Obesity Association with the Mode of Delivery

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Abstract
Back ground: Obesity is an epidemic not only in developed countries but also in the developing world. Furthermore, obesity is becoming an increasingly common problem, both in general population and in women of the reproductive age. There is a growing body of evidence suggesting that obese pregnant women are at greater risk of a number of maternal and fetal complications of pregnancy.
Objective: To study the influence of BMI on the mood of delivery, fetal body weight and post labour complications.
Patients and methods: A cross sectional study was conducted at Daquk and Kirkuk general Hospital in Kirkuk governorate. The study was carried out over 60 days extended from 15th of May to 15th of July2015. The study enrolled a total of 81 nulliparous women in labour, with single tone fetus with vertex presentation. The demographic and clinical characteristics were gathered using a questionnaire and obstetrical examination performed for all included patients.
Results: There were no women of this study participant with BMI of less than 20, while the predominant BMI in our study cohort was the 25 – 29.9. A 27.2% of the total rate of cesarean section (30.9%) is with BMI of ≥25. The obesity rate was more in urban. Post date (>42 wk) with a highest rate in women with BMI of ≥ 25. In addition, 69.1% (56/81) were delivered with vaginal delivery and 30.9% (25/81) were delivered by CS. Obesity do influence development of complications during pregnancy with risk of more than 8 times. The total percentage of CS (52%) with foetal complication which are the indication for cesarean section. The preterm labor was about 5 times in women with BMI of ≥25; the same pattern was demonstrated for post date. OR not confirmed presence of association between normal BMI and vaginal delivery. The highest post vaginal delivery complication rate was in women with BMI of ≥25, episiotomy was the most frequent one. Cesarean section, underweight and overweight fetus, preterm term labour and post date were more predominant in women with BMI of ≥25. More than halve of post date delivery was in women with BMI <25.
Conclusion: obese and overweight women were with higher rate of cesarean section, preterm labour, postdate, and post vaginal delivery complications, however, these findings need to be confirmed in a large scale study.
Key words: Obesity, BMI, cesarean section, preterm, postdate, vaginal delivery complications.

Introduction

Childbirth is a profound and powerful human experience and delivery methods, either vaginally or by caesarean section, is likely to impact on mothers feelings.[1]. Body mass index (BMI) is used to measure obesity, and it is defined as the ratio of body weight in kilograms divided by the square height in meters [2]. BMI is widely used to categorize the degree of obesity and to guide recommendations for weight gain during pregnancy [3]. Obesity has emerged as a major public health problem around the globe over the past two decades [4]. As the overall prevalence of obesity increases so does the number of women of reproductive age who are overweight or obese [5]. Obesity is an epidemic not only in developed countries but also in the developing world. Furthermore, obesity is becoming an increasingly common problem, both in general population and in women of the reproductive age [6]. There is a growing body of evidence suggesting that obese pregnant women are at greater risk of a number of maternal and fetal complications of pregnancy, including pre-eclampsia, caesarean section intrauterine death [7,8].

Obesity negatively impacts the health of women in many ways. Being overweight or obese increases the relative risk of diabetes, hypertension and coronary artery disease in women. Women who are obese have a higher risk of low back pain and knee osteoarthritis [9]. Obesity negatively affects both contraception and fertility as well. Maternal obesity is linked with higher rates of cesarean section. Pregnancy outcomes are negatively affected by maternal obesity (increased risk of neonatal mortality and malformations).

Cesarean birth rates have risen dramatically during the past decade, reaching more than 50% in some regions of the world, despite a lack of evidence of any increase in obstetric emergencies [10]. The marked increase in primary elective cesarean delivery, particularly among women without an established medical indication, has stimulated debate in the medical community and heightened interest and publicity [11].

Obesity is a growing global health problem, more than half of the adult women are overweight and almost 30% are obese. The problems associated with obesity, such as diabetes, hypertension, thrombo-embolism and coronary heart disease, are well described in the non-pregnant population, but the condition itself holds specific risks during the ante-, intra- and postpartum periods of the pregnant woman [12]. Of particular concern is the intrapartum period. Complications such as slow progress during labour and increased rates of caesarean section are best addressed proactively. For this reason certain sources advocate that all morbidly obese women be referred for evaluation of the pregnancy and planning of labour and delivery by an anesthetist and a specialist obstetrician [12,13].

Patients and methods

Study population

An 81 nulliparous women in labor were recruited from labor unit and enrolled in the study. Their age range from 17 to 41 years with mean age of 23±2 years. The inclusion criteria are primigravida women, single fetus and cephalic presentation. While the exclusion criteria are: multiparty, multiple pregnancy, non cephalic presentation, obvious congenital abnormality confirmed by ultrasound, placenta previa, placental abraption, intrauterine death, and medical problem with pregnancy. The study design was approved by Tikrit University College of Medicine Ethical Committee and informed consent taken from each woman before enrollment in the study.

Study design

A cross sectional study was conducted at Daquk and Kirkuk General Hospital in Kirkuk Governorate. The study was carried out over 60 days extended from 15th of May to 15th of July 2015.

Data collection:-

Maternal height and weight be for labor were taken, used to calculate BMI. It was calculated for each patient by using the formula: BMI (kg/m2) = Weight / Height^2. Then the women were grouped into four categories with respect to their BMI: Under weight (≤20), normal (20-25), overweight (25-<30), obese (30-<35) and morbidly obese (≥35) [1]. Demographic, clinical and investigational characteristics were collected according to pre-pared questionnaire.

Statistical analysis

Data were analyzed by Statistical Package for Social Sciences (SPSS) software, version 16. P value<0.05 was considered as statistically significant. Descriptive analysis and multivariable regression was used to calculate odd ratios (OR) with 95% confidence intervals (CI).

Results

Frequency Distribution of BMI

There was no women of this study participant with BMI of less than 20, while the predominant BMI in our study cohort was the 25 – 29.9 which forms 43.2% [35/81], followed by those with 30 – 34.9 which forms 30.9% [25/81]. In addition, BMI of 35 and above forms 14.8% [12/81] and those with BMI of 20-24.9 forms 11.1% [9/81]. Thus only 11.1% of women included in this study are with normal BMI, Table 1.

Caesarian Section Frequency in Relation to BMI.

The total frequency rate of caesarian section in our study population was 30.9% [25/81] and only 3.7% of such rate are with normal BMI, while 27.2% of the total rate of CS [30.9%] are with BMI of ≥25. This indicated that only 3/25 [12%] of those with CS are with normal BMI and thus obesity was a risk factor for CS, Table 1.

Frequency of BMI in Relation to Residence.

The distribution of the study population in rural [49.4%, 40/81] and urban [50.6%, 41/81] areas about equal. In rural area, the highest rate [47.5%, 19/40] of the patients were with BMI of 25-29.9 and only 15% [6/40] of women from rural area are with BMI of 20-24.9. However, in urban area, 39% [16/41] of women are with BMI of 25-29.9 and 30-34.9 for each. In urban about half [7.3%, 3/41] of the rate of rural [15%, 6/40] are with normal BMI. The obesity rate was more in urban [92.6%, 38/41] than in rural [85%, 34/40] areas, Table 2.

BMI in Relation to Pregnancy Duration.

The total incidence of preterm labor [<36 wk+6 d) was 6.2% [5/81], of them 1.2% were with BMI of <25, while 5% were with BMI of ≥25. Post date [>42 wk] forms 23.5% [19/81] of total with a highest rate in women with BMI of 25-29.9 [11.1%], followed by those with BMI of 30-34.9 [7.4%] and 3.7% in women with BMI of ≥35. Only 1.2% of post date were in women with BMI of <25. Although, 29.7% of our cohort study were with pre and post date, 70.4% were with normal due of labor, Table 3.

Table 1. Frequency of Cesarean Section in Relation to BMI

Cesarean Section		BMI				Total
		20- 24.9	25-29.9	30-34.9	35-	
No Cesarean section	Count	6	28	16	6	56
	% within CS	10.7%	50.0%	28.6%	10.7%	100.0%
	% within BMI	66.7%	80.0%	64.0%	50.0%	69.1%
	% of Total	7.4%	34.6%	19.8%	7.4%	69.1%
Cesarean Section	Count	3	7	9	6	25
	% within CS	12.0%	28.0%	36.0%	24.0%	100.0%
	% within BMI	33.3%	20.0%	36.0%	50.0%	30.9%
	% of Total	3.7%	8.6%	11.1%	7.4%	30.9%
Total	Count	9	35	25	12	81
	% within CS	11.1%	43.2%	30.9%	14.8%	100.0%
	% within BMI	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	11.1%	43.2%	30.9%	14.8%	100.0%

X^2=2.93; P>0.05

Table 2. Frequency of BMI in Relation to Residence

Residence		BMI				Total
		20-24.9	25-29.9	30-34.9	35-	
Rural	Count	6	19	9	6	40
	% within Residence	15.0%	47.5%	22.5%	15.0%	100.0%
	% within BMI	66.7%	54.3%	36.0%	50.0%	49.4%
	% of Total	7.4%	23.5%	11.1%	7.4%	49.4%
Urban	Count	3	16	16	6	41
	% within Residence	7.3%	39.0%	39.0%	14.6%	100.0%
	% within BMI	33.3%	45.7%	64.0%	50.0%	50.6%
	% of Total	3.7%	19.8%	19.8%	7.4%	50.6%
Total	Count	9	35	25	12	81
	% within Residence	11.1%	43.2%	30.9%	14.8%	100.0%
	% within BMI	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	11.1%	43.2%	30.9%	14.8%	100.0%

X^2=3.2; P>0.05

Table 3. BMI in Relation to Pregnancy Duration

Pregnancy Duration		BMI				Total
		< 25	25-29.9	30-34.9	35-	
<36 week + 6 day	Count	1	2	2	0	5
	% within pregnancy duration	20.0%	40.0%	40.0%	.0%	100.0%
	% within BMI	11.1%	5.7%	8.0%	.0%	6.2%
	% of Total	1.2%	2.5%	2.5%	.0%	6.2%
37 week to 41 week+6 day	Count	7	24	17	9	57
	% within pregnancy duration	12.3%	42.1%	29.8%	15.8%	100.0%
	% within BMI	77.8%	68.6%	68.0%	75.0%	70.4%
	% of Total	8.6%	29.6%	21.0%	11.1%	70.4%
>42 week	Count	1	9	6	3	19
	% within pregnancy duration	5.3%	47.4%	31.6%	15.8%	100.0%
	% within BMI	11.1%	25.7%	24.0%	25.0%	23.5%
	% of Total	1.2%	11.1%	7.4%	3.7%	23.5%
Total	Count	9	35	25	12	81
	% within pregnancy duration	11.1%	43.2%	30.9%	14.8%	100.0%
	% within BMI	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	11.1%	43.2%	30.9%	14.8%	100.0%

X^2=2.06; P>0.05

Frequency of Vaginal Delivery in Relation to BMI

Higher vaginal delivery was demonstrated in pregnant women with BMI of 25-29.9 in a rate of 34.6% [28/81], followed by women with BMI of 30-34.9 in a rate of 19.8% [16/81]. While vaginal delivery rate was 7.4% [6/81] in women with normal body weight. In addition, 69.1% [56/81] were delivered with vaginal delivery and 30.9% [25/81] were delivered by CS, Table 4.

Frequency of Complications in Relation to BMI

Maternal complication was developed in 69.1% [57/81] of pregnant women and of these rate 34.6% in women with BMI of 25-29.9, followed in those with 30-34.9 with a rate of 19.8%. However, the complication was with rate of 7.4% in women with normal BMI [20-24.9], while it was with a rate of 61.7% in obese women. Thus obesity does influence development of complications during pregnancy with risk of more than 8 times of that in women with normal BMI, Table 5.

Frequency of Cesarean Section due to Foetal Complications.

Of the total number of CS [25 cases], 13 [52%] with foetal complication which are the indication for CS, while in 12 [48%] of the CS cases there were no foetal complications. Thus in about half of cases the decision for performance of CS is not right, Table 6.

Table 4. Frequency of Vaginal Delivery [VD] in Relation to BMI.

Vaginal Delivery		BMI				Total
		< 25	25-29.9	30-34.9	35-	
No	Count	3	7	9	6	25
	% within V D	12.0%	28.0%	36.0%	24.0%	100.0%
	% within BMI	33.3%	20.0%	36.0%	50.0%	30.9%
	% of Total	3.7%	8.6%	11.1%	7.4%	30.9%
Yes	Count	6	28	16	6	56
	% within V D	10.7%	50.0%	28.6%	10.7%	100.0%
	% within BMI	66.7%	80.0%	64.0%	50.0%	69.1%
	% of Total	7.4%	34.6%	19.8%	7.4%	69.1%
Total	Count	9	35	25	12	81
	% within V D	11.1%	43.2%	30.9%	14.8%	100.0%
	% within BMI	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	11.1%	43.2%	30.9%	14.8%	100.0%

X^2=4.33; P>0.05

Table 5. Frequency of Complications in Relation to BMI.

Complication		BMI				Total
		< 25	25-29.9	30-34.9	35-	
No	Count	3	7	9	6	25
	% within Complication	12.0%	28.0%	36.0%	24.0%	100.0%
	% within BMI	33.3%	20.0%	36.0%	50.0%	30.9%
	% of Total	3.7%	8.6%	11.1%	7.4%	30.9%
Yes	Count	6	28	16	6	56
	% within Complication	10.7%	50.0%	28.6%	10.7%	100.0%
	% within BMI	66.7%	80.0%	64.0%	50.0%	69.1%
	% of Total	7.4%	34.6%	19.8%	7.4%	69.1%
Total	Count	9	35	25	12	81
	% within Complication	11.1%	43.2%	30.9%	14.8%	100.0%
	% within BMI	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	11.1%	43.2%	30.9%	14.8%	100.0%

X^2=4.33; P>0.05

Table 6. Frequency of Cesarean Section due to Foetal Complications.

Variable	Number CS	Percent CS
Foetal complication	13	52
No foetal complication	12	48
Total	25	100

Foetal Body Weight in Relation to BMI

Foetal body weight in an descending pattern was 28.4%, 27.2%, 16%, 14.8%, and 13.6% for ≤ 2.5, 2.6-3, 3.1-3.5, 3.6-4, ≥4.1 respectively. In women with normal BMI, 88.8% [8/9] were with foetal body weight of ≤ 2.5 and 2.6 – 3 in a rate of 44.4% for each. In women with BMI of 25-29.9, the highest rate [34.3% within BMI and 14.8% of total] of delivery outcome was with body weight of 2.6 – 3 and 3.1- 3.5. While in women with BMI 30-34.9, the highest rate of body weight of 3.6-4 in a rate of 36% within BMI and 11.1% of the total. In addition, women with BMI of ≥35, the foetal body weight was ≥4.1 in a rate of 50% within BMI and 7.4% of the total. The above results indicated an increase of foetal body weight with the increase of women BMI [X^2=37.93; P=0.000], Table 7.

Table 7. Foetal Body Weight (FBW) in Relation to BMI.

Foetal Body Weight		BMI				Total
		< 25	25-29.9	30-34.9	35-	
≤ 2.5	Count	4	6	1	0	11
	% within FBW	36.4%	54.5%	9.1%	.0%	100.0%
	% within BMI	44.4%	17.1%	4.0%	.0%	13.6%
	% of Total	4.9%	7.4%	1.2%	.0%	13.6%
2.6 – 3	Count	4	12	4	3	23
	% within FBW	17.4%	52.2%	17.4%	13.0%	100.0%
	% within BMI	44.4%	34.3%	16.0%	25.0%	28.4%
	% of Total	4.9%	14.8%	4.9%	3.7%	28.4%
3.1 – 3.5	Count	0	12	8	2	22
	% within FBW	.0%	54.5%	36.4%	9.1%	100.0%
	% within BMI	.0%	34.3%	32.0%	16.7%	27.2%
	% of Total	.0%	14.8%	9.9%	2.5%	27.2%
3.6 –	Count	1	2	9	1	13
	% within FBW	7.7%	15.4%	69.2%	7.7%	100.0%
	% within BMI	11.1%	5.7%	36.0%	8.3%	16.0%
	% of Total	1.2%	2.5%	11.1%	1.2%	16.0%
≥ 4.1	Count	0	3	3	6	12
	% within FBW	.0%	25.0%	25.0%	50.0%	100.0%
	% within BMI	.0%	8.6%	12.0%	50.0%	14.8%
	% of Total	.0%	3.7%	3.7%	7.4%	14.8%
Total	Count	9	35	25	12	81
	% within FBW	11.1%	43.2%	30.9%	14.8%	100.0%
	% within BMI	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	11.1%	43.2%	30.9%	14.8%	100.0%

X^2=37.93; P=0.000

Duration of Pregnancy in Relation to BMI<25 and ≥25

The preterm labor was about 5 times in women with BMI of ≥25 [4.9%; 4/72] as compared to those with BMI of <25 [1.2%;1/9]. The same pattern was demonstrated for post date as it was with rate of 22.2% in women with BMI of ≥25 [18/72] and 1.2 in those with BMI of <25, Table 8.

Vaginal Delivery Frequency in Relation to BMI<25 and ≥25

The frequency of vaginal delivery was 10.7% [6/56] in women with BMI of <25, while it was 89.3% [50/56] in those with BMI of ≥25 and OR not confirmed presence of association [OR=1.136; P>0.05] between normal BMI and vaginal delivery, Table 9. In addition, spontaneous vaginal delivery form a rate of 39.5%, while induced vaginal delivery form a rate of 22.2% in women with BMI of ≥25. While in women with BMI of <25, spontaneous vaginal delivery was demonstrated in 6.2%, and induced vaginal delivery form a rate of 1.2%, Table 10.

Complication Frequency in Relation to BMI<25 and ≥25

Post vaginal delivery complications developed in 69.1% [56/81] of the total study population and the highest was in women with BMI of ≥25. Within vaginal delivery group, complication rate was 89.3% [50/56] in women with BMI of ≥25, while it was 10.7% in women with BMI of <25. However, the OR not reaches significant levels which were influenced by sample size, Table 11.

In women with BMI of ≥25, episiotomy as type of vaginal delivery complication forms the highest [29.2%] rate of complication followed by those with episiotomy and post-partum haemorrhage [15.3%]. However, vaginal tear form 5.6%, while episiotomy, vaginal tear and post-partum haemorrhage form 2.8%, but perineal tear and episiotomy form 2.8%. In women with BMI of <25, episiotomy was the predominant complication types and form 44.4%, followed by PPH which forms 11.1%. Thus types of vaginal delivery complications in obese women are with wide range of types as compared to those with <25 BMI, Table 12.

Caesarean Section Frequency in Relation to BMI<25 and ≥25.

Caesarean section was more predominant in women with BMI of ≥25 [88%, 22/25], as compared to those with normal BMI [12%, 3/25], Table 13.

Foetal Body Weight in Relation to BMI<25 and ≥25

In women with normal BMI, the predominant foetal weight was ≤2.5 and 2.6 -3 in a rate of 44.4% [4/9] for each. While in obese and overweight women the predominant foetal weight was that of 3.1-3.5 [30.6%, 22/72], followed by foetal body weight of 26.4% [19/72]. The differences in frequency of foetal body weight in relation BMI stratification of <25 and ≥25 was significant [X^2=12.42, P=0.014]. The frequency distribution of foetal body weight between women with normal weight and obese was confirmed by odd ratio [OR=14.15, P<0.02]. In addition, underweight and overweight were predominant in women with BMI of ≥25, Table 14.

Frequency of haemoglobin levels in relation to BMI

Hb levels of less than 10 mg were demonstrated in 2.5%, 14.8%, 7.4% and 1.2% in women with BMI of <25, 25-29.9, 30-34.9 and ≥ 35 respectively. While the corresponding values in those with Hb of more than 10 mg were 8.6%, 28.4%, 23.5%, 13.6%, respectively, Table 15.

Table 8. Duration of Pregnancy [PD] in Relation to BMI<25 and ≥25

Pregnancy Duration		BMI		Total
		<25	≥25	
<36 week + 6 day	Count	1	4	5
	% within PD	20.0%	80.0%	100.0%
	% within BMI25	11.1%	5.6%	6.2%
	% of Total	1.2%	4.9%	6.2%
37 week to 41 week+6 day	Count	7	50	57
	% within PD	12.3%	87.7%	100.0%
	% within BMI25	77.8%	69.4%	70.4%
	% of Total	8.6%	61.7%	70.4%
>42 week	Count	1	18	19
	% within PD	5.3%	94.7%	100.0%
	% within BMI25	11.1%	25.0%	23.5%
	% of Total	1.2%	22.2%	23.5%
Total	Count	9	72	81
	% within PD	11.1%	88.9%	100.0%
	% within BMI25	100.0%	100.0%	100.0%
	% of Total	11.1%	88.9%	100.0%

X^2=1.13; P>0.05

Table 9. Vaginal Delivery (VD) Frequency in Relation to BMI<25 and ≥25

Delivery method		BMI		Total
		<25	≥25	
No vaginal delivery	Count	3	22	25
	% within VD	12.0%	88.0%	100.0%
	% within BMI25	33.3%	30.6%	30.9%
	% of Total	3.7%	27.2%	30.9%
Vaginal delivery	Count	6	50	56
	% within VD	10.7%	89.3%	100.0%
	% within BMI25	66.7%	69.4%	69.1%
	% of Total	7.4%	61.7%	69.1%
Total	Count	9	72	81
	% within VD	11.1%	88.9%	100.0%
	% within BMI25	100.0%	100.0%	100.0%
	% of Total	11.1%	88.9%	100.0%

X^2=0.03; P>0.05

OR=1.136 [0.26-4.96], P=0.05

Table 10. Vaginal Delivery Types (VDT) Frequency in Relation to BMI<25 and ≥25

Vaginal Delivery		BMI <25	BMI ≥25	Total
Cesarean section	Count	3	22	25
	% within VDT	12.0%	88.0%	100.0%
	% within BMI25	33.3%	30.6%	30.9%
	% of Total	3.7%	27.2%	30.9%
Spontaneous vaginal delivery	Count	5	32	37
	% within VDT	13.5%	86.5%	100.0%
	% within BMI25	55.6%	44.4%	45.7%
	% of Total	6.2%	39.5%	45.7%
Induced vaginal delivery	Count	1	18	19
	% within VDT	5.3%	94.7%	100.0%
	% within BMI25	11.1%	25.0%	23.5%
	% of Total	1.2%	22.2%	23.5%
Total	Count	9	72	81
	% within VDT	11.1%	88.9%	100.0%
	% within BMI25	100.0%	100.0%	100.0%
	% of Total	11.1%	88.9%	100.0%

X^2=0.89; P>0.05

Table 11. Complications Frequency in Relation to BMI<25 and ≥25

Complication		BMI <25	BMI ≥25	Total
No complication	Count	3	22	25
	% within VD	12.0%	88.0%	100.0%
	% within BMI25	33.3%	30.6%	30.9%
	% of Total	3.7%	27.2%	30.9%
Complication	Count	6	50	56
	% within VD	10.7%	89.3%	100.0%
	% within BMI25	66.7%	69.4%	69.1%
	% of Total	7.4%	61.7%	69.1%
Total	Count	9	72	81
	% within VD	11.1%	88.9%	100.0%
	% within BMI25	100.0%	100.0%	100.0%
	% of Total	11.1%	88.9%	100.0%

X^2=0.03; P>0.05
OR=1.136 [0.26-4.96], P>0.05.

Table 12.Complication (COMP) Types Frequency in Relation to BMI<25 and ≥25

Complication		BMI		Total
		<25	≥25	
Absent	Count	4	31	35
	% within COMP	11.4%	88.6%	100.0%
	% within BMI25	44.4%	43.1%	43.2%
	% of Total	4.9%	38.3%	43.2%
Episiotomy	Count	4	21	25
	% within COMP	16.0%	84.0%	100.0%
	% within BMI25	44.4%	29.2%	30.9%
	% of Total	4.9%	25.9%	30.9%
Vaginal tear	Count	0	4	4
	% within COMP	.0%	100.0%	100.0%
	% within BMI25	.0%	5.6%	4.9%
	% of Total	.0%	4.9%	4.9%
Post partum haemorrhage (PPH)	Count	1	0	1
	% within COMP	100.0%	.0%	100.0%
	% within BMI25	11.1%	.0%	1.2%
	% of Total	1.2%	.0%	1.2%
Episiotomy Perineal tear	Count	0	2	2
	% within COMP	.0%	100.0%	100.0%
	% within BMI25	.0%	2.8%	2.5%
	% of Total	.0%	2.5%	2.5%
Episiotomy, PPH	Count	0	11	11
	% within COMP	.0%	100.0%	100.0%
	% within BMI25	.0%	15.3%	13.6%
	% of Total	.0%	13.6%	13.6%
Vaginal tear, PPH	Count	0	1	1
	% within COMP	.0%	100.0%	100.0%
	% within BMI25	.0%	1.4%	1.2%
	% of Total	.0%	1.2%	1.2%
Episiotomy, vaginal tear, PPH	Count	0	2	2
	% within COMP	.0%	100.0%	100.0%
	% within BMI25	.0%	2.8%	2.5%
	% of Total	.0%	2.5%	2.5%
Total	Count	9	72	81
	% within COMP	11.1%	88.9%	100.0%
	% within BMI25	100.0%	100.0%	100.0%
	% of Total	11.1%	88.9%	100.0%

X^2=11.14; P>0.05

Table 13.Cesarian Section (CS) Frequency in Relation to BMI<25 and ≥25

CS		BMI		
		<25	≥25	Total
No	Count	6	50	56
	% within CS	10.7%	89.3%	100.0%
	% within BMI25	66.7%	70.8%	70.4%
	% of Total	7.4%	63.0%	70.4%
Yes	Count	3	22	25
	% within CS	12.0%	88.0%	100.0%
	% within BMI25	33.3%	29.2%	29.6%
	% of Total	3.7%	25.9%	29.6%
Total	Count	9	72	81
	% within CS	11.1%	88.9%	100.0%
	% within BMI25	100.0%	100.0%	100.0%
	% of Total	11.1%	88.9%	100.0%

X^2=0.08; P>0.05, OR=0.82 (0.188-3.604), P>0.05.

Table 14.Foetal Body Weight in Relation to BMI<25 and ≥25.

Foetal Body Weight		BMI		
		<25	≥25	Total
≤ 2.5	Count	4	7	11
	% within Fetal bodyweight	36.4%	63.6%	100.0%
	% within BMI25	44.4%	9.7%	13.6%
	% of Total	4.9%	8.6%	13.6%
2.6 – 3	Count	4	19	23
	% within Fetal bodyweight	17.4%	82.6%	100.0%
	% within BMI25	44.4%	26.4%	28.4%
	% of Total	4.9%	23.5%	28.4%
3.1 – 3.5	Count	0	22	22
	% within Fetal bodyweight	.0%	100.0%	100.0%
	% within BMI25	.0%	30.6%	27.2%
	% of Total	.0%	27.2%	27.2%
3.6 –	Count	1	12	13
	% within Fetal bodyweight	7.7%	92.3%	100.0%
	% within BMI25	11.1%	16.7%	16.0%
	% of Total	1.2%	14.8%	16.0%
≥ 4.1	Count	0	12	12
	% within Fetal bodyweight	.0%	100.0%	100.0%
	% within BMI25	.0%	16.7%	14.8%
	% of Total	.0%	14.8%	14.8%

X^2=12.42; P=0.014; OR=14.15, P<0.02.

Table 15. Haemoglobin (Hb) Value Frequency in Relation to BMI

Hb		BMI				Total
		< 25	25-29.9	30-34.9	35-	
<10	Count	2	12	6	1	21
	% within Hb10	9.5%	57.1%	28.6%	4.8%	100.0%
	% within BMI	22.2%	34.3%	24.0%	8.3%	25.9%
	% of Total	2.5%	14.8%	7.4%	1.2%	25.9%
≥10	Count	7	23	19	11	60
	% within Hb10	11.7%	38.3%	31.7%	18.3%	100.0%
	% within BMI	77.8%	65.7%	76.0%	91.7%	74.1%
	% of Total	8.6%	28.4%	23.5%	13.6%	74.1%
Total	Count	9	35	25	12	81
	% within Hb10	11.1%	43.2%	30.9%	14.8%	100.0%
	% within BMI	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	11.1%	43.2%	30.9%	14.8%	100.0%

X^2=3.32; P>0.05

Discussion

Obesity is a common problem in both developed and developing countries with impact on community health. The present study indicated that only 11.1% of women included in this study are with normal BMI. Unfortunately, it seems that 88.9% of our study cohort are prone to develop the side effects of obesity. Gaur et al [14] study conducted in India found that the majority of studied population, 54.4% were of normal body weight but 37.2% underweight and 8.4% were overweight.

An Australian study on more than 14,000 pregnant women found that 34% were overweight, obese or morbidity obese [15]. However, the present study shows that 88.9% of the pregnant women included in the study were obese or overweight, but none are underweight. In a USA one third of women of reproductive age are reported to be obese [16,17]. Graves et al [18] in a Canadian study reported normal BMI in 52.1%, whereas 20.6% were overweight and 17.4% were obese. An increasing trend towards obesity was found over the last two decades and 45.7% of our pregnant population has a BMI greater than 30, which is higher to that reported for UK in 2005 [19].

Cesarean section was the method of delivery in 30.9% and 27.2% of the total rate of CS are with BMI of ≥25. This finding indicated that obesity and overweight was a risk factor for CS. This findings was in consistent to that reported by others [14,18,20-24].

Reported studies suggested that method of delivery is influenced by obesity [25] and cesarean section rates increased with the increase in BMI [19,20]. The present study was restricted to nulliparous women at term to ensure homogenicity of the study population. The risk of cesarean section was 3.7% in women with BMI of less than 25 and increased to 11.1% in those with BMI of 30-34.9. However, then decline to 7.4% in women with BMI of ≥35. Thus the distribution of cesarean section in relation to BMI with bell shape pattern and plateau at BMI of 30-34.9.

Rezaie et al [20] in a recent study reported a linear pattern of frequency for cesarean section in relation to BMI. In addition, Mantakas and Farrell [23] in a large scale study of nulliparous women reported an increase of cesarean section from 18.2%in women with normal BMI to 40.6% in those with BMI of >40. Comparison of obese women to those with normal BMI has significantly higher rates of cesarean section [26, 27]. Barau et al [28] and Rezaie et al [20] have described a linear association between maternal BMI and the risk of cesarean section. In addition, obesity is an independent risk factor for failed trial of labour after previous cesarean section [29-31]. Previous studies have shown a proportional increase in the risk of cesarean section corresponding to the level of maternal obesity [22,26,28,33-36].

The exact cause of increase in cesarean section rate among obese women is not fully understood. The increase in cesarean section rate may be due to cephalo-pelvic disproportion [26], failure to progress [37], intrauterine growth restriction [38], presenting as foetal distress [27], and fat deposition in the maternal pelvis, [39] or the obstetrician decision or patients demand.

Labour in overweight and obese women is slower than in women with a normal weight [24]. The presence of intra abdominal adipose tissue interferes mechanically with foetal passage and obstructs the progression of labour [39]. In addition, myometrium in obese women contracted with less force and frequency and had less Ca_2^+ flux that of women with a normal weight and thus obesity may impair the ability of the uterus to contract in labour [40]. Wray [41] reported that elevated cholesterol level has been shown to decrease uterine contractibility and obese women are more likely to have elevated cholesterol levels than women with normal weight. Cholesterol elevation may lead to subsequent higher incidence of dysfunctional labour in obese women and increase the practice of cesarean section [20]. Differences in decision making which may be influenced by patients demand, private medical work, and patient unsatisfaction in governmental health care delivery may lead to increase in rate of cesarean section. Furthermore, foetal complication forms 52% as a cause for cesarean section.

BMI of ≥25 frequency was higher in women from urban than those from rural areas; however, the difference was not statistically significant. Thus residence not significantly influences BMI in our studied population. This finding was consistent with that reported in Moroccan population [42]. However, to illustrate such link a large scale study need to be performed. One of the important finding of the present study was high cesarean rate [30.9%]. This finding confirms the importance of understanding the causes or contributing factors and presenting approaches for avoiding or reducing cesarean section. This and reported studies [20,22,23,43-45] show that obese and overweight women were more likely to required cesarean section compared with women with normal BMI.

Obesity was with risk on foetal health as this study indicated. Both preterm labour and postdate labour were with more incidence in overweight and obese women than in those with normal weight. Kiran et al [19] detected a higher incidence of postdates and induction of labour in women with increased BMI. Although an

increased risk of postdates been previously demonstrated, these women do appear to require induction of labour [46]. Graves et al [18] reported that obese women were twice as likely to undergo induction for postdates.

Vaginal delivery rate was 69.1% in our study cohort and its pattern with BMI about with normal distribution as it was 7.4% in women with BMI of 20 – 24.9 and those with BMI ≥35, while it was 34.6% for BMI of 25-29.9 and 19.8% for BMI of 30-34.9. Vaginal delivery was more predominant in women with BMI of >25, however, induced vaginal delivery was 22 times in women with BMI of >25 as compared to those with BMI of <25. Mochhoury et al [42] in Moroccan population suggest high vaginal delivery rate in women with BMI of <25 as compared to those with BMI of >25. Reported studies suggest that forceps' delivery was high with overweight women [14,19,47]. Recently, Ngoga et al [37] reported vaginal delivery rate of 65% in women with morbid obesity and 98.6% in control group, while the rate of induction of labour was 36% and 3.3% for obese and control group respectively. Graves et al [18] reported that 21.7% of women included in their study cohort were experienced induction of labour and the induction was significantly related to BMI. Accumulating evidence suggests that obesity contributes to the increased rates of labour induction [19,46,48] and obstetrical intervention [49,50]. In obese women labour progression was slower than in normal weight women [24,26].

The present study shows that maternal complication of vaginal delivery was too much high [69.1%] indicating the possibility of malpractice. However, 61.7% of the above rate was in women with BMI of ≥25. Thus obesity does influence development of complications during pregnancy with risk of more than 8 times of that in women with normal BMI. However, OR not confirm an association between BMI and maternal complications studies in this study and not reach a significant levels which was influenced by sample size. In women with BMI of ≥25, episiotomy as type of vaginal delivery complication forms the highest [29.2%] rate of complication followed by those with episiotomy and post-partum haemorrhage [15.3%]. However, vaginal tear form 5.6%, while episiotomy, vaginal tear and post-partum haemorrhage form 2.8%, but perineal tear and episiotomy form 2.8%.

In women with BMI of <25, episiotomy was the predominant complication types and form 44.4%, followed by PPH which forms 11.1%. Thus types of vaginal delivery complications in obese women are with wide range of types as compared to those with <25 BMI. In obese women perineal tear and episiotomy were reported in 47.7% and 9% respectively, while in control group the corresponding values were 11.7% and 4.4% respectively [37]. Perineal tear was 23% in women with BMI of >30 and 6.9% in those with BMI <20 in Moroccan women [42].

Vaginal delivery complications may be a cascade of events with the starting point being postdates, and then a difficult induction leading to other interventions [19]. Perineal tears were not increased in Kiran et al [19] study cohort due to postdates, although it has been reported by others[51], and vaginal and perineal tears rate was 11.1% in women with BMI of >25. The perineal and vaginal tears disparities between different studies perhaps because cesarean section was practiced more often than vaginal delivery.

Maternal complication mainly is a result of labour sequences. Blood loss increased with the increase in cesarean section rate; however, obese women who had vaginal delivery also had excessive blood loss over 500 ml when compared with those with a BMI of 20-30 [19]. The present study confirm these finding as post partum haemorrhage was demonstrate in 17.3% in women with BMI >25, while it was 1.2%

in women with BMI of <25. This finding was consistent to that reported by others [46;51].

This study and that reported in literature clearly demonstrate the increased risk associated with overweight and obese and thus this group of pregnant women needs to be regarded as " risk group". Antenatal care monitoring and follow up must be arranged for such group and their regular attending to primary health care centre must be compulsory.

Ducarne et al. [52] found out that the average weight of newborns was influenced by the BMI of their mothers, and there were also a greater number of children in these obese patients who were macrocosmic. Mochhoury et al [42] they observed that pregestational high body mass index combined with high weight gain was a low factor risk for low birth weight outcome. Cnattingius et al.[39] confirmed the idea and stated that overweight protects against low birth weight. However, this not that case in the present study findings. Our finding indicated that low birth weight was demonstrated in 8.9% in women with BMI of ≥25, while it was 4.9% in women with BMI of <25. In addition, overweight fetuses was demonstrated in 14.8% in women with BMI of ≥25, while nil recorded in those with BMI of <25. Therefore, pregestational, at labour BMI and gestational weight gain are major factors in determining birth weight. Nesbitt et al. [53] stated that the risk of shoulder dystocia is increased by 5% for newborn whose weight is between 4,000 and 4,250 g and by 21% for newborns whose weight is between 4,750 and 5,000 g. Thus 14.8% of baby delivered to women with obese and overweight women are with risk of development of shoulder dystocia.

Foetal overweight was increased with the increase of BMI, it was with zero rate in women with BMI of 20-24.9 and increased to 3.7% in women with BMI of 25-34.9 and then increased to 7.4% in women with BMI of ≥35. However, foetal underweight was with a rate of 4.9% in women with BMI of 20-24.9 and increased to 7.4% in those with BMI of 25-29.9 and then reduced to 1.2% and 0% for women with BMI of 30-34.9 and ≥35 respectively. Thus the pattern of association between maternal BMI and foetal birth weight was not the same for underweight and overweight babies, but contrasted to each other. Odd ratio (OR) confirmed a highly significant influence of at labour maternal BMI on foetal body weight.

Normal birth weight observed in 71.6%, while underweight or overweight children were born in cases of extremes of BMI but with reverse trend. A finding that was consistent to that reported by others [14, 47,54, 55]. OR confirmed the association between increase in foetal body weight and increased in maternal BMI [OR=14.15, P<0.02]. In addition, underweight and overweight were predominant in women with BMI of ≥25 and such association was reported in other studies with high OR [14] or 1.5 to 3 [47,54,55]. In a recently reported study [37] birth weight was 3.516 Kgm in women with morbid obesity while it was 3.008 Kgm in control. in addition, other study reported a double risk of baby macrosomia in women with BMI of >30 as compared to those with BMI of <30 [19]. Other studies reported increased macrosomia rate in relation to increased maternal BMI [42,56,57]. Risk of underweight baby was more in underweight and overweight women and thus maintaining of normal BMI during pregnancy is very important to achieve healthy pregnancy outcomes.

The present study indicated a positive association between duration of pregnancy and maternal BMI, preterm labour was demonstrated about 5 times in women with BMI of ≥25 as compared to those with BMI of <25. In addition, the postdates was 18.5 times in those with BMI of ≥25 than in those with BMI of <25.

However, normal pregnancy duration was demonstrated in 7.1 times in women with BMI of ≥25 than those with BMI of <25. Gestation period was significantly longer in women with morbid obesity than in control [37]. Women with BMI of >30 were at increased risk of postdates pregnancy and more likely to require induction of labour [19].

Comparison between women with BMI of <25 and ≥25 stratification, this study indicated that induced vaginal delivery was 18.5 time, maternal complications was 8.33 times, cesarean section was 7 times, foetal overweight was 14.8 times, underweight baby was 1.8 times in obese and overweight than in normal weight women. These findings agreed to that reported previously for different geographical areas [14,42].

Pawalia et al [58] in a systematic review that included 121 studies reported that obesity overweight was associated with many pre-, peri-, and post natal complications. The studies performed in the last decade indicated a significant association between obesity and overweight and pregnancy outcome complications [59-76]. Risk of anaemia in pregnant women was 4.7 times in underweight women as compared to normal weight women. However, in the present study the higher rate of anaemia [14.8%] was demonstrated in women with BMI of 25-29.9, while it was 2.5% in women with BMI of <25 and 23.4% in those with BMI of >25. In addition, the ratio of >25/<25 BMI was 9.36 times in women with Hb of <10 g/dl, while it was 7.6 in women with Hb of >10 g/dl. Verma and Shrimali [77], found that underweight women are with high incidence of anaemia. Additionally, Mocking et al [78] in a comparative study reported that women with high BMI are with higher haemoglobin level during their antenatal follow up.

In conclusion, obese and overweight women were with higher rate of cesarean section, preterm labour, postdate, anaemia, and post vaginal delivery complications, however, these findings need to be confirmed in a large scale study.

References

1. WHO. Global database on BMI. BMI classification. http://apps.who.int/bmi/index.jsp?introPage=intro_3.html.
2. Wardlaw T, Blanc A, Ahman E. Low birth weight: country, regional and global estimates. New York. United Nations Children's Fund and World Health Organization, 2004.
3. McDonald SD, Han Z, Mulla S, Beyene J. Overweight obesity in mothers and risk of preterm birth and low birth weight infants: systemic review and meta-analysis. BMJ 2010;341:c3428.
4. Banjare JB, Bhalerao S. Obesity associated non-communicable disease burden. Int J Health Allied Sci 2016;5:81-7
5. Nieuwoudt M, Merwe JL, Harvey J, Hall DR. Pregnancy outcomes in super-obese women- an even bigger problem? A prospective cohort study. South Afr J Obstet Gynecol 2014;20(2):54-9.
6. Martin JA, Hamilton BE, Sutton PD, Ventura SJ, Menacker F, Kirmeyer S, et al. Centers for Disease Control and Prevention. National Center for Health Statistics, National Vital Statistics System. Births 2007;56:1-103.
7. Myrex P, Harper L, Gould S. An evaluation of birth outcomes in overweight and obese pregnant women who exercised during pregnancy. Sports 2018;6:138.
8. McDonald SD, Han Z, Mulla S, Beyene J. Overweight obesity in mothers and risk of preterm birth and low birth weight infants: systemic review and meta-analysis. BMJ 2010;341:c3428

9. Rasmussen KM, Yaktine AL. Weight gain during pregnancy: Reexamining the guidelines, The National Academy Press,2009.
10. Cogswell ME, Yip R. The influence of fetal and maternal factors on the distribution of birth weight. Sem Perinatol 1995;19:222-40.
11. Aras RY. Teenage pregnancy- an epidemiological perspective. J Fam Welf 1986;33:65-74.
12. Donna MS, Ensminger ME, Young JK. Mechanisms for maternal age differences in birth weight. Am J Epid 1995;142:504-14.
13. Usha TS, Hemmadi S, Bethel J, Evans J. Outcome of pregnancy in a women with an increased body mass index. Int J Obest Gynae 2003;112:768-72.
14. Gaur K, Yaday A, Raj A, Jain A. Study of the association of body mass index with pregnancy outcome. Int J Innovative Res Develop 2013;2(7):65-70.
15. Kulie T, Slattengren A, Redmer J, Counts H, Eglash A, Schrager S. Obesity and women's health : an evidence based review. J Am Board Fam Med 2011;24:75-85.
16. Yang L, Colditz GA. Prevalence of overweight and obesity in the United States, 2007–2012. JAMA Intern Med 2015;175, 1412–1413.
17. Ogden CL, Carroll MD, Flegal KM. Prevalence of obesity in the United States. JAMA 2014;312, 189–190(2014).
18. Graves BW, Dejoy SA, Heath A, Pekow P (2006). Maternal body mass index, delivery route, and induction of labor in a midwifery caseload. J. Midwifery Women Health 51(4):254-259.
19. Kiran TSU, Hemmadi S, Bethel J, Evansa J. Outcome of pregnancy in a woman with an increased body mass index. BJOG 2005;112:768– 772.
20. Rezai M, Shahoei R, Shahghebi S. The effect of maternal body mass index on the delivery route in nulliparous women. J Public Health Epidemiol 2013:5(8):346-350.
21. Bergholt T, Lim LK, Jorgensen JS, Robson MS. Maternal body mass index in the first trimester and risk of cesarean delivery in nulliparous women in spontaneous labor. Am J Obstet Gynecol 2007;196:163.e1-163e5.
22. Kominiarek MA, Vanveldhusien P, Hibbard J, Landy H, Haberman S, Learman L, et al. The maternal body mass index: a strong association with delivery route. Am J Obstet Gynecol 2010; 264:e1-7.
23. Mantakas A, Farrell T. The influence of increasing BMI in nuliparous women on pregnancy outcome. Eur J Obstet Gynecol Reproduct Biol 2010;153:43-46
24. Vahratian A, Zhang J, Troendle JF, Savitz DA, Siega-Riz AM. Maternal pre-pregnancy overweight and obesity and the pattern of labor progression in term nulliparous women. Obstet Gynecol 2004;104:943-510.
25. Ehrenberg HM, Durnwald CP, Catalano P, Mercer BM. The influence of obesity and diabetes on the risk of cesarean delivery. Am J Obstet Gynecol 2004;191:969-74.
26. Weiss JL, Malone FD, Emig D, Ball RH, Nyberg DA, Comstock CH, et al. Obesity, obstetric complications and cesarean delivery rate–a population-based screening study. Am J Obstet Gynecol 2004; 190(4):1091-7.
27. Dresner M, Brocklesby J, Bamber J. Audit of the influence of body mass index on the performance of epidural analgesia in labour and the subsequent mode of delivery. BJOG 2006;113:1178–1181.
28. Barau G, Robillard P, Hulsey T, Dedecker F, Laffite A, Gerardin P, Kauffmann E. Linear association between maternal pre-pregnancy body mass index and risk of caesarean section in term deliveries. BJOG 2006;113:1173–1177

29. Hibbard JU, Gilbert S, Landon MB, Hauth JC, Leveno KJ, Spong CY, **et al.** Trial of labor or repeat cesarean delivery in women with morbid obesity and previous **c**esarean delivery. Obstet Gynecol 2006;108(1):125-33.
30. Goodall PT, Ahn JT, Chapa JB, Hibbard JU. Obesity as a risk factor for failed trial of labor in patients with previous cesarean delivery. Am J Obstet Gynecol 2005;192:1423–1426.
31. Bujold E, Hammoud A, Schild C, Krapp M, Baumann P. The role of maternal body mass index in outcomes of vaginal births after cesarean. Am J Obstet Gynecol 2005;193(4):1517–1521.
32. Crane JM, White J, Murphy P, Burrage L, Hutchens D: The effect of gestational weight gain by body mass index on maternal and neonatal outcomes. J Obstet Gynaecol Canada: JOGC 2009;31(1):28-35.
33. Kaiser OPS, Kirby RS. Obesity as a risk factor for cesarean in a low-risk population. Obstet Gynecol 2001;97(1):39-43.
34. Kominarak MA, Zhang J, Vanveldhuisen P, Troendle J, Beaver J, Hibbard J. Contemporary Labor Patterns: The Impact of Maternal Body Mass Index. Am J Obstet Gynecol. 2011; 205(3): 244.e1–244.e8
35. Sheiner E, Levy A, Menes TS, Silverberg D, Katz M, Mazor M. Maternal obesity as an independent risk factor for caesarean delivery. Paediatr Perinat Epidemiol 2004;18:196–201
36. Al-Kubaisy W, Al-Rubaey M, Al-Naggar RA, Karim B, Mohd Noor N. Maternal obesity and its relation with the cesarean section: A hospital based cross sectional study in Iraq. BMC Pregnancy and Childbirth 2014;14:235.
37. Ngoga E, Hali D, Mattheyes F, Grove D. Outcome of pregnancy in the morbidly obese woman. SA Fam Pract 2009;51(1):39-41.
38. Rode L, Nilas L, Wøjdemann K, Tabor A. Obesity-Related Complications in Danish Single Cephalic Term Pregnancies. Obstet Gynecol 2005;105:537– 42.
39. Cnattingius S, Villamor E, Johansson S, Edstedt B, Persson M, Wikstrom AK, Granath F. Maternal obesity and risk of preterm delivery. JAMA 2013;309(22):2362-70.
40. Zhang J, Bricker L, Wray S, Quenby S. Poor uterine contractility in obese women. BJOG 2007;114:343-8.
41. Wray S. Insights into the uterus. Exp Physiol. 92: 621-31.
42. Mochhoury L, Razine R, Kasouati J, Kabiri M, Barka A. Body Mass Index, Gestational Weight Gain, and Obstetric Complications in Moroccan Population. Journal of Pregnancy Volume 2013, Article ID 379461, 6 pages.
43. Athukorala C, Rumbold AR, Willson KJ, Crowther CA. The risk of adverse pregnancy outcomes in women who are overweight or obese. BMC Pregnancy and Childbirth 2010;10:56.
44. Demont- Heinrich C, Hansen M, Mc Culloch A, Archer L. The Association of Prepregnancy Body Mass Index and Adverse Maternal and Perinatal Outcomes. Colorado Department of Public Health and Environment 2009;69:1-6.
45. Park JH, Lee BE, Park HS, Ha EH, Lee SW, Kim YJ. Association between pre-pregnancy body mass index and socioeconomic status and impact on pregnancy outcomes in Korea. J Obstet Gynecol Res 2011;37(2):138-145.
46. Seibre NJ, Jolly M, Harris JP, et al. Maternal obesity and pregnancy outcome: a study of 287,213 pregnancies in London. Int J Obstet Relat Metab Disord 2001:1175– 1182.

47. Bhattacharya S, Campbell DM, Liston WA, Bhattacharya S. Effect of body mass index on pregnancy outcomes in nulliparous women delivering singleton babies. BMC Public Health. 2007;7:168.
48. Vinturache A, Moledina N, McDonald S, Slater D, Tough S. Pre-pregnancy Body Mass Index (BMI) and delivery outcomes in a Canadian population. BMC Pregnancy and Childbirth 2014; 14:422
49. Chu SY, Kim SY, Lau J, Schmid CH, Dietz PM, Callaghan WM, Curtis KM, et al. Maternal obesity and risk of stillbirth: a meta-analysis. Am J Obstet Gynecol 2007;197:223-8.
50. Cedergren M. Maternal morbid obesity and the risk of adverse pregnancy outcome. Obstet Gynecol 2004;103:219-224
51. Bowers D, Cohen WR. Obesity and related pregnancy complications in an inner-city clinic. J Perinatol 1999;19(3):216 – 219
52. Ducarne G, Rodrigues A, Aissaoui F, Davitian C, Iuzam CP. Grossesse des patient obeses: quelsrisquesfaut –ilcraindre? Gynecologie Obstetrique Fertilite 2007;35:19-24.
53. Nesbitt TS, Gilbert SM, Herrchen B. Shoulder dystocia and associated risk factors with macrosomic infants born in California. Am J Obstet Gynecol 1998;179:476-80.
54. Gogoi G, Ahmed FU. Effect of maternal nutritional status on the birth weight among women of tea tribe in Dibrugarh district. Indian J Community Med 2007;32:120-2.
55. Vinturache AE, Chaput KH, Tough SC. Pre-pregnancy body mass index (BMI) and macrosomia in a Canadian birth cohort. JN Mater Fetal Neonatal Med 2017;30(1):109-116.
56. Steinfeld JD, Valentine S, Lerer T, Ingardia CJ, Wax JR, Curry SL. Obesity-related complications of pregnancy vary by race. J Matern Fetal Med 2000;9(4):238–241
57. Tilton Z, Hodgson MI, Donoso E, Arteaga A, Rosso P. Complications and outcome of pregnancy in obese women. Nutrition 1989;5(2):95–99.
58. Pawalia A, Savant S, Kulandaivelan S, Yadav AS**.** Effect of pre-pregnancy BMI (Obesity) on pregnancy related complications with specific emphasis on Indian Studies: Systematic review based on PRISMA Guideline. Indian J Obst Gynecol Res 2016;3(3):239-252.
59. Pawalia A, Yadav VS, Kulandivilan S. Effect of Obesity on Pregnancy Outcomes –Indian Perspective: A Review. Int J Sci Res 2015;4(7):453-457.
60. Sharmila G, Sudha M. Maternal body mass index in outcome of pregnancy. Int J Reprod Contracept Obstet Gynecol. 2016;5(8):2652-2656.
61. Hope AC. Pre-pregnancy BMI and preterm birth among Hispanic teens. Master thesis, University of Massachusetts Amherest, 202, 2015.
62. Nascimento IB, Dienstmann G, Souza ML, Silva TR, Fleig R, Silva C. Dyslipidemia and maternal obesity: prematurity and neonatal prognosis. Rev Assoc Med Bras 2018;64(3):264-71.
63. Derraik JG, Lundgren M, Cutfield WS, Ahlsson F. Association between preterm birth and lower adult height in women. Am J Epidemiol 2017;185(1):48-53.
64. Donmez S, Guner O. Relationship between weight pre-pregnancy and weight gain during pregnancy with preterm birth. J Nut Health Sci 2017;4(2):207.
65. McDonald SD, Han Z, Mulla S, Beyene J. Overweight obesity in mothers and risk of preterm birth and low birth weight infants: systemic review and meta-analysis. BMJ 2010;341:c3428.

66. Parker MG, Ouyang F, Pearson C, Gillman M, Belfort MB, Hong X, et al. Prepregnancy body mass index and risk of preterm birth: association heterogeneity by preterm subgroup. BMC Pregnancy Childbirth 2014;14:153.
67. Shaw GM, Wise PH, Mayo J, Carmichael SL, Ley C, Lyell DJ, et al. Maternal prepregnancy body mass index and risk of spontaneous preterm birth. Paed Perinat Epidemiol 2014;28:302-11.
68. Hajagos-Toth J, Ducza E, Samavati R, Vari SG, Gaspar R. Obesity in pregnancy: a novel concept on the roles of adipokines in uterine contractability. Croat Med J 2017;58:96-104.
69. Lowe NK, Corwin EJ. Proposed biological linkages between obesity, stress, and inefficient uterine contractility during labor in humans. Med Hypotheses. 2011;76:755-60.
70. Kidder MG, Winterhager E. Physiological roles of connexins in labour and lactation. Reproduction. 2015;150:R129-36.
71. Mendelson CR. Minireview: fetal-maternal hormonal signaling in pregnancy and labor. Mol Endocrinol. 2009;23:947-54.
72. Elmes MJ, Tan DS, Cheng Z, Wathes DC, McMullen S. The effects of a high-fat, high-cholesterol diet on markers of uterine contractility during parturition in the rat. Reproduction. 2011;141:283-90.
73. Carlson NS, Hernandez TL, Hurt KJ. Parturition dysfunction in obesity: time to target the pathobiology. Reprod Biol Endocrinol. 2015;13:135.
74. Moynihan AT, Hehir MP, Glavey SV, Smith TJ, Morrison JJ. Inhibitory effect of leptin on human uterine contractility in vitro. Am J Obstet Gynecol. 2006;195: 504-9.
75. Zelig CM, Nichols SF, Dolinsky BM, Hecht MW, Napolitano PG. Interaction between maternal obesity and Bishop Score in predicting successful induction of labor in term, nulliparous patients. Am J Perinatol. 2013;30:75-80.
76. Lassiter JR, Holliday N, Lewis DF, Mulekar M, Abshire J, Brocato B. Induction of labor with an unfavorable cervix: how does BMI affect success? J Maternal Fetal Neonatal Med. 2016;29:3000-2.
77. Verma A, Sharimali L. Maternal body mass index and pregnancy outcome.. J Clin Diag Res 2012;6(9):1531-3.
78. Mocking M, Savitri AI, Uiterwaal CSP, Amelia D, Antwi E, Baharuddin M, et al. Does body mass index early in pregnancy influence the risk of maternal anaemia? An observational study in Indonesian and Ghanaian women. BMC Public Health 2018;18:873