, stillbirth, congenital anomalies, large for gestational age with possible birth injury, and childhood obesity.¹⁰

This study was designed to identify the maternal outcomes of pregnancies of an obese women in comparison to normal weight women, and to measure the risk of obesity on each of these outcomes.

METHODS

Setting and Study Design: A retrospective cohort study was conducted at family teaching centres in Al-Karkh and Al-Rasafa health directorate in Baghdad in from 2nd of May to 31st August 2016.

Ethical Consideration: The study protocol was approved by the scientific and ethical research committees of Al-Karkh and Al-Rasafa Health Directorates and in accordance to the regulations of Iraqi Ministry of Health. Data of all participants were kept confidential and only used for the purpose of this study.

Definition of the cases, inclusion and exclusion criteria: Obese and normal weight pregnant women with single tone gestation who were attending Maternal and Child health units in the selected family teaching centres and had complete record data during 2015 were the target of this study. For sake of inclusion criteria of this study, obese were defined as BMI of 30-39.9 kg/m², while normal weight was defined as a BMI of 18.5-24.9 kg/m² according to WHO criteria.³ This study has included those pregnant women who had their first antenatal care visit during the first trimester and their last prenatal visit recorded at equal or greater than 36 weeks gestation except preterm. (According to WHO

at least four visits).^{11,12} Women with a history of chronic medical disease like hypertension, diabetes, tuberculosis, asthma, and cardiovascular diseases; or those whom their records including parametric measurements were missing were excluded from this study.

Sample size: The sample size of this study was 844 pregnant mothers based on the assumption that 15% of the pregnant mothers with normal weight (unexposed) in first trimester had unfavourable outcomes, depending on the available data of the annual report of Iraqi Ministry of Health 2016,¹³ with 5% marginal error and 95% CI.

A preliminary pilot study was carried out in Al-Thubbat Family Teaching Centre in (this centre was not included in study) Al-Rasafa district in Baghdad City for 2 weeks. Data were extracted from 40 records of normal weight pregnant women to assess the availability and accessibility of data, then reliability of the results were measured. These results were not included in the final calculation of this study.

Calculation of sample size:¹⁴

Expected incidence in unexposed	0.15
Assumed relative risk	1.5
Confidence level	0.95
Power	0.8
Study type	Retrospective Cohort
Sample size per group	422
Total sample size (both groups)	844

Sampling: Six family teaching centres are distributed equally in Al-Karkh and Al-Rasafa Health directorates in Baghdad. We have randomly chosen two centres from each health directorate; Bab Al-Ma'adham and Al-Mustansyriah Family Teaching Centres from Al-Rasafa Health Directorate, and Al-Adel and Al-Mansur Family Teaching Centres from Al-Karkh Health Directorate.

Data collection: on searching the records of the four family teaching centres included in this study, we found 4680 pregnant women recorded from 1 January and 31 December of 2015. After applying the inclusion criteria of our study 2164 women's records were excluded; 708 women due to incomplete antenatal records, 38 women gave birth twins, 248 were under weight (BMI <18.5 kg/m²), 958 were overweight (BMI 25-29.9 kg/m²) and 212 morbid obese (BMI

$\geq 40 \text{ kg/m}^2$). The final study's records consisted of 2516; 1384 were obese and 1132 were normal weight; the computer's program chose 429 obese pregnant women and 429 normal weight pregnant women. The data were collected from 2nd of May to 31st August 2016 and the following data were extracted: demographic information of the mother like mother's age, parity, employment, and educational level; maternal outcomes like gestational hypertension (GHT), preeclampsia (PET), preterm labour, gestational diabetes mellitus (GDM), abortion, anemia, type of delivery. Maternal BMI was calculated as weight in kg at first antenatal visit (booking), divided by squared height in meters. Collection of data 4 months, analysis of data 2 months, drafts writing 2 months and research writing 2 months. The data were collected on 5 days per week, about 4-5 hours per day.

Anthropometric measurement: Anthropometric measures were done by health workers in antenatal care units during mother's visits. Measurement of body weight was carried with light outdoor clothes without shoes using a weighing digital scale (Seca). Before each measurement the digital scale was adjusted to zero, and the weight taken to the nearest fraction of Kg (to the closest 0.1 Kg). Height was measured by using standing height measurement (Seca). When measuring a woman's height, she stands straight with her feet together, looks straight ahead, and stands with her heels against a wall or measuring board. Maternal variables were 7 variables, **Table 1** demonstrates the used scoring for the maternal variables, a "0" score were given when the response for the variable was favourable and a score of "1" if the response was unfavourable¹⁵ i.e. if pregnant mother had score of 0 she was included in the favourable

outcome category and if she had 1 or more then she was included in the unfavourable category.

Statistic: Analysis of data was carried out using the available statistical package of SPSS-17. Data were presented in simple measures of frequency, percentage, mean and standard deviation. The categorical data or frequency of an event expressed as numbers and frequencies. Chi square test of association was used to compare between two proportions. A 'P' value of ≤ 0.05 was considered as statistically significant. Relative risks (RR) with 95% confidence interval were estimated to find the association between exposure and outcome. Logistic regression analysis carried out to control for confounding variables.

RESULTS

This study included the records of 858 pregnant women with an age range between 15-49 years. The mean age of the mothers was 28.13 ± 7.05 years. Of them, 429 women were obese ($\text{BMI}=30\text{-}39.9 \text{ kg/m}^2$), their mean age was 26.83 ± 8.58 years. While 429 women were having a normal weight ($\text{BMI} 18.5\text{-}24.9 \text{ kg/m}^2$), their mean age was 23.83 ± 7.53 years. See **table 2**.

Table 3 Showed the effect of weight of the mothers on maternal outcomes. Obese pregnant women had 81.1% unfavourable outcomes while normal weight pregnant women had 68.8% ($P < 0.0001$).

Tables 4 to 10 show that gestational hypertension, preeclampsia, premature labour, gestational diabetes mellitus, abortion, anaemia, and delivery by caesarean section are more prevalent in obese pregnant women than in normal weight pregnant women, and all these results were statistically significant.

Table 11 summarizes the association of age, parity, employment status, and level of education of the pregnant women on maternal outcomes in both groups, normal weight and obese women. All these parameters have shown a statistically significant effect.

Binary logistic regression analysis was used to predict the risk of unfavourable ma-

Table 1: The maternal variables of obese and normal weight pregnant women and their favourable and unfavourable outcomes in Baghdad city 2015.

Variables	Unfavourable outcome	Favourable outcome
Gestational Hypertension ¹⁶	Yes $>140/90 \text{ mmHg}$	No $\leq 140/90 \text{ mmHg}$
Preeclampsia ¹⁷	Yes	No
Premature labour ¹⁸	Yes	No
Gestational Diabetes ¹⁹	Yes, $\text{FBS} > 126 \text{ mg/dl}$	No, $\text{FBS} \leq 126 \text{ mg/dl}$
Abortion ²⁰	Yes	No
Anaemia ²¹	Yes, $< 11 \text{ g/dl}$	No, $\geq 11 \text{ g/dl}$
Type of delivery ²²	CS	NVD

CS: Caesarean Section, FBS: Fasting Blood Sugar, NVD: Normal Vaginal Delivery,

Table 2: Characteristics and maternal outcomes of obese and normal weight pregnant women in Baghdad city 2015.

Maternal Variables		Obese (429)		Normal (429)		Total
		N	%	N	%	
Maternal age (years)	15-18	107	38.8	169	61.2	276
	19-35	222	51.5	209	48.5	431
	>35	100	66.2	51	33.8	151
Parity	Prim	159	59.8	107	40.2	266
	Multi	270	45.6	322	54.4	592
Employment	Yes	81	57.9	59	42.1	140
	No	348	48.5	370	51.5	718
Educational level	Illiterate	17	43.6	22	56.4	39
	Primary	108	51.9	100	48.1	208
	Secondary	152	46.5	175	53.5	327
	Higher	152	53.5	132	46.5	284
Gestational Hypertension	Yes	60	81.1	14	18.9	74
	No	369	47.1	415	52.9	784
Preeclampsia	Yes	25	69.4	11	30.6	36
	No	404	49.1	418	50.9	822
Premature labour	Yes	27	77	8	23	35
	No	402	49	421	51	823
Gestational Diabetes	Yes	39	66.1	20	33.9	59
	No	390	48.8	409	51.2	799
Abortion	Yes	80	58.4	57	41.6	137
	No	349	48.4	372	51.6	721
Anaemia	Yes	139	57	105	43	244
	No	290	47.2	324	52.8	614
Delivery type	CS	255	55.1	208	44.9	463
	NVD	174	44.1	221	55.9	395

CS: Caesarean Section, NVD: Normal Vaginal Delivery

ternal outcomes on various associated factors in pregnant women. The obesity during pregnancy was observed to cause unfavourable maternal outcomes 2.99 times the risk than normal weight during pregnancy (95% CI 1.97-4.45). Those pregnant women with illiterate and primary educational level had 1.68 times the risk of unfavourable maternal outcomes (95%CI 1.11-2.55), compared to those pregnant women with secondary and higher educational level. Regarding mother age, parity and employment had no significant difference to the risk of unfavourable maternal outcomes, [table 12](#).

DISCUSSION

This is a retrospective cohort study trying to explore the effect of obesity during pregnancy and its outcome. In this study, the prevalence of

Table 3: Risk of maternal obesity during pregnancy on maternal outcomes in Baghdad city 2015.

Mother weight status	Maternal Outcomes				RR	95 % CI	P value
	Unfavourable		Favourable				
	N	%	N	%			
Obese (429)	348	81.1	81	18.9	1.2	1.1-1.28	< 0.0001
Normal (429)	295	68.8	134	31.2			
Total (858)	643	74.9	215	25.1			

Table 4: Risk of gestational hypertension in cohort study of obese pregnant women compared with pregnant women of normal weight in Baghdad city 2015.

Mother weight status	Gestational Hypertension				RR	95 % CI	P value
	Yes		No				
	N	%	N	%			
Obese (429)	60	14	369	86	4.28	2.43 - 7.53	< 0.0001
Normal (429)	14	3.3	415	96.7			
Total (858)	74	8.6	784	91.4			

Table 5: Risk of preeclampsia in cohort study of obese pregnant women compared with pregnant women of normal weight in Baghdad city 2015.

Mother weight status	Preeclampsia				RR	95 % CI	P value
	Yes		No				
	N	%	N	%			
Obese (429)	25	5.8	404	94.2	2.27	1.13 - 4.56	0.020
Normal (429)	11	2.6	418	97.4			
Total (858)	36	4.2	822	95.8			

Table 6: Risk of premature labour in cohort study of obese pregnant women compared with pregnant women of normal weight in Baghdad city 2015.

Mother weight status	Premature labour				RR	95 % CI	P value
	Yes		No				
	N	%	N	%			
Obese (429)	27	6.3	402	93.7	3.4	1.55 - 7.34	0.002
Normal (429)	8	1.9	421	98.1			
Total (858)	35	4.1	823	95.9			

obesity in pregnant women was 30.1%, which is approximate to a previous study in Iraq 35.8%.²³ The national Iraqi report 2015 documented that prevalence of obesity in females 18 years and above was 42.6%.²⁴ The results of this study identified several factors related to pregnancy and delivery which are more common among obese mothers than normal weight mothers.

This study shows that an increasing BMI was associated with a risk of maternal complications, the obese pregnant women had 1.2 times the risk of unfavourable maternal outcomes

Table 7: Risk of gestational DM in cohort study of obese pregnant women compared with pregnant women of normal weight in Baghdad city 2015.

Mother weight status	Gestational DM				RR	95 % CI	P value
	Yes		No				
	N	%	N	%			
Obese (429)	39	9.1	390	90.9	1.95	1.16 - 3.29	0.010
Normal (429)	20	4.7	409	95.3			
Total (858)	59	6.9	799	93.1			

Table 9: Risk of anaemia in cohort study of obese pregnant women compared with pregnant women of normal weight in Baghdad city 2015.

Mother weight status	Anaemia				RR	95 % CI	P value
	Yes		No				
	N	%	N	%			
Obese (429)	139	32.4	290	67.6			
Normal (429)	105	24.5	324	75.5	1.32	1.07 - 1.64	0.011
Total (858)	244	28.4	614	71.6			

Table 8: Risk of abortion in cohort study of obese pregnant women compared with pregnant women of normal weight in Baghdad city 2015.

Mother weight status	Abortion				RR	95 % CI	P value
	Yes		No				
	N	%	N	%			
Obese (429)	80	18.6	349	81.4			
Normal (429)	57	13.3	372	86.7	1.40	1.03 - 1.92	0.032
Total (858)	137	16	721	84			

Table 10: Risk of caesarean section in cohort study of obese pregnant women compared with pregnant women of normal weight in Baghdad city 2015.

Baghdad City 2013							
Mother weight status	Type of delivery				RR	95 % CI	P value
	CS		NVD				
	N	%	N	%			
Obese (429)	139	32.4	290	67.6	1.32	1.07 - 1.64	0.011
Normal (429)	105	24.5	324	75.5			
Total (858)	244	28.4	614	71.6			
CS: Caesarean Section, NVD: Normal Vaginal Delivery							

CS: Caesarean Section, NVD: Normal Vaginal Delivery

Table 11: The risk of mother age, parity, employment, and educational levels in cohort study of obese pregnant women compared with pregnant women of normal weight in Baghdad city 2015.

Variables			Outcomes				RR	95%CI	P value
			Unfavourable		Favourable				
			N	%	N	%			
Mother age	15-18 y	Obese	86	80.4	21	19.6	1.1	0.95 -1.24	0.21
		Normal	125	74	44	26			
	19-35 y	Obese	177	79.7	45	20.3	1.39	1.09 - 1.79	0.004
		Normal	141	67.5	68	32.5			
	>35y	Obese	85	85	15	15	1.5	1.16 - 1.92	0.002
		Normal	29	56.9	22	43.1			
Parity	Prim	Obese	116	73	43	27	0.91	0.79-1.04	0.154
		Normal	86	80.3	21	19.6			
	Multi	Obese	213	78.9	57	21.1	1.26	1.33 - 1.4	0.0001
		Normal	202	62.7	120	37.3			
Employee	Yes	Obese	72	88.9	9	11.1	1.31	1.08 -1.69	0.0001
		Normal	40	67.8	19	32.2			
	No	Obese	276	79.3	72	20.7	1.2	1.05 - 1.26	0.0015
		Normal	255	68.9	115	31.1			
Educational level	Illiterate	Obese	13	76.5	4	23.5	2.10	1.14 - 3.88	0.017
		Normal	8	36.4	14	63.6			
	Primary	Obese	88	81.5	20	18.5	1.2	1.02 - 1.41	0.028
		Normal	68	68	32	32			
	Secondary	Obese	125	82.2	27	18.5	1.63	0.98 - 1.23	0.103
		Normal	131	75.3	44	24.7			
	Higher	Obese	117	77	35	23	1.09	0.95 - 1.26	0.22
		Normal	93	70.5	39	29.5			

Table 12: Logistic regression of unfavourable maternal outcomes

Variables	B	P value	RR	CI
Maternal weight	1.09	0.000	2.99	1.97-4.45
Mother age	-0.35	0.86	0.97	0.66-1.42
Parity	-0.19	0.34	0.83	0.55-1.24
Employment	-0.09	0.74	0.91	0.50-1.63
Educational level	0.52	0.014	1.68	1.11-2.55

RR: Relative Risk, CI: Confidence Interval

(95% CI=1.1-1.28). Previous studies showed that maternal obesity associated with adverse maternal outcomes.²⁵ The etiology of the increase of this risk is still uncertain, probably, a wide range of metabolic, inflammatory and vascular factors are implicated together with social characteristics, genetic factors, unhealthy dietary habits and lack of physical activity

Maternal unfavorable outcomes:

Gestational hypertension and PET: Maternal obesity is associated with an increased risk of hypertensive disorders of pregnancy, including preeclampsia, and the risk increases linearly as BMI increases.¹⁷ It is significant in these results that obese pregnant women had 4.28 times the risk of developed HT (95%CI=2.43 - 7.53). As in this cohort, similar results had also been observed the association of increased BMI with development of GHT.²⁶

The possible mechanisms by which obesity could be induced hypertensive disorders during pregnancy are not well-understood. Some researchers thought that, both obesity and hypertensive disorders of pregnancy, accompanied with oxidative stress, elevated inflammatory markers, and dislipidaemia.²⁷

The obese pregnant women had 2.27 times the risk of developed PET (95%CI=1.13 - 4.56). A large review among 13 cohort studies showed that there was a strong positive association between maternal obesity and preeclampsia.²⁸ The underlying mechanism by which obesity increases the risk of preeclampsia is unknown but may involve subclinical inflammation, which plays a role in the development of cardiovascular disease in obese pregnant women.²⁹

Premature labour: In this study, preterm labour was significant. The obese pregnant women had 3.4 times the risk of premature delivery (95%CI=1.55 - 7.34). Similarly, some studies sug-

gested that obese mothers are more often electively delivered preterm due to increased risks of obesity related pregnancy complications and are also at increased risk of spontaneous extremely preterm labour (<34 weeks).³⁰ Some authors explained that leptin (a product of adipose tissue) and cholesterol both inhibit the contractility of myometrial strips leading to preterm labour.³¹

Gestational DM: Gestational diabetes were more common also in obese pregnant women 9.1%, (P=0.010). The obese pregnant women had 1.95 times the risk of developed DM (95%CI=1.16-3.29). Maternal obesity was known to be an important risk factor for GDM, as in large cohort studies were reporting a three-fold increased risk compared to women with a healthy weight.³² GDM is the clinical manifestation of glucose intolerance in pregnancy (decreased insulin sensitivity), leading to hyperglycaemia.³³

Abortion: Abortions in this study were significant in obese pregnant women had 1.40 the risk of abortion (95%CI=1.03 - 1.92). A previous study observed that obese women had high percentage of abortions (11.9%) compared to normal weight women (6.7%).³⁴ The increase of this risk might be due to decrease foliate or hyperglycaemia in obese pregnant women.

Anaemia during pregnancy: The obese pregnant women had 1.32 the risk of development of anaemia (95%CI=1.07 - 1.64). In fact, obesity had been shown to be positively associated with iron status in two studies, they showed that anaemia were more common in obese pregnant women compared to normal weight pregnant women.³⁵ On the other hand, a study by Garcia-Valdes et al (n=240) found no differences in haemoglobin level in obese pregnant women, as compared to normal weight women.³⁶ This might due to increase demand of iron and vitamins during pregnancy.

Caesarean section: The results was observed that obese pregnant women had a high percentage of caesarean sections (CS) (P=0.0014), obese pregnant women had 1.23 times the risk delivered by CS (95%CI=1.1-1.39), in this study, the records didn't mention the indication of CS neither elective nor emergency. This finding was in agreement with a previous study which found that caesarean deliveries increased significantly in all categories of obesity.³⁷

The reason that obese pregnant women were more likely to end up with a caesarean delivery was not known, but a study explained that myometrium of obese women was less responsive to oxytocin that leads to prolongation of labour and end up in CS.³⁸ Other theory, the presence of excess intra abdominal adipose tissue lead to a relative narrower pelvis and itself could prolong labour.³⁹

The findings from logistic regression analysis indicated that maternal obesity and lower educational level (illiterate and primary) had associations to unfavourable maternal outcomes (RR=2.99, 95%CI 1.97-4.45, RR= 1.68, 95%CI 1.11-2.55 respectively), while mother age, parity, and employment had no associations to unfavourable maternal outcomes.

Mother age: Obesity in this study were common among pregnant women aged >35 year raised the possibility 1.5 times the risk of unfavourable maternal outcomes, also pregnant women aged 19-34 years had the risk of development of unfavourable maternal outcomes RR=1.39, which may be due to detrimental effects on decidual and placental development.⁴⁰

Parity: Regarding parity, obese multiparous pregnant women had 1.23 times the risk for unfavourable outcomes. This is because, most women did not go back to their weight before pregnancy and this result in a higher weight in subsequent pregnancies. This result was similar to other.⁴¹

Educational level: The obese pregnant women with illiterate and with primary educational level had 2.10, 1.2 times the risk of unfavourable maternal outcomes respectively. A previous USA study found that highly educated women had healthy behaviour practices than lower educated women.⁴²

Employment: Employed obese pregnant women in this study had high risk of unfavourable maternal outcomes (RR=1.31, 95%=1.08 -1.69) had also association to unfavourable maternal outcomes (RR=1.2, 95%=1.05 - 1.26) compared to normal weight. We could not find a study talking about this factor.

Despite statistically significant association between maternal educational level, obesity during pregnancy and unfavourable outcome in this study, no certain explanations were documented.⁴³ The possible explanation is that the

women with higher education are more likely to take care of their weight and body shape and practice a healthy lifestyle such as regular exercise and healthy diet.

CONCLUSIONS

Obese pregnant women had a higher risk for unfavourable maternal outcomes, which includes GHT, PET, preterm labour, GDM, abortion, anaemia and delivery by CS. The risk of unfavourable maternal outcomes was more in obese pregnant women aged 19-35 years and >35 years, multipara and those with illiterate and primary educational levels.

In obese pregnant women, the risk for unfavourable maternal outcomes is higher in illiterate and primary school level than those of higher educational level, while employment status has not increased this risk.

REFERENCES

1. Guelinckx I, Devlieger R, Beckers K, Vansant G. Maternal obesity: Pregnancy complications, gestational weight gain and nutrition. *Obes Rev*. 2008; 9: 140-150.
2. Murphy VE, Smith R, Giles WB, Clifton VL. Endocrine regulation of human fetal growth: The role of the mother, placenta, and fetus. *Endocrine reviews*. 2006; 27: 141-169.
3. Flodmark CE, Lissau I, Moreno LA, Pietrobello A, and Widhalm K. New insights into the field of children and adolescents' obesity. *The European perspective Int J of Obesity, Obesity Related Metabolic Disorder*. 2004; 28:1189.
4. Ogden C L, Carroll M D, Kit B K. Prevalence of obesity among adults: United States, 2011-2012. *NCHS Data Brief*. 2013; (131):1-8.
5. Finucane MM, Stevens GA, Cowan MJ, Danaei G, Lin JK. National, regional, and global trends in body-mass index since 1980: systematic analysis of health examination surveys and epidemiological studies with 960 country-years and 9.1 million participants. *Lancet*. 2011; 377(9765): 557-67.
6. WHO|Global Health Observatory. Available at: <http://apps.who.int/gho/data/node.main.A900A?lang=en>. (Accessed Aug 10 2015).
7. Ministry of Health. Chronic Non-Communicable Diseases Risk Factors Survey in Iraq 2006.
8. Ministry of Health. Non communicable Diseases Risk Factors STEPS Survey Iraq 2015. Available at: http://www.who.int/chp/steps/Iraq_2015_STEPS_FactSheet.
9. Yazdani S, Yosofniyapasha Y, Nasab BH, Mojaveri MH, Bouzari Z. Effect of maternal body mass index on pregnancy outcome and newborn weight. *BMC Res Notes*. 2012; 5:34-8.
10. American College of Obstetricians and Gynecologists. ACOG Committee opinion no. 549: obesity in pregnancy. *Obstet Gynecol*. 2013 Jan;121(1):213-7. doi: <http://10.1097/01.AOG.0000425667.10377.60>.
11. Yogev Y, Catalano PM. Pregnancy and Obesity. *Obstet Gynecol Clin N Am*. 2009; 36: 285-300.

12. WHO, 2002, Antenatal Care Randomized Trial: Manual for the Implementation of the New Model, Geneva: WHO. Available at: http://whqlibdoc.who.int/hq/2001/WHO_RHR_01.30.
13. USAID, Child Survival and Health Grants Program (CSHGP), Technical Reference Materials: Maternal and Newborn Care, Washington, DC: USAID2009. http://www.usaid.gov/our_work/global_health/home/Funding/cs_grants/cs_index.html
14. Ministry of health: annual report. Iraq 2016. Available at: <https://www.dropbox.com/s/> (Accessed at 20 August 2016).
15. Epi Tools epidemiological – Sample size for a cohort study. Available at: <http://epitools.ausvet.com.au/content.php?page=SampleSize>. (Accessed at 7 Aug 2015).
16. Leve LD, Kerr DCR, Harold GT. Young adult outcomes associated with teen pregnancy among high-risk girls in an RCT of multi-dimensional treatment fosters care. *J of child adolesc Substance abuse*. 2013; 22(5): 421–434.
17. Visintin C, Muggleston MA, Almerie MQ, Nherera LM, James D, and Walkinshaw S. Management of hypertensive disorders during pregnancy: summary of NICE guidance. *BMJ*. 2010; 341: c2207.
18. Lo JO, Mission JF, Caughey AB. Hypertensive disease of pregnancy and maternal mortality. *Current Opinion in Obstetrics and Gynecology*. 2013 Apr 1;25(2):124–32.
19. Aviram A. Maternal obesity: Implications for pregnancy outcome and risks-A link to maternal nutrition. *Int J of obstet & gynecol*. 2011; 115:56–28.
20. Donovan, Peter J, McIntyre, H David. “Drugs for gestational diabetes”. *Australian Prescriber*. 2010 1 Oct; 33 (5): 141–144.
21. American Diabetes Association. Diagnosis and classification of diabetes mellitus. *Diabet Care* 2013; 36(Suppl 1):S67–74.
22. Grimes, DA, Stuart G. “Abortion jabberwocky: the need for better terminology”. *Contraception*. 2010; 81 (2): 93–6.
23. Stothard, K. J., Tennant, P. W., Bell, R. and Rankin, J. Maternal overweight and obesity and the risk of congenital anomalies: a systematic review and meta-analysis. *JAMA*. 2009; 301, 636–650.
24. Ministry of Health. Non communicable Diseases Risk Factors STEPS Survey Iraq 2015. Available at: http://www.who.int/chp/steps/iraq_2015_STEPS_FactSheet.
25. Al-Ani ZR, Al-Dulaimy WZ, Al-Dulaimy KM, Al-Haj SA, Al-Nuaimi YAR, Ayad Kh Al-Maraie, et al. Postpartum Weight: A Guide for Calculation of the Expected Prepregnancy Weight to study the risk of maternal overweight and obesity on congenital anomalies. *J Obes Weight Loss Ther*. 2016; 6: 330.
26. Gardosi J, Madurasinghe V, Williams M, Malik A, Francis A. Maternal and fetal risk factors for stillbirth: population based study. *BMJ*. 2013; 346: f108.
27. Fatma M. Al-Hakmani, Faiza A. Al-Fadhil, Lamia H. Al-Balushi, Norah A. Al-Harthy, Zakiya A. Al-Bahri, Naama A. Al-Rawahi, et al. The effect of obesity on pregnancy and its outcome in the population of Oman, Seeb Province. *Oman Med J*. 2016 Jan; 31(1): 12–17.
28. Weiss JL, Malone FD, Emig D. Obesity, obstetric complications and cesarean delivery rate-a population-based screening study. *Am J Obstet Gynecol*. 2004; 190:1091–1097.
29. Tabandeh A, Kashani E. Effects of maternal body mass index and weight gain during pregnancy on the outcome of delivery. *J Gorgan Uni Med Sci*. 2007; 9:20–4.
30. Driul L, Cacciaguerra G, Citossi A, Martina MD, Peressini L, Marchesoni D. Prepregnancy body mass index and adverse pregnancy outcomes. *Arch Gynecol Obstet*. 2008; 278:23–26.
31. Beyer DA, Amari F, Ludders DW. Obesity decreases the chance to deliver spontaneously. *Arch Gynecol Obstet*. 2011; 28:981–988.
32. Barros FC, Victora CG, Matijasevich A, Santos IS, Horta BL, Silveira MF, et al. Preterm births, low birth weight, and intrauterine growth restriction three birth cohorts in Southern Brazil: 1982, 1993 and 2004. *Cad Saude Publica* 2008; 24:390–8. 26.
33. Nohr EA, Bech BH, Vaeth M, Rasmussen KM, Henriksen TB, Olsen J. Obesity, gestational weight gain and preterm birth: a study within the Danish National Birth Cohort. *Pediat & perinatal epidemiology*. 2007; 21(1):5–14.
34. Cunningham C, Teale GR. A profile of body mass index in a large rural Victorian obstetric cohort. *Med J Aust* 2013; 198: 39–42.
35. Wendt AS, Jefferds ME, Perrine CG, Halleslevens P, Sullivan KM. Obese women less likely to have low serum ferritin, Nicaragua. *Public Health Nutr*. 2015; 18(4):736–741.
36. Kordas K, Fonseca Centeno ZY, Pachon H, Jimenez Soto AZ. Being overweight or obese is associated with lower prevalence of anemia among Colombian women of reproductive age. *J of Nutrit*. 2013; 143(2):175–81.
37. Le Nguyen Bao K, Tran Thuy N, Nguyen Huu C, Khouw I, Deurenberg P. Anemia and iron deficiency in Vietnamese children, 6 to 11 years old. *Asia Pac J Public Health*. 2016 Jul; 28(5 Suppl):945–1025.
38. Nuthalapaty FS, Rouse DJ, Owen J. The association of maternal weight with cesarean risk, labor duration, and cervical dilation rate during labor induction. *Obstet Gynecol*. 2004; 103:452–456.
39. Arrowsmith S, Wray S, Quenby S. Maternal obesity and labour complications following induction of labour in prolonged pregnancy. *BJOG*. 2011; 118:578–88.
40. Heslehurst N, Ells L, Simpson H, Batterham A, Wilkinson J, Summerbell C. Trends in maternal obesity incidence rates, demographic predictors, and health inequalities in 36 821 women over a 15-year period. *BJOG*. 2007; 114(2):187–194.
41. Yeh J, Shelton JA. Increasing pre pregnancy body mass index: analysis of trends and contributing variables. *Am J Obstet Gynecol* 2005; 193:1994–8.
42. Xie Y, Harville EW, Madkour AS. Academic performance, educational aspiration and birth outcomes among adolescent mothers: a national longitudinal study. *BMC Pregnancy and Childbirth*. 2014; 14:3.
43. Souza JP, Tuncalp O, Vogel JP, Bohren M, Widmer M, Oladapo OT, et al. Obstetric transition: the pathway towards ending preventable maternal deaths. *BJOG*. 2014; 121(Suppl. 1):1–4.

Abbreviation list: Body Mass Index (BMI), Confidence interval (CI), Cesarean Sections (CS), Gestational Diabetes Mellitus (GDM), Gestational Hypertension (GHT), Kilogram (kg), Preeclampsia (PET), Relative risks (RR), Statistical Package for the Social Sciences (SPSS), World Health Organization (WHO)

Conflict of interest: Authors have nothing to declare.

Funding: Self funding