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Review Article

Maternal Overweight or Obesity and Associated Risks

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Abstract

Obesity is a risk factor for wide number of health problems. These problems can be avoided by losing the excess weight thus maintaining a normal BMI. Obesity in pregnancy can have adverse impacts not only on maternal but fetal health also. It leads to metabolic changes in overweight and obese women which are different from normal weight pregnant women. The worldwide increase in obesity especially in women of reproductive age group is associated with several obstetric complications such as gestational diabetes, macrosomia, shoulder dystocia, etc. A healthy pre-pregnancy BMI and appropriate weight gain during pregnancy is considered to be a preventive strategy to avoid these complications. Moreover maternal nutrition during pregnancy can have a direct impact on fetal health. Several strategies like pre-conception counseling, healthy lifestyle, educating young girls, weight loss prior to pregnancy etc. can be adopted. The importance of normalizing BMI and gaining less weight during pregnancy is still being overlooked. Screening of women before pregnancy and creating awareness is a key to limit the occurrences of such complications. In the present review, the possible complications of maternal obesity and the preventive strategies for the same have been discussed.

Keywords: Gestational diabetes; Pre eclampsia; Macrosomia; Shoulder dystocia

Introduction

Obesity is a complex, multi-factorial chronic disease involving genetic, physiological, metabolic, behavioral, psychological and environmental (social and cultural) components. The global epidemic of overweight and obesity - "globesity" - is rapidly becoming a major public health problem in many parts of the world [1]. Approximately 7% of the worldwide adult population is obese. Obesity has reached epidemic proportions in Indian the 21st century, with morbid obesity affecting 5% of the country's population [1]. Overweight is more prevalent among the urban and high socioeconomic status groups, especially among women. A higher prevalence of obesity seen in the urban areas in developing countries is associated with the change from rural to urban lifestyle causing decreased levels of physical activity and an increase intake of energy-dense diet [2].

According to the National Family Health Survey-3,the percentage of women aged 15-49 years (child-bearing age) who are overweight or obese increased from 11% in NFHS- 2 to 15% in NFHS-3. While obesity is a known cause for many health problems, including type 2 diabetes mellitus, hypertension, coronary heart disease, and stroke, obese women have higher

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risk of complications during pregnancy and delivery. Furthermore, their obesity may have adverse effect on the health of their offspring [3].

Pre gravidic weight is an important factor influencing fetal and pregnancy outcome. In particular, the maternal BMI is one of the best markers of nutritional status. To improve the maternal & child health outcomes women not only should be within normal BMI range when they conceive but also should gain within the ranges recommended in the new guidelines given by Institute of Medicine (Table 1). These guidelines recommend smaller weight gains for women with high pre-pregnancy BMI, particularly for women entering pregnancy with a BMI of at least 30 kg/sq.mt. Meeting these challenges means that women will need pre-conception counseling, which may include plans for weight loss; and both women and their care providers need to know and understand the new guidelines. For many women, this will mean gaining less during pregnancy which may be particularly challenging for women who are overweight or obese at conception [4].

The IOM guidelines recommend that health care providers should chart women's weight gain and share the results with them so that they become aware of their progress toward their weight-gain goal. To assist health care providers in doing this, the committee has prepared charts that could be used as a basis for this discussion with the pregnant woman and could also be included in her medical record. These charts reflect the fact that typically only some weight gain usually occurs in the first trimester and that weight gain is greater and close to linear in the second and third trimesters. Figure 1 represents the chart showing recommended weight gain by week for obese pregnant women (BMI: ≥ 30 kg/m^2).

The purpose of this paper is to describe an overview of complications associated with maternal obesity with the help of researches that document the impact of maternal overweight/obesity on "pregnancy outcomes" both maternal and fetal and possible strategies to prevent and treat them. The review also compares metabolic changes that take place during pregnancy in normal as versus obese pregnant women in an attempt to highlight maternal obesity as an avoidable risk factor.

Method

The PubMed and Google Scholar search of relevant articles for ten years between from year 2001-2011 as well as reference list of these articles was done. Full text was retrieved for abstracts that mentioned a relationship between maternal obesity and pregnancy complications from a case control or cohort study. The review therefore aims to summarize the complications associated with maternal pre-pregnancy overweight and obesity and to discuss possible strategies to improve the life-style habits of pregnant women.

Impaired metabolic changes among overweight/obese women during pregnancy:

From the beginning of pregnancy maternal metabolism undergoes a number of changes to adapt to fetal and placental needs. In the first trimester these needs are mainly qualitative for organ development, since embryogenic growth is still limited. In this period, hyperphagia and rise in insulin sensitivity allow the mother to store fats in adipose tissue and increase her net body weight [5].

Lipid metabolism undergoes major adjustment during pregnancy. There is a significant 50-80% increase in basal fat oxidation during pregnancy [6] and marked hyperlipidemia in pregnancy [7]. In obese pregnant women, this hyperlipidemia is exaggerated. Collectively the pattern of dyslipidemia observed in obese pregnancy is similar to those observed in non-pregnant obese individuals [8].

In pregnancy, the majority of amino acids are utilized for protein synthesis, with a reduction in the amount oxidized by 10% [9]. At present, the impact of obesity on amino acid metabolism is unknown. However, in non-pregnant obese women, protein synthesis is stimulated less in a hyper-insulinemic state in comparison with lean women, with no difference in protein oxidation. Obesity is also associated with a greater supply of gluconeogenic amino acids to the liver with preference of their use over glycogen for glucose production [10].

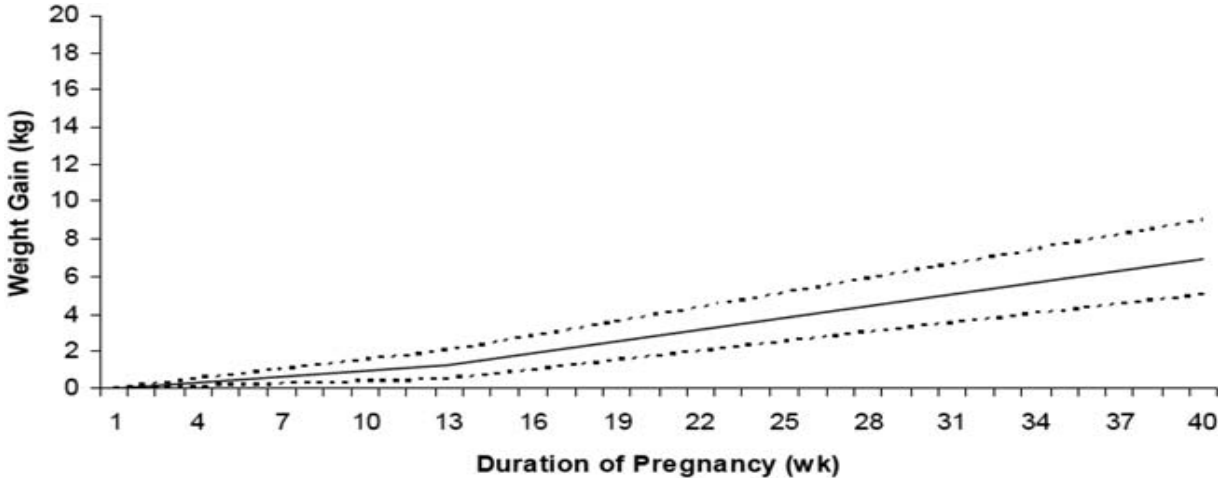

Figure 1: Recommended weight gain by week of pregnancy for obese (BMI_30 kg/m^2) women (dashed lines represent the range of weight gain) [4].

In normal pregnancies, dynamic changes in glucose homeostasis and insulin sensitivity accompany the alterations in lipid and protein metabolism. In early pregnancies, maternal fasting glucose decreases by 2 mg/dl very early in gestation (weeks 6-10), with little further decrease by the third trimester [11]. Facilitating these alterations in glucose homeostasis is marked changes in insulin secretion and sensitivity. During early pregnancies, glucose tolerance is normal or slightly improved and peripheral (muscle) sensitivity to insulin and hepatic basal glucose production is normal. Consequently by the third trimester, basal and 24 h mean insulin concentrations may double and the first and second phases of insulin release are 3-3.5-fold greater in late pregnancy [12].

The impact of obesity on these changes is substantial, in particular the decline in fasting glucose in early gestation is reduced, and glucose is not reduced at all in severely obese women [11]. In late gestation, the normal reduction in peripheral insulin sensitivity of 50% is reduced in obese women [12]. In addition, there is marked peripheral and hepatic insulin resistance, which manifests as reduced insulin-mediated glucose disposal, a large reduction in insulin-stimulated carbohydrate oxidation and a reduction in insulin suppression of endogenous glucose production, all of which are reversed in the post-partum period [13].

Importantly, the overall effects of this impaired insulin resistance are not limited to glucose. In the postprandial state, this obesity-related insulin resistance exaggerates the normal circulatory increases in metabolic fuels, i.e. glucose, lipids and amino acids. In fact, the fasting, post-prandial and integrated 24 h plasma concentrations of all three macro-nutrients are affected by enhanced insulin resistance in obese women.

Consequently, the impaired glucose uptake exposes the fetus to hyperglycemia; the inability to suppress whole body lipolysis leads to an increase in free fatty acids available for placental transfer, and the decreased ability of insulin to suppress amino acid turnover causes an elevation in maternal concentrations of branched-chain amino acids, again facilitating transfer of excess nutrients to the fetus [14,15]. Collectively, the data would suggest that the anabolic response to pregnancy may be impaired in obese women, raising the possibility that mechanisms may exist to limit fetal growth in a hyper insulinemic and glucose-rich environment.

Studies showing the complications of maternal overweight and obesity

Several prospective cohort studies as well as retrospective studies have determined the impact of maternal pre pregnancy BMI of the corresponding pregnancy outcomes. Majority of these studies show adverse outcomes with complications for the mother as well the child. Table 2 summarizes them in brief.

Table 1: IOM recommendations for pregnancy weight gain by BMI at conception.

Pre pregnancy BMI	BMI(kg/m^2) (WHO)	Total Weight Gain Range (lbs)	Rates of Weight Gain* 2nd and 3rd Trimester (Mean Range in lbs/wk)
Underweight	<18.5	28-40	1 (1–1.3)
Normal weight	18.5-24.9	25-35	1 (0.8–1)
Overweight	25-29.9	15-25	0.6 (0.5–0.7)
Obese (all classes)	≥ 30	11-20	0.5 (0.4–0.6)

*Calculations assume a 0.5–2 kg (1.1–4.4 lbs) weight gain in the first trimester [4].

Inclusion criteria

Studies dated only after 1998 were included in this review for updated data. Only those studies which aimed to show a direct relationship between maternal overweight/obesity on maternal and fetal outcomes were included. For relevant results studies with sample size more than 400 subjects were selected. Studies showing maternal outcomes like gestational diabetes mellitus, pre eclampsia and C-section delivery and fetal outcomes like macrosomia, low Apgar scores and birth defects were considered.

Exclusion criteria

Studies showing any other maternal complications than maternal overweight and obesity such as pre-pregnancy diabetes or hypertension were excluded. Postpartum maternal complications and long term complications of child were not studied. Studies with smaller sample size were excluded. Studies which showed interventional dietary or clinical modifications were also excluded to assess the impact solely of maternal obesity on the outcomes.

Several studies have mentioned about the outcomes of maternal obesity but in the present review we discuss about the possible strategies to prevent and treat them. Emphasis being laid upon the importance of pre-conceptional normal BMI and avoiding excess weight gain during pregnancy. Very few studies have focused upon the dietary interventions during pregnancy [16,17]. The importance of normalizing BMI before pregnancy is still being overlooked.

Complications during pregnancy and adverse reproductive outcomes

The most common complications during pregnancy among obese women are:

Maternal complications:

- Gestational Diabetes Mellitus
- Pre eclampsia
- Cesarean section

Fetal complications:

- Macrosomia
- Low Apgar score
- Shoulder dystocia

Several studies have determined the effect of pre-pregnancy BMI on the occurrence of these complications.

Gestational Diabetes Mellitus (GDM): Gestational Diabetes Mellitus is defined/ characterized by insulin resistance and inadequate insulin secretion, resulting in hyperglycemia first diagnosed in pregnancy. Gestational diabetes occurs only during pregnancy and usually resolves after pregnancy. It occurs in 5-10% of pregnancies and most commonly arises after 20 weeks of gestation. Overweight & obesity in mothers increased the risk of suffering from GDM is a finding of several studies [19-21].

A Population based cohort study in Denmark showed that odds of developing GDM was 3.5,7.7 and 11.0

Table 2: Summary of selected studies on maternal overweight and obesity and associated maternal and fetal risks

Name of Study	Author/Journal and Year	Sample size / Place of study	Pre-pregnancy BMI (kg/m²)	Maternal risks	Fetal risks
Pregnancy Complications and Outcomes Among Overweight and Obese Nulliparous Women	Baeten et al. [19]	96,801/ Aberdeen	Overweight (BMI=25.0–29.9) Obese (BMI=30.0)	Gestational diabetes mellitus, pre eclampsia, or eclampsia,cesarean delivery	Macrosomia (>4000 g)
Maternal obesity and pregnancy outcome: a study of 287 213 pregnancies in London	Sebire et al. [20]	287 213/ London	Moderately obese (BMI 25–29.9),Very obese (BMI 30)	Gestational diabetes, pre eclampsia, gestational hypertension, cesarean delivery	Low Apgar scores, macrosomia (birth weight above the 90th percentile)
Effect of Body Mass Index on Obstetric Outcomes in North Karnataka – A Longitudinal Study	Metgud et al. [21]	1138/ North Karnataka	Obese=(≥BMI 23)	PIH, cesarean delivery	-
The risk of adverse pregnancy outcomes in women who are overweight or obese	Athukorala et al. [22]	1661/ Australia	Overweight=(BMI 25-29.9), Obese=(BMI 30-34.9)	Gestational diabetes, pre eclampsia, cesarean delivery	LGA, Macrosomia (birth weight ≥ 4.5 kg)
Effect of Body Mass Index on pregnancy out-comes in nulliparous women delivering singleton babies	Bhattacharya et al. [26]	24,241/ Aberdeen	Overweight=(BMI 25 – 29.9), Obese=(BMI 30 – 34.9), Morbidly obese =(BMI > 35)	Pre eclampsia, cesarean delivery	Risk of birth weights >4,000 g
Maternal Obesity in Early Pregnancy and Risk of Adverse Outcomes	Bautista-Castano et al. [29]	6,887/Canary Island, a Spanish community	Overweight (BMI=25–29.9),Obese (BMI=30)	GDM, C-section, Pre eclampsia	Low Apgar scores, macrosomia
Atlantic Dip: The Impact of Obesity on Pregnancy Outcome in Glucose-Tolerant Women	Owens et al. Diabetes Care 33:577–579, 2010	2,329/5 centers along the Irish Atlantic seaboard	Overweight=BMI (25–29.9) ,Obese=(BMI 30)	Gestational diabetes, preeclampsia, cesarean delivery	Shoulder dystocia. Apgar score, stillbirth
Effect of Pre pregnancy Maternal Overweight and Obesity on Pregnancy Outcome	Ovesen et al. [25]	403,092/ Denmark	Overweight=[BMI] 25–29.9), Obese=(BMI 30–35), Severely obese=(BMI higher than 35).	Gestational diabetes, preeclampsia, cesarean delivery	Shoulder dystocia, macrosomia (>4500gm), low Apgar scores
Maternal Outcomes in Pregnancies Complicated by Obesity	Robinson et al. [30]	142,404/Nova Scotia	Obesity=(90–120 kg) ,Severe obesity=(>120 kg)	Cesarean delivery , pregnancy induced hypertension	-
10. Gestational Weight Gain and Pregnancy Outcomes in 481 Obese Glucose-Tolerant Women	Jensen et al. [37]	481/Danish university centers	BMI=/ >30	Hypertension, C-section	LGA, macrosomia (birth weight >4000gms)

Table 3: Plasma glucose goals during GDM.

Test	Blood glucose (mg/dl)
Fasting plasma glucose	65-95
1 hour postprandial	≤ 140
2 hour postprandial	≤ 120

in overweight, obese and severely obese women [3]. The odds of developing GDM were increased in those with raised BMI even after adjusting for demographic characteristics and history of diabetes were the findings of a retrospective study in London (Odds Ratio of 1.68 & 3.6 for moderately obese (BMI 25-29.9 kg/sq.mt.) and very obese (BMI 30 kg/sq.mt.) respectively [20]. Similar study in Australia found that obese women (BMI 30-34.9 kg/sq.mt.) were at a higher risk of developing gestational diabetes than women with a normal BMI (18.5-24.9 kg/sq.mt.) with a relative risk of 2.10 [22]. Results of a study conducted in Washington State showed that the odds of developing GDM in overweight (25-29.9 kg/sq.mt.) & obese women (>30 kg/sq.mt.) were higher when compared to lean women (BMI <20 kg/sq.mt.) even after adjusting for potential confounders such as mother's age, smoking during pregnancy, weight gain in pregnancy etc. [19]. Overall, the data suggests that being overweight or obese leads to an increased risk of GDM. Several strategies can be adopted to manage GDM which are as follows-

All women with GDM should receive medical nutrition therapy at diagnosis of GDM. Monitoring records guide nutrition therapy and are used to determine if insulin therapy is needed. Insulin therapy is added if glucose levels exceed a target range (Table 3) on 2 or more occasions in a 1-2 week period without some obvious explanation from food records or if glucose levels are consistently elevated because of patient's dietary indiscretions after medical nutrition therapy intervention.

Medical nutrition therapy for gestational diabetes primarily involves a carbohydrate controlled meal plan that promotes optimal nutrition for maternal and fetal health with adequate energy for appropriate gestational weight gain, achievement and maintenance of normo-glycemia and absence of ketosis. Specific nutrition and food recommendations are determined and modified based on individual assessment and blood glucose records.

Carbohydrates should be distributed throughout the day into three small-moderate size meals and two to four snacks. All women require a minimum of 175 gm of carbohydrates daily. An evening snack is usually needed to prevent ketosis overnight. Initial food plan may have approximately 30 gm carbohydrates at breakfast. To satisfy hunger, protein foods can be added because they do not affect blood glucose levels as much. Although calorie restriction must be viewed with caution, in obese women with GDM a 30% calorie restriction (an intake of about 1700-1800 Kcal daily) may reduce hyperglycemia without ketonemia and reduce the rate of maternal weight gain. Intake below these levels is not advised. The pattern of weight gain during pregnancy for women with GDM should be similar to that of women without diabetes. Weight loss is not recommended for overweight and obese women with GDM; however modest energy and carbohydrate restriction may be appropriate.

Exercise can also assist in overcoming peripheral resistance to insulin and in controlling fasting and post prandial hyperglycemia. It may be used as an adjunct to nutrition therapy to improve maternal glycemia. The ideal form of exercise is unknown, but a brisk walk after meals is often recommended [23].

Pre eclampsia: Hypertensive disorders during pregnancy are one of the main causes of maternal death worldwide. Preeclampsia is a multi-systemic disorder peculiar to pregnancy after 20 weeks of gestation. Maternal obesity is associated with a higher risk of adverse maternal and perinatal outcomes. It is a validated risk factor for pre eclampsia, but the mechanism of how it imparts increased risk is not completely understood [24]. In a study on Irish pregnant women odds ratio (OR) for pregnancy induced

hypertension increased from 4.3 to 9 to 11.3% in normal BMI, overweight and obese women, respectively (P<0.01). Pre eclampsia risk doubled from 2.7 to 4.7 to 6% in normal BMI, overweight and obese women, respectively (P<0.01). The overall risk of hypertensive disorders increased from 5 to 9.7 to 12.7% in normal BMI, overweight and obese women respectively (P<0.01). The OR of having a pregnancy complicated by hypertension was 2.30 (95% CI 1.55–3.40, P<0.01) in overweight and 3.29 (2.14-5.05, P<0.01) in obese women [25]. In a study conducted in London the odds of developing pre eclampsia were increased in those with raised BMI even after adjusting for demographic characteristics & history of diabetes [20]. Pregnancy-induced hypertension rates were higher among the moderately obese women i.e.90-120kg (adjusted OR 2.38, 95% CI 2.24-2.52) and severely obese women i.e. >120 kg (adjusted OR 3.00, 95% CI 2.49-3.62) compared with the non-obese women were findings of a study in Canada (Robinson et al, 2005). In a retrospective cohort study based on nulliparous women both pre-eclampsia and gestational hypertension increased linearly with increasing BMI, resulting in an adjusted Odds Ratio of 7.2 (95% CI 4.7, 11.2) for pre-eclampsia and 3.1 (95% CI 2.0, 4.3) for gestational hypertension in the morbidly obese category when compared to those of normal BMI [26]. In an Australian study it was found that obese women were at higher risk of developing pre-eclampsia compared with women with a normal BMI (RR 2.99 [95%CI 1.88, 4.73], p<0.0001). They were more likely to be hospitalised for hypertension than women with a normal BMI (RR 2.87 [95%CI 1.70, 4.84], p=0.0001). Compared to women with a normal BMI, overweight and obese women had an increased risk of pregnancy-induced hypertension (PIH) than women with a normal BMI (RR 1.94 [95%CI 1.43, 2.65], p<0.0001 and RR 3.19 [95%CI 2.36, 4.30], p<0.0001, respectively) and severe PIH (RR 2.76 [95%CI 1.35, 5.64], p=0.01 and RR 4.00 [95%CI 1.93, 8.30], p=0.0002, respectively) [22]. A similar study showed that increased BMI was associated with increased incidence of pre eclampsia (9% of the cases) while the incidence of pre eclampsia in the cases of normal BMI was only 4% and the relative risk of pre eclampsia in cases of increased BMI was 2.25 [24].

Management of Pre-eclampsia: The objectives of treatment for established pre-eclampsia or pregnancy induced hypertension are to prevent eclampsia as well as other severe complications. Close maternal evaluation is aimed at observing progression of the condition, both to prevent maternal complications and to determine whether fetal well-being can be assessed. Even though the only definitive treatment of pre-eclampsia is delivery, some non-pharmacological approaches are proposed as part of an overall strategy of management of the disease [27].

Cesarean section (CD): Obesity is an independent predictor of CD in pregnant women. The decreased rate of cervical dilation, increased induction rate, presence of comorbid conditions, concern about neonatal shoulder dystocia, and weight gain in excess of recommendations all may contribute to the high rate of CD in obese parturients. Excess weight gain above the figures listed in Institute of Medicine (IOM) guidelines is associated with increased risk of CD, regardless of pre pregnancy BMI. Nearly a quarter of primary CDs of nulliparous women could be avoided if no women gained weight in excess of the IOM recommendations [28].

An Australian study, compared to women with a normal BMI((18.5-24.9 kg/m^2), overweight (BMI 25-29.9 kg/m^2) and obese (BMI 30-34.9 kg/m^2) women it was shown that obese and overweight women were more likely to undergo a cesarean section overall (RR 1.42 [95%CI 1.18, 1.70], p=0.0002 and RR 1.63 [95%CI 1.34, 1.99] p<0.0001, respectively) and have an emergency cesarean section (RR 1.48 [95%CI 1.19, 1.83], p=0.0004 and 1.77 [95%CI1.40, 2.23], p<0.0001, respectively) [22]. Another prospective study of the impact of obesity on pregnancy outcome showed that the risk of an emergency cesarean delivery increased from 10 to 12.4 to 16.1% in NBMI, OW, and OB women, respectively (P<0.01). The trend was similar for elective cesarean delivery, increasing from 6.5 to 11 to 16.5% NBMI, OW, and OB women, respectively (P<0.01) [25].

In an Indian study based in Karnataka compared to pregnant women who had normal BMI, women who had BMI ≥ 23 were at increased risk for cesarean delivery [21]. A similar study, based on all nulliparous women delivering singleton babies in Aberdeen found that both

elective and emergency cesarean sections were more common in the morbidly obese group (BMI > 35 Kg/m^2), but only emergency cesarean section rates were significantly different in the other BMI categories. In contrast to women with normal BMI (20-24.9 Kg/m^2), women who were morbidly obese had a 3 times (95% CI 1.7, 6.1) higher risk of having an elective cesarean section, and 2.8 times (95% CI 2.0, 3.9) higher risk of an emergency cesarean section. The adjusted Odds Ratios for emergency cesarean section increased with increasing BMI [26].

Planned and especially emergency cesarean deliveries were increased with increasing BMI [3,20]. A 15-year, population-based cohort study found that obese women had a higher rate of cesarean delivery, with the adjusted OR increasing with increased maternal weight) [28,29]. Thus overall studies conclude that the risk of cesarean delivery increased with each level of increasing BMI.

Fetal outcomes in overweight and obese mothers: Maternal obesity confers risk on the child equally as it affects the mother. Several studies have associated the impact of maternal overweight and obesity on the birth outcomes.

Macrosomia: Macrosomia refers to a fetus weighing 4000 g or more at birth. Severe macrosomia denotes a birth weight of 4500 g or more. Maternal obesity is a well-known risk factor for fetal macrosomia. Owens et al. [25] found that the percentage of macrosomic neonates (more than 4,000 g) increased from 15.5% to 21.4% to 27.8% in normal weight, overweight, and obese women, respectively. Compared with lean women, women with normal BMI were slightly less likely to deliver a low-birth weight (<2500 g) infant, and obese, overweight, and normal-weight women were each slightly less likely to deliver a small-for-gestational-age (<10^{th} percentile) infant and were each more likely to deliver a macrosomic infant (≥ 4000 g) [19]. The risk of giving birth to a macrosomic neonate (more than 4,500 g) increased with increasing BMI 5 and it was observed that being obese or overweight at the start of pregnancy increased the risk of having an overweight baby (macrosomia) [3]. Babies of obese mothers were more likely to be macrosomic than those of mothers with a normal (RR 4.54 [95%CI 2.01, 10.24], p=0.0003) [22]. The term large for gestational age refers to infants whose birth weight exceeds 90^{th} percentile for growth at a specific gestational age. Babies of obese mothers were more likely to be large for gestational age (LFGA) compared with babies of women with a normal BMI (RR 2.08 [95%CI 1.47, 2.93], p<0.0001) [19]. A study in London showed that the prevalence of large for gestational age babies (birth weight >90^{th} centile) was almost twice as high in the very obese compared to the normal group. An increased placental supply of nutrients to the fetus is a possible mechanism involved in the occurrence of macrosomia. Therefore maternal reserves and intake during pregnancy will have an impact of birth weight [20].

Apgar score: Apgar score is a simple scoring method developed to quickly assess the health of a newborn baby. A newborn baby is scored from 0 to 2 in 5 areas like appearance, pulse, grimace, activity and respiration. For the total Apgar score, the numbers are added up to a maximum of 10. Apgars are usually taken at one minute and 5 minutes after birth. If a baby has low Apgar score at 1 minute they will improve by 5 minutes [31]. With increasing BMI, the risks of having a neonate with a low Apgar score increased [3]. Overweight and obese women are at increased risk of having children with abnormal Apgar score (at the first minute than women with normal weight, RR=1.327 (95% CI 1.043–1.689) and RR=1.777 (95% CI 1.382–2.286), respectively. However, the association became non-significant at the fifth minute, RR=1.208 (95% CI 0.628–2.323) and RR=1.658 (95% CI 0.847–3.246) [19].

Shoulder dystocia: Shoulder dystocia is an obstetric emergency occurs when further delivery of the fetal head and body is prevented by impaction of the shoulders anteriorly behind the maternal symphysis pubis, or in some cases posteriorly behind the maternal sacral promontory [32]. In unadjusted analyses, the risk of shoulder dystocia was significantly increased in the overweight, obese and severely obese women, but in the adjusted analyses the association disappeared [3].

Management of obesity in pregnancy

Dietary recommendations for obese pregnant women should consider optimal weight gain. Obese or overweight women need not gain as much weight during pregnancy as normal weight or thin women. Also, obese women may be resistant the idea of gaining further weight, special attention may be required to explain them that pregnancy is not a time for weight loss. Some practical guidelines for obese pregnant women are as follows:

Practical guidelines for overweight and obese mothers

- Weight loss is not advised during pregnancy.
- For women with a BMI 26.1-29.0, a weight gain of 7-11.5 kg and a normal dietary intake should be recommended.
- For women with BMI of >29.0, mothers should be advised to gain at least 7 kg during pregnancy.
- Nutritional counseling should focus on lowering intake of energy- dense foods that are low in other nutrients.
- Obese women should be made aware of the increased risk for glucose intolerance. Screening for GDM should occur at the first prenatal visit, with repeated testing at 28 weeks of gestation of negative.
- Frequent blood pressure monitoring with a cuff of appropriate size is essential. If the patient has chronic hypertension, appropriate medication and a reduced sodium diet are indicated.
- Weight loss should be encouraged after delivery [27].
- Nutritional management of Gestational Diabetes:
- Goals of Medical Nutrition Therapy-
- Optimal nutrition for developing fetus.
- Optimal nutrition for mother.
- Maternal euglycemia without distorting diet
- Good nutrition patterns taught to the family "gatekeeper"
- Nutritional patterns that prevent or forestall recurrence of GDM and onset of Type 2 diabetes mellitus.

The 'ideal' calorie intake to recommend for women with GDM is unknown. Calorie intake must take into account maternal height, pregravid age, maternal age, gestational age, physical activity and smoking. To give one guideline, 30 Kcal/ kg ideal body weight in the second trimester and 38 Kcal/ kg ideal body weight in the third trimester may be used as a starting point. Moderate calorie restrictions (33% of normal calories) approximately 1,800 calories has been shown to reduce macrosomia without neonatal morbidity or maternal ketonemia. However, some risk to the fetus may occur in calorie restriction during pregnancy, even in obese women and caution should be exercised [33].

The American College of Obstetrics and Gynecology has given certain recommendations for obese women who are pregnant or planning a pregnancy include the following:

- Preconception assessment and counseling are strongly encouraged and should include the provision and counseling are strongly encouraged and should include the provision of specific information concerning the maternal and fetal risks of obesity in pregnancy and encouragement to undertake a weight- reduction program.
- At the initial prenatal visit, height and weight should be recorded for all women to allow calculation of BMI and recommendations for appropriate weight gain, guided by IOM recommendations, should be reviewed both at the initial visit and periodically throughout pregnancy.
- Nutrition consultation should be offered to all overweight or obese women and they should be encouraged to follow an exercise program. Nutrition and exercise counseling should continue postpartum and before attempting another pregnancy.
- Women who have undergone bariatric surgery should be evaluated for nutritional deficiencies in iron, Vitamin B12, folic acid, Vitamin D and calcium.
- Consideration should be given to using a higher dose of pre-operative antibiotics for cesarean delivery prophylaxis.
- Consultation with a weight reduction specialist before attempting another pregnancy should be encouraged [34].

Conclusion

The prevalence of obesity among pregnant women is rising exposing the mother and her child to short-term and long-term health problems. A causal relationship between pre pregnancy BMI and obstetrics complications is proven. Weight management is important for every women of reproductive age: women with a normal BMI should strive for maintenance of normal weight and overweight/obese women should achieve normal BMI before conception. Maternal overweight and obesity is one of the few risk factors for poor gestational outcomes which can be modified before a pregnancy. Obese women considering pregnancy should be informed of the risks that maternal obesity confers on a pregnancy. Health care professionals need to encourage and assist obese women to make lifestyle changes to lose weight pre conceptually in an attempt to optimize pregnancy outcomes and potentially decrease the risk of complications in pregnancy. Normalization of pre-conception BMI is an effective tool to avoid majority of these complications.

References

1. Sharma S (2010) Obesity- a global menace. Indian J Maternal and Child Health 12: 1-8.
2. Ramachandran A, Snehalatha C (2010) Rising burden of obesity in Asia. J Obes 2010: 8.
3. Ovesen P, Rasmussen S, Kesmodel U (2011) Effect of Pre pregnancy Maternal Overweight and Obesity on Pregnancy Outcome. Obstet Gynecol 118: 305-312.
4. Institute of medicine (2009) Re-examining the guidelines. Washington, National Academy press.
5. Cetin I, Alvino G, Radaelli T, Pardi G (2005) Fetal Nutrition: A review. Acta Pediatr Suppl 94: 7-13.
6. Okereke NC, Huston-Presley L, Amini SB, Kalhan S, Catalano PM (2004) Longitudinal changes in energy expenditure and body composition in obese women with normal and impaired glucose tolerance. Am J Physiol Endocrinol Metab 287: E472-E479.
7. Knopp RH, Warth MR, Carrol CJ (1973) Lipid metabolism in pregnancy. I. Changes in lipoprotein triglyceride and cholesterol in normal pregnancy and the effects of diabetes mellitus. J Reprod Med 10: 95-101.
8. Sattar N, Greer IA, Louden J, Lindsay G, McConnell M, et al. (1997) Lipoprotein subfraction changes in normal pregnancy: threshold effect of plasma triglyceride on appearance of small, dense low density lipoprotein. J Clin Endocrinol Metab 82: 2483-2491.
9. Duggleby SL, Jackson AA (2001) Relationship of maternal protein turnover and lean body mass during pregnancy and birth length. Clin Sci (Lond) 101: 65-72.
10. Chevalier S, Marliss EB, Morais JA, Lamarche M, Gougeon R (2005) Whole-body protein anabolic response is resistant to the action of insulin in obese women. Am J Clin Nutr 82: 355-365.
11. Mills JL, Jovanovic L, Knopp R, Aarons J, Conley M, et al. (1998) Physiological reduction in fasting plasma glucose concentration in the first trimester of normal pregnancy: the diabetes in early pregnancy study. Metabolism, 47: 1140-1144.
12. Catalano PM, Tyzbir ED, Roman NM, Amini SB, Sims EA (1991) Longitudinal changes in insulin release and insulin resistance in nonobese pregnant women. Am J Obstet Gynecol 165: 1667-1672.
13. Sivan E, Homko CJ, Chen X, Reece EA, Boden G (1999) Effect of insulin on fat metabolism during and after normal pregnancy. Diabetes 48: 834-838.
14. Kalkhoff RK, Kandaraki E, Morrow PG, Mitchell TH, Kelber S, et al. (1998) Relationship between neonatal birth weight and maternal plasma amino acid profiles in lean and obese non diabetic women and in type I diabetic pregnant women. Metabolism 37: 234-239.
15. Nolan CJ, Riley SF, Sheedy MT, Walstab JE, Beischer NA (1995) Maternal serum triglyceride,

glucose tolerance, and neonatal birth weight ratio in pregnancy. Diabetes Care 18: 1550-1556.

16. Baeten JM, Bukusi EA, Lambe M (2001) Pregnancy Complications and Outcomes Among Overweight and Obese Nulliparous Women. Am J Public Health 91: 436-440.

17. Sebire NJ, Jolly M, Harris JP, Wadsworth J, Joffe M, et al. (2001) Maternal obesity and pregnancy outcome: a study of 287213 pregnancies in London. Int J Obes Relat Metab Disord 25: 1175-1182.

18. Metgud CS, Naik VA, Mallapur (2011) Effect of Body Mass Index on Obstetric Outcomes in North Karnataka – A Longitudinal Study. Indian J Maternal Child Health 13: 2-7.

19. Athukorala C, Rumbold AR, Willson KJ, Crowther CA (2010) The risk of adverse pregnancy outcomes in women who are overweight or obese. BMC Pregnancy Childbirth 10: 56.

20. Krause's Food & Nutrition Therapy (2008) Medical Nutrition Therapy for Diabetes Mellitus & Hypoglycemia of Nondiabetic Origin. 12th edition Page No.788-789.

21. El-Makhzangy I, Moiety F, Anwer M (2010) Relationship between maternal obesity and increased risk of preeclampsia. AJOL 46.

22. Owens LA, O'Sullivan EP, Kirwan B, Avalos G, Gaffney G, et al. (2010) ATLANTIC DIP: The Impact of Obesity on Pregnancy Outcome in Glucose-Tolerant Women. Diabetes Care 33: 577-579.

23. Bhattacharya S, Campbell DM, Liston WA (2007) Effect of Body Mass Index on pregnancy outcomes in nulliparous women delivering singleton babies. BMC Public Health 7: 168.

24. Allen L, Prentice A (2005) Pregnancy-Pre eclampsia and diet; Pregnancy: Dietary guidelines and safe supplements use. Encyclopedia of human nutrition. Volume 4 Page No. 33-35.

25. Wispelwey BP, Sheiner E (2013) Cesarean delivery in obese women: a comprehensive review. The Journal of Maternal-Fetal and Neonatal Medicine 26: 547-551.

26. Bautista-Castano I, Henriquez-Sanchez P, Alema´n-Perez N, Garcia-Salvador JJ, Gonzalez-Quesada A, et al. (2013) Maternal Obesity in Early Pregnancy and Risk of Adverse Outcomes. PLoS One 8: e80410.

27. Robinson HE, O'Connell CM, Joseph KS, McLeod NL (2005) Maternal Outcomes in Pregnancies Complicated by Obesity. Ostet Gynecol 106: 1357-1364.

28. Zimmerman, G. H. (2013). Birth trauma: Posttraumatic stress disorder after childbirth. International Journal of Childbirth Education, 28(3), 61-66.

29. Joseph G. Ouzounian, Goodwin TM, Montoro MN, Muderspach L, Paulson R, Roy S. Shoulder Dystocia Management of common problems in obstetrics and gynecology. 5th edition Chapter 12.

30. Thomas-Doberson D (1999) Nutritional management of gestational diabetes and nutritional management of women with a history of gestational diabetes: Two different therapies or same? Clinical Diabetes 17.

31. Committee Obstetric Practice (2013) Obesity in pregnancy American College of Obstetrics and Gynecologists: Committee opinion No. 549-January 2013.

32. Fred Arnold, SulabhaParasuraman, P. Arokiasamy, Monica Kothari Nutrition in India International Institute for Population Sciences and Macro International (2007) National Family Health Survey (NFHS – 3), 2005-06: India: Volume I. Mumbai: IIPS.

33. Carlson KJ, Eisenstat SA, Ziporyn T (2004) The New Harvard Guide to Women's Health. Harvard University Press Reference Library.

34. Jensen DM, Ovesen P, Beck-Nielsen H, Mølsted-Pedersen L, Sørensen B, et al. (2005) Gestational Weight Gain and Pregnancy Outcomes in 481 Obese Glucose-Tolerant Women. Diabetes Care 28: 2118-2122.

35. Asbee SM, Jenkins TR, Butler JR, White J, Elliot M, Rutledge A. (2009) Preventing excessive weight gain during pregnancy through dietary and lifestyle counseling: a randomized controlled trial. Obstet Gynecol. 113(2 Pt 1): 305-12.

36. Wolff S, Legarth J, Vangsgaard K, Toubro S, Astrup A (2008) A randomized trial of the effects of dietary counseling on gestational weight gain and glucose metabolism in obese pregnant women. Int J Obes (Lond) 32: 495-501.

37. Abrams B, Carmichael S, Selvin S.(1995) Factors associated with the pattern of maternal weight gain during pregnancy.Obstetrics and Gynecology;86(2):170–176.

38. Carmichael S, Abrams B, Selvin S.(1997) The pattern of maternal weight gain in women with good pregnancy outcomes. American Journal of Public Health;87(12):1984–1988.

39. Siega-Riz AM, Adair LS, Hobel CJ.(1994) Institute of Medicine maternal weight gain recommendations and pregnancy outcome in a predominantly Hispanic population. Obstetrics and Gynecology.;84(4):565–573.