ORIGINAL RESEARCH

Evaluation of association between sonographic maternal adiposity and pregnancy outcomes

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ABSTRACT

Background: Maternal obesity can result in negative outcomes for both mother and fetuses and also has health implications later in life for both mother and child. The present study was conducted to evaluate the association between sonographic maternal adiposity and pregnancy outcomes. **Materials & Methods:** 120 subjects were examined sonographically for maternal subcutaneous fat thickness (SFT) during routine scan at 11-14 weeks (SFT1) and again at 18-22 weeks (SFT2) after a thorough general physical, systemic and per abdomen examination. **Results:** Only 2 (1.66%) neonates had APGARscore less than 7/10. No neonate needed resuscitation.102/120 (85%) neonates had normal birth weight(2.5-4kg),16/120 (13.3%) neonates were with low birth weight (LBW) and 2/120 (1.66%) were macrosomic(>4kg). 17(14.2%) neonates required admission to NICU. A logistic regression analysis was not applied to predict APGAR below normal and need for resuscitation as the number of participants in each group was less. **Conclusion:** The sonologically assessed adiposity correlates well with the adverse pregnancy outcome and maternal subcutaneous fat thickness is the best marker of maternal adiposity. Therefore, the scans for measuring MSFT1 and MSFT2 can be combined with the routine obstetric scan at 11-14 weeks and 18-22 weeks.

Key words: macrosomic, APGAR, sonographic

INTRODUCTION

Adipose tissue is a specialized connective tissue consisting of lipid rich cells called adipocytes. The main function of Adipose tissue is to store energy in the form of lipid. Apart from functioning as a store house of energy, adipose tissue has a complex and essential function playing an important role in endocrine and immune regulations releasing signals that affect the physiology of body. Obesity is a state of abnormal or excessive fat accumulation, occurring most commonly due to an excessive intake off a trich food, and/ or due to decreased physical activity, other factors like metabolic and endocrine derangement and genetics also have a role to play. Obesity is a global problem especially in a modern world as itincreases the risk of developing potentially dangerous conditions such as high blood pressure, Type 2 diabetes, coronary heart disease, stroke, and even some cancers.

Maternal obesity can result in negative outcomes for both mother and fetuses and also has health implications later in life for both mother and child. Increasing obesity is associated with increased adverse obstetric and fetal outcomes, especially higher incidence of pre-eclampsia, gestational diabetes, abnormal labour, caesarean section, Deep vein thrombosis (DVT), wound infection, fetal macrosomia, unexplained fetal death, respiratory distress and neonatal death. Excessive accumulation of adipose tissue during pregnancy gives rise to chronic inflammatory responses and deranges metabolic homeostasis resulting in obesity related disorders in pregnancy such as Gestational diabetes mellitus (GDM), hypertensive disorder in pregnancy (Gestational hypertension, pre-eclampsia and eclampsia) and fetal growth disorders (FGD).1 Maternal obesity and GDM are independently linked to unfavorable pregnancy outcomes with some

variations in the influence of each condition . GDM increases the risk of hypertensive disorders of pregnancy, polyhydramnios, and premature delivery. GDM also causes excessive fetal growth, which increases the risk of caesarean deliveries, shoulder dystocia, and neonatal hypoglycemia. Long-term complicationsof GDM include diabetes and cardiovascular disease in mothers, obesity and diabetes in the offspring. Long-term complications of maternal obesity include obesity and diabetes in the offspring. The fetus is at risk for macrosomia, caesarean deliveries, stillbirth and congenital anomalies.

Sonographical fetal abdominal wall thickness (FAWT) has also been investigated as a sensitive and specific predictor of fetal growth and fetal weight. The measurement of FAWT has the high percentage of technical error. MSFT is considered a surrogate marker for obesity-related adverse pregnancy outcome. BMI and MSFT are both significantly associated with pregnancy outcome. A SFT as measured by ultrasound during the first trimester of pregnancy can be used to predict the risk of developing GDM during the second trimester of pregnancy and for predicting the prognosis. SFT at 18-22 weeks is better as compared to BMI and MSFT is a significantindependent predictor of adverse pregnancy outcome. The present study was conducted to evaluate the association between sonographic maternal adiposity and pregnancy outcomes.

MATERIALS & METHODS

The present study was conducted in a period of one year with effect from 1st April 2021 to 31st March 2022 at Kamla Nehru State Hospital for Mother and Child, Indira Gandhi Medical College, Shimla. Gravid subjects attending the antenatal OPD at Kamla Nehru Hospital for Mother and Child, Indira Gandhi Medical College, Shimla with a singleton intrauterine pregnancy during the study period were recruited for the study after taking an informed written consent and clearance from the Ethics Committee of IGMC, Shimla.

A detailed history regarding age, parity, socio-economic status, past and personal history, family history, menstrual and obstetric history was taken.120 subjects enrolled for the study were examined sonographically for maternal subcutaneous fat thickness (SFT) during routine scan at 11-14 weeks (SFT1) and again at 18-22 weeks (SFT2) after a thorough general physical, systemic and per abdomen examination.

Scans for sonographic maternal adiposity were done on LOGIQ-P6 (General Electric Medical Systems, Milwaukee, WI) ultrasound machine using multi-frequency convex probe (frequency range of 4–8 MHz) by an expert Radiologist at Kamla Nehru state Hospital for Mother and Child, Shimla.Maternal adiposity was estimated by measuring the sub-cutaneous fat thickness (SFT) which was recorded twice during the study; once during the routine 11-14 weeks (SFT1) scan and then again during the routine scanning at 18-22 weeks (SFT2).

All recruited women were subjected to 75g OGTT (oral glucose tolerance test) at 24-28 weeks as per the DIPSI guidelines (75g anhydrous glucose was ingested with 300 ml water over 5 minutes irrespective of the time of the day and the last meal status. Blood sugar was tested 2 hours later).Diagnosis of GDM was made using the following criteria outlined by DIPSI. Fetal outcome, neonatal outcomewere recorded. Data thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

RESULTS

Table1: Maternal Age

Age (in years)	Frequency	Percentage
<25	37	30.83
26-30	46	38.33
31-35	32	26.67
36-39	5	4.17

Majority (38.33%) were 26-30 years old, 37/120 (30.83%) were less than 25years, 32/120(26.67%) were 31-35years old, 5/120(4.17%) were between 36-39years of age.

Table 2: Parity

Parity	Frequency	Percentage
1	54	45.00
2	48	40.00
3	16	13.33
4	2	1.67

Most of the participants were Paraone(45%) followed by Para 2, Para 3 and Para 4 in 40%,13.33% and 1.67% respectively.

Table III: Mean Maternal Subcutaneous Fat Thickness (MSFT) in relation to period ofGestation (POG)

Gestation at MSFT measurement	Mean MSFT (mm)	SD(±mm)	T test value	P-value
11-14weeks (MSFT1)	10.26	3.46		

18-22weeks (MSFT2)	13.55	4.39	-18.7	<0.01

The mean MSFT at 11-14weeks (MSFT1) was 10.26±3.46mm and mean MSFT at 18-22weeks (MSFT2) was 13.55±4.39mm. Therefore, the mean MSFT at 18-22weeks (MSFT2) was significantly higher as compared to mean MSFT at11-14 weeks (MSFT1) $p<0.05$.

Table IV: Proportions of cases as per the Maternal Outcomes

Maternal outcomes	Yes	Percentage	No	Percentage
GDM	23	19.17	97	80.83
GHTN	11	9.17	109	90.83
Pre-eclampsia	3	2.50	117	97.50
Eclampsia	0	0.00	120	100.00
APH	3	2.50	117	97.50
Preterm<37weeks	9	7.50	111	92.50
Term≥37weeks	111	92.50	9	7.50
Inductionoflabor	29	24.17	91	75.83
Spontaneouslabor	91	75.83	29	24.17
Vaginaldelivery	98	81.67	22	18.33
CaesareanSection	22	18.33	98	81.67
PPH	0	0.00	120	100.00
Wound Sepsis	0	0.00	120	100.00

23/120(19.14%) had gestational diabetes mellitus(GDM),11/120(9.14%) had Gestational hypertension(GHTN), 3/120(2.50%) had pre-eclampsia,3/120(2.50%) had antepartum hemorrhage. Preterm deliveries occurred in 9/120(7.5%) and Term deliveries in 111/120(92.50%) of all deliveries. 75.83%(91/120) had spontaneous onset of labor and 24.17%(29/120)had induced labor. Majority 98/120(81.67%) of participants delivered vaginally and 22/120(18.33%) had caesarian deliveries. A logistic regression analysis was not applied to predict eclampsia, APH, PPH and wound sepsis as the number of participants with these complications was less.

Table V: Proportions of cases according to Fetal Outcomes

Variables		N=120	Percentage
Biophysical profile(BPP)	Normal(10/10)	94	78.33
	Abnormal(≤8/10)	26	21.67
Non stresstest(NST)	Reactive	118	98.33
	Non-reactive	2	1.66
Fetal heart rate(FHR)	Normal	118	98.33
	Bradycardia	2	1.66
	Tachycardia	0	0

BPP was normal in 94/120(78.33%) and 26/120(21.67%) of participants showed abnormal fetal BPP result. Non stress test (NST) was reactive inmajority 118/120(98.33%) and 2/120 (1.66%) participants had non-reactive NST. There were only 2/120 (1.66%) participants with FHR (fetal heart rate) reported as bradycardia and FHR was normal in rest11/120(98.33%) ofthe participants.

Table VI: Proportions of cases according to Neonatal Outcomes

Variables		Number	Percentage
APGAR score at 1minute and 5minute	Normal(7/10ormore)	118	98.33
	Abnormal(<7/10)	2	1.66
Need for resuscitation	Yes	0	0
	No	120	100
Birth weight(BW)	LBW(<2.5kg)	16	13.3
	Normal(2.5-4kg)	102	85
	Macrosomia(>4kg)	2	1.66
Neonatal intensive care unit (NICU) admission	Yes	17	14.2
	No	103	85.8

Only 2(1.66%) neonates had APGAR score less than 7/10. No neonate needed resuscitation.102/120(85%) neonates had normal birth weight(2.5-4kg), 16/120(13.3%) neonates were with low birth weight (LBW) and 2/120(1.66%) were macrosomic (>4kg). 17(14.2%) neonates required admission to NICU. A logistic regression analysis was not applied to predict APGAR below normal and need for resuscitation as the number of participants in each group was less.

DISCUSSION

Distribution of fat within the body is significant with central abdominal obesity (adipose tissue around the trunk) increasing the risk of cardiovascular disease,

hypertension and diabetes, whereas peripheral adiposity (adipose tissue around the bottom and thighs) appears to be protective. Central adiposity can be readily and reliably assessed by densitometry studies or Computed tomography(CT) and by Magnetic resonance imaging(MRI), however these are not feasible methods for use in pregnancy as these use harmful ionizing radiations (densitometry and CT) or are expensive and not readily available (MRI). An alternative index of central adiposity is the subcutaneous fat thickness (SFT). It has been shown to be a quick, safe, reliable, reproducible and available tool for quantifying adiposity in clinical practice.The present study was conducted to evaluate the association between sonographic maternal adiposity and pregnancy outcomes.

We found that majority(38.33%) were 26-30 years old, 37/120 (30.83%) were less than 25 years, 32/120(26.67%) were 31-35years old, 5/120(4.17%) were between 36-39years of age. Most of the participants were Paraone(45%) followed by Para 2, Para 3 and Para 4 in 40%, 13.33% and 1.67% respectively. Mehmet Sukru Budak et al[10] conducted a prospective comparative study on 50 cases with GDM and 50 cases without GDM in the GDM screening program at 24–28 gestational weeks between January 2018 and May 2018 and found that abdominal subcutaneous fat thickness (ASFT) was higher in those with GDM compared to those without GDM (P < 0.05). For an ASFT cut-off point value of 18.1 mm for the prediction of cases with GDM, the sensitivity, specificity, negative and positive predictive values were 72.0%, 60.0%, 64.2% and 68.1%, respectively. The risk of GDM increased 3.86-fold in those with ASFT level >18.1 mm (P = 0.001).

We observed that the mean MSFT at 11-14weeks (MSFT1) was 10.26±3.46mm and mean MSFT at 18-22weeks (MSFT2) was 13.55±4.39mm. Therefore, the mean MSFT at 18-22weeks (MSFT2) was significantly higher as compared to mean MSFT at11-14 weeks (MSFT1) p<0.05.23/120 (19.14%) had gestational diabetes mellitus (GDM),11/120 (9.14%) had Gestational hypertension (GHTN), 3/120 (2.50%) had pre-eclampsia, 3/120 (2.50%)had antepartum hemorrhage. Preterm deliveries occurred in 9/120 (7.5%) and term deliveries in 111/120 (92.50%) of all deliveries. 75.83% (91/120) had spontaneous onset of labor and 24.17% (29/120)had induced labor. Majority 98/120 (81.67%) of participants delivered vaginally and22/120 (18.33%) had caesarian deliveries. A logistic regression analysis was not applied to predict eclampsia, APH, PPH and wound sepsis as the number of participants with these complications was less. Iñigo Melchor et al[11] conducted a cohort study on 16,609 women who delivered singleton babies in a 5-year period (2013–2017) and they found that compared to women of normal weight (n = 9778), obese women (n = 2207) had a higher risk of preeclampsia (OR 2.199, 95% CI: 1.46–3.29), rectovaginal group B streptococcus colonization (OR 1.299, 95% CI: 1.14–1.47), induction of labor (OR 1.593, 95% CI: 1.44–1.75), cesarean section (OR 2.755, 95% CI: 2.46–3.08), cesarean section in women with a history of cesarean delivery (OR 1.409, 95% CI: 1.03–1.92), fetal weight ≥4000 g (OR 2.090, 95% CI: 1.803–2.422) and admission to the neonatal intensive care unit (NICU) (OR 1.341, 95% CI: 1.12–1.59). No association was found with preterm birth (OR 0.936, 95% CI: 0.77–1.13), stillbirth (OR 0.921, 95% CI:0.41–2.02) or neonatal mortality (OR 2.205, 95% CI: 0.86–5.62).

We found that BPP was normal in 94/120(78.33%) and 26/120 (21.67%) of participants showed abnormal fetal BPP result. Non stress test (NST) was reactive inmajority 118/120 (98.33%) and2/120 (1.66%) participants hadnon-reactive NST.There were only 2/120 (1.66%) participants with FHR (fetal heart rate) reported asbradycardia and FHR was normal in rest11/120 (98.33%) ofthe participants.Only 2 (1.66%) neonates had APGAR score less than 7/10. No neonate needed resuscitation.102/120 (85%) neonates had normal birth weight (2.5-4kg),16/120 (13.3%) neonates were with low birth weight (LBW) and 2/120 (1.66%) were macrosomic (>4kg). 17(14.2%) neonates required admission to NICU. A logistic regression analysis was not applied to predict APGAR below normal and need for resuscitation as the number of participants in each group was less. Nabnita Patnaik et al[12] conduced a cohort study on the effect of increased maternal BMI on fetal outcome in Telangana, in their study the mean age was 27.21 years, mean BMI (kg/m2) was 27.49 and mean weight gain was 7.14 kgs. Most common neonatal complication was Low Birth Weight (7%) followed by Meconium Aspiration Syndrome (6%), Sepsis (6%). Neonatal death was observed among 5% subjects and still birth was reported among 4%. They concluded that maternal obesityis associated with an increased risk of neonatal complications like low birth weight, Meconium Aspiration Syndrome and Sepsis.

CONCLUSION

Authors found that the sonologically assessed adiposity correlates well with the adverse pregnancy outcome and maternal subcutaneous fat thickness is the best marker of maternal adiposity. Therefore, the scans for measuring MSFT1 and MSFT2 can be combined with the routine obstetric scan at 11-14 weeks and 18-22 weeks.

REFERENCES

1. Wahabi HA, Fayed AA, Alzeidan RA, Mandil AA. The independent effects of maternal obesity and gestational diabetes on the pregnancy outcomes. BMC endocrine disorders. 2014 Dec;14(1):1-7.
2. De Souza LR, Berger H, Retnakaran R, Maguire JL, Nathens AB, Connelly PW, Ray JG. First-trimester maternal abdominal adiposity predictsdysglycemia and gestational diabetes mellitus in midpregnancy. Diabetes Care. 2016 Jan 1;39(1):61-4.

3. Kretzer DC, Matos S, Von Diemen L, de Azevedo Magalhães JA, Schöffel AC, Goldani MZ, da Silva Rocha A, Bernardi JR. Anthropometrical measurements and maternal visceral fat during first half of pregnancy: a cross-sectional survey. BMC Pregnancy and Childbirth. 2020 Dec;20(1):1-7.
4. Mongelli M, Condous G. Ultrasound in the management of obesity in pregnancy. AJUM,May 2016;19(2).
5. John J, Mahendran M. Maternal and fetal outcomes of obese pregnant women: a prospective cohort study. International Journal of Reproduction, Contraception, Obstetrics and Gynecology. 2017 Feb 1;6(2):725-30.
6. Takai IU, Omeje IJ, Kwayabura AS. First trimester body mass index and pregnancy outcomes: A 3-year retrospective study from a low-resource setting. Archives of International Surgery. 2017 Apr 1;7(2):41.
7. Eley V, Sekar R, Chin A, Donovan T, Krepska A, Lawrence M, Bell S, McGrath S, Robinson A, Webb L, Marquart L. Increased maternal abdominal subcutaneous fat thickness and body mass index are associated with increased cesarean delivery: A prospective cohort study. Acta Obstetricia et Gynecologica Scandinavica. 2019 Feb;98(2):196-204.
8. Doi L, Williams AJ, Marryat L, Frank J. Cohort study of high maternal body mass index and the risk of adverse pregnancy and delivery outcomes in Scotland. BMJ open. 2020 Feb 1;10(2):e026168.
9. Cremona A, Hayes K, O'Gorman CS, Laighin CN, Ismail KI, Donnelly AE, Hamilton J, Cotter A. Inter and intra-reliability of ultrasonography for the measurement of abdominal subcutaneous & visceral adipose tissue thickness at 12 weeks gestation. BMC Medical Imaging. 2019 Dec;19(1):1-8.
10. Melchor I, Burgos J, Del Campo A, Aiartzaguena A, Gutiérrez J, Melchor JC. Effect of maternal obesity on pregnancy outcomes in women delivering singleton babies: a historical cohort study. Journal of perinatal medicine. 2019 Aug 1;47(6):625-30.
11. Budak MS, Kahramanoglu I, Vitale SG, Akgol S, Dilek ME, Kartal S, Caruso S, Kahveci B, Obut M, Bademkiran MH, Cianci A. Maternal abdominal subcutaneous fat thickness as a simple predictor for gestational diabetes mellitus. Journal of Perinatal Medicine. 2019 Aug 1;47(6):605-10.
12. Patnaik N. Study the effect of increased maternal BMI on foetal outcome: A prospective observational study. Journal of Family Medicine and Primary Care. 2020 Dec;9(12):5906.