ISSN: 2837-4835

Research article

International Internal Medicine Journal

Assessment of Maternal Abdominal Subcutaneous Fat Thickness (Sft) Measured by Ultrasound as an Independent Predictor of Adverse Pregnancy Outcomes

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Submitted: 2023, Jun 10; **Accepted**: 2023, June 19: **Published**: 2023, July 27

Citation: Surendran, N., Gupta, P., Aggarwal, U., Shekhawat, P. (2023). Assessment of Maternal Abdominal Subcutaneous Fat Thickness (Sft) Measured by Ultrasound as an Independent Predictor of Adverse Pregnancy Outcomes. *Int Internal Med J, 1*(3), 131-135.

Abstract

Introduction: *Obese pregnant women are at increased risk for a variety of maternal and perinatal complications. The maternal risks related to obesity include Gestational Diabetes mellitus, Preeclampsia, increased caesarean sections. The fetes is at risk of stillbirth, preterm birth and congenital anomalies. This study focuses on the use of Maternal abdominal subcutaneous fat thickness (SFT) as a surrogate measure for central obesity as measured by ultrasound, and determining its efficacy compared to BMI in predicting obesity related pregnancy complications.*

Objective: *To measure mid-trimester SFT in antenatal women and establish SFT as an independent predictor of obesity related adverse pregnancy outcomes*

Methods: *This was a prospective cohort study. 150 pregnant women between 20-40 years of age were recruited. Demographic data of each participant was collected from the OPD. USG for abdominal subcutaneous fat thickness (SFT) was done at 18-22 wks period of gestation. The participants were followed up to labour. Adverse pregnancy outcomes and their correlation with the SFT measured was studied.*

Results: *There was significant positive correlation between BMI and SFT (r=0.591, p<0.001) .A positive correlation was noticed between BMI and adverse pregnancy outcomes such as PIH, GDM , preterm birth , postdates and NICU admissions. SFT independently showed a positive correlation with the above parameters. The mean SFT among women without PIH was 11.45 mm, and with PIH was 16.48 mm[p <0.001].Mean SFT were 11.68mm and 16.24 mm among the ladies without and with GDM respectively[p<0.001]. The mean SFT for term pregnancies was 12.06 mm whereas the mean SFT for preterm births was 14.21 showing positive correlation between SFT and preterm birth. SFT also showed positive correlation with need for NICU admission for neonates [SFT avg being 11.72mm and 14.94 mm in the 2 groups]. A comparative analysis was done between BMI and SFT regarding their correlation to the various outcomes. SFT showed higher correlation coefficients for these variables than BMI, with lower p values suggesting more statistical significance.*

Conclusion: *BMI showed a positive correlation with adverse pregnancy outcomes in mother as well as fetes, SFT showed greater and more statistically significant correlation for adverse outcomes. Thus it was concluded that SFT is a better independent predictor of obesity related adverse pregnancy outcomes.*

Keywords: Obesity, Body Mass Index[BMI], Subcutaneous Fat Thickness[SFT], GDM, Pre-eclampsia, Preterm.

1. Introduction

Obesity is a medical condition where excess body fat has accumulated to a level that it may have a negative effect on health of the person. The proportion of global adult women with overweight has risen significantly over the past 4 decades and the growing trend was observed in both high income and middle income countries. In 2014, the percentage of female with overweight and obesity in India was 21.7%, and India had the leading number of overweight and obese pregnant women (11.1%) in theworld1. Obese pregnant women are at increased risk for a range of maternal and perinatal complications, and the risks are increased with increasing degrees of maternal obesity. The maternal risks during pregnancy include mainly Gestational Diabetes mellitus and Preeclampsia. The fetes is at risk of stillbirth, preterm birth and congenital anomalies. Obesity in pregnancy can also affect wellbeing of both mother and child later in life. For women, these risks include heart disease and hypertension, while children have a risk of future obesity and heart disease. Studies in recent years have highlighted that the oocyte

and/or early pre-implantation embryo is mostly vulnerable to the effects of maternal obesity resulting in long-lasting endocrine and metabolic effects for the offspring [1].There are a number of methods to quantitatively define and categorize obesity.
They are –

1. Body mass index (BMI): It is calculated by a person's weight in kilograms divided by their height squared in meters.
2. Abdominal Circumference
3. Body Fat Percentage
4. SFT (subcutaneous fat thickness)

BMI is the most widely used criterion. However, BMI has a disadvantage that it does not reflect fat distribution or the ratio of adipose to non-adipose tissue. Other disadvantages include not accounting for gender, ethnicity, muscle mass, and frame size [2]. Maternal abdominal subcutaneous fat thickness can be used as a surrogate measure for central obesity and is readily and accurately measured by ultrasound, a quick, safe modality used routinely in pregnancy. Some recent studies demonstrated that subcutaneous adiposity is associated with insulin resistance4.From retrospective studies there is some indication that abdominal SFT at mid pregnancy between 18- and 22-weeks' gestation is superior to BMI to identify risk for obesity related pregnancy complications.

2. Objective

We aimed at establishing Abdominal SFT (as measured by USG) and as a novel, reliable marker to predict obesity related adverse pregnancy outcomes.

3. Materials and Methods

• Study design : prospective cohort study
• Study setting: Obstetrics & Gynaecology department of ESI PGIMSR and associated model hospital, Basaidarapur, New Delhi.
• Study period – from December 2018 to February2020
• The age of the study population – 20-40yrs
• Sample size –150

4. Procedure

A prospective longitudinal cohort study was conducted in the department of Obstetrics & Gynaecology, ESI PGIMSR, New Delhi over a period of 2 years from 2018-2020. Pregnant women were recruited from the ante natal OPD after meeting the inclusion and exclusion criteria.

4.1 Inclusion Criteria

Pregnant women with singleton intrauterine pregnancy presenting to the OPD in first trimester

4.2 Exclusion Criteria

- History of cardiovascular diseases
- Diabetes mellitus
- Chronic hypertension
- Smoking

Demographic data was collected about each participant at the first antenatal visit from the OPD; these included age, height, weight, smoking habit, and parity. Informed consent was obtained from the patients andrelatives.USG for abdominal subcutaneous fat thickness (SFT) was done at 18-22 wks period of gestation. All scans were performed by the same operator using a high-resolution multi frequency B-mode scan 2.5–5.0 MHz transducer.

SFT measurements were performed in the midline of the pelvis demonstrating uterus, cervix and placenta. Three measures were taken from the skin line to the peritoneum, and the mean measure will be used. The first measurement was done close to the midline and two measurements were taken 5 mm on either side to take into account the curvature from the ultrasound transducer face, ensuring the measurements were done perpendicular to the anterior border. The callipers were placed from skin line to peritoneal fascia.

The participants were followed up to labour. The following adverse pregnancy outcomes were observed and their correlation with the SFT measured were studied:
1. pregnancy-induced hypertension
2. Gestational Diabetes Mellitus
3. Caesarean section
4. Preterm delivery (< 37 weeks POG)
5. Post datism
6. Neonatal respiratory distress and NICU admission

The same outcomes were correlated with BMI .The women were stratified into BMI categories according to World Health Organization (WHO). Analysis was performed for BMI distribution and SFT measures.

5. Statistical Analysis

Statistical testing was conducted with the statistical package for the social science system version SPSS 17.0. Continuous variables were presented as mean SD or median (IQR) for non-normally distributed data. Categorical variables were expressed as frequencies and percentages. Correlation between BMI and SFT were done using Pearson correlation. For all statistical tests, a p value less than 0.05 was taken to indicate a significant difference.

6. Results

In this study, the150 participants were divided into 4 categories according to BMI: Underweight [BMI18.5], Normal [BMI 18.5-24.9], Overweight [BMI 25-29.9] and Obese [BMI >30].We compared the SFT values among the various BMI categories (underweight, normal, overweight, obese). SFT 1, SFT2 and SFT3 are the measurements taken in the same woman at 3 different points 0.5mm apart and SFT Avg is the average value of the 3 measurements. The individual SFT measurements as well as SFT average showed a linear relationship with BMI which was statistically significant.[table 1] There was significant positive correlation between BMI and SFT1 ($r=0.590$, $p<0.001$), SFT2 ($r=0.595$, p<0.001), SFT3 (r=0.587, p<0.001) and average SFT(r=0.591, p<0.001) respectively[Table 2/ Fig 1.]. Since 'r' lies in between 0.50<r<0.60, it shows that there was moderately positive significant correlation.

The incidence of PIH showed a positive correlation with obesity as measured by BMI.SFT 1,SFT 2 ,SFT 3 and SFT Avg showed increasing values as we moved from the group with no PIH(SFT Avg = 11.45 mm) to the group with PIH (SFT Avg = 16.48mm), hence showing an average difference of 5mm among the groups. This linearity had a p value of 0.001, hence being statistically significant. [Tables 3&4]

The incidence of GDM followed an increasing trend according to the maternal BMI. The figures were 0%, 6.7%, 22.5% and 44.4% in UW, NORMAL, OW and OBESE groups respectively. This pointed towards a strong association between GDM and obesity with a p value of 0.001 which was significant.[Table 5/ Fig 2.]

Likewise, comparison of SFT and GDM showed a positive correlation between the 2 parameters. Mean SFT values were 11.68mm and 16.24 mm among the groups without and with GDM respectively , hence confirming that an increased SFT was a predictor of adverse pregnancy outcome such as GDM. The finding was statistically significant as the p value was <0.001.[table 6]

Women with normal BMI showed term deliveries in 93.3% and preterm births in only 6.7 %. This was less compared to underweight category (16.6%), overweight group (17.5%) and obese category (22.2%). Hence the plot showed a J shaped curve, thus showing a positive association of preterm birth with both underweight as well as overweight/obese groups. However this association was not statistically significant [p valueof0.163].Whereas, the incidence of preterm births showed a linear relation with SFT. The mean SFT for term pregnancies was 12.06 mm whereas the mean SFT for preterm births was 14.21 mm showing an average increase of 2.2 mm in the preterm group. [Tables 7 & 8]This derivation also reached statistical significance, with the p values of 0.036[SFT1] , 0.023[SFT2], 0.034[SFT3] and 0.032[SFTAVG].

Tables 9-10 show the correlation of neonatal ICU admissions with obesity. An increasing trend was observed with increasing BMI, though this observation was not statistically significant. There was positive correlation between maternal abdominal SFT measurement and the requirement of neonatal Intensive care. It can be observed that the average SFT of mothers of thoseinfantswhodidnotrequireNICUadmissionwas11.72mmwithastandarddeviationof3.09 mm. As against this ,the average SFT of mothers whose infants were admitted in NICU was 14.94 with a standard deviation of 3.44 mm. Similar trend was found among SFT1, SFT2 and SFT3 values(p=<0.001).

Finally the individual relationship of BMI as well as SFT with the various parameters of the study were compiled [Table 11]. The analysis was made using Spearman's correlation coefficient [ranging from -1 to +1]. The variables taken were incidence of PIH, GDM, Preterm, Postdates, and NICU admissions. Their correlation coefficients with BMI were 0.284, 0.266, 0.172, 0.147 and 0.157 respectively. In comparison to BMI, SFT showed higher correlation coefficients for these variables [0.454, 0.432, 0.226, 0.101 and 0.377 respectively]. The p values were lower for SFT suggesting greater statistical significance.

7. Discussion

In this study a significant positive correlation was established between BMI and mid-trimester SFT with a correlation coefficient of 0.591.this result was comparable to a study by Suresh A et al which showed a correlation coefficient of 0.53 [3].

PIH is classified as gestational hypertension, preeclampsia, eclampsia, chronic hypertension with superimposed pre-eclampsia. Gestational hypertension is defined as BP higher than 140mm of Hg (systolic) or 90 mm of Hg (diastolic) on at least 2 occasions 4 hour apart in a woman who had normal blood pressure prior to 20 weeks. Preeclampsia is diagnosed when a woman with gestational hypertension also has proteinuria. The incidence of PIH showed a positive correlation with increasing BMI. An average of 5 mm increase in SFT measurements were seen in ladies with PIH. The mean SFT among women without PIH was 11.45 mm whereas the mean SFT of women with PIH was 16.48 mm .these values were statistically significant , with a p value <0.001 , affirming the statement that SFT can be an effective marker for prediction of PIH .

Gestational diabetes mellitus (GDM) is defined as any degree of glucose intolerance with onset or first recognition during pregnancy. The definition applies whether insulin or only diet modification is used for treatment and whether or not the condition persists after pregnancy. Numerous studies across the world have reported an increased risk of gestational diabetes mellitus (GDM) among women who are overweight or obese compared with lean or normal-weight women. A Meta – regression analysis of 20 studies done by SY Chu et al indicated that high maternal weight is associated with a substantially higher risk of GDM [4]. A more recent prospective study by H Kansu Celik and colleagues showed a positive and significant correlation between a 50-g GCT level and BMI, WC, and SAT thickness (p < 0.001) [5]. ROC curve analysis showed SAT [subcutaneous adipose tissue] thickness above 16.75 mm predicted gestational diabetes mellitus (GDM) with a sensitivity of 71.7%, a specificity of 57.1%.Similarly, in our study a positive correlation between GDM and BMI with a p value of 0.001 was derived. Mean SFT were 11.68mm and 16.24 mm among the ladies without and with GDM respectively, hence confirming that an increased SFT is a predictor of GDM. The positive correlation of SFT with GDM and PIH were in coherence with the results obtained from a study by Kennedy NJ et al , which showed that with every 5mm rise in SFT there was an increased risk of 22-24% for GDM and 18% for PIH [6].

Preterm is defined as babies born alive before 37 weeks of pregnancy are completed. It is the leading cause of infant mortality, neonatal morbidity, and long-term disability among non-malformed infants, and these risks increase with decreasing gestational age.

Studies have reported that women with obesity grades 2 to 3 (BMI ≥35) have increased risks of very and moderately preterm delivery (<32 weeks and 32-36 weeks, respectively), while associations between overweight (BMI 25-<30) and obesity grade 1 (BMI 30-<35) and preterm delivery are less consistent [7,8]. Two studies have also recently reported an increased risk of extremely preterm delivery (< 28 weeks) among obese (BMI≥30)women [9,10]. In our study ,The plot showed a J shaped curve, thus showing a positive association of preterm birth with both underweight as well as overweight/obese groups. Also, there was a positive correlation with SFT [11,12]. This was true for all 3 SFT measurements. The mean SFT for term pregnancies was 12.06 mm whereas the mean SFT for preterm births was 14.21 mm showing an average increase of 2.2 mm among the 2 groups. This correlation also reached statistical significance, with the p values of 0.036[SFT1] , 0.023[SFT2], 0.034[SFT3] and 0.032[SFT AVG].

Neonatal outcomes were evaluated in terms of 3 parameters – birth weight, APGAR score at 1 min, and 5 min. The observations didn't show any definite pattern as the values were comparable in all 4 groups. Increased maternal BMI showed a rise in the requirement of neonatal Intensive care within the first 24 hours. While 0% of underweight mothers and 13.5 % of normal mothers had their neonates kept in NICU transiently, the percentages of NICU admissions among overweight and obese mothers were 25% and 33.3% respectively. This correlation, however could not reach statistical significance. There was significant positive correlation between maternal abdominal SFT measurement and the requirement of neonatal Intensive care. The average SFT of mothers of those infants who did not require NICU admission was 11.72 mm while, the average SFT of mothers of those infants who were admitted in NICU was 14.94 with a standard deviation of 3.44 mm. This result was again comparable to the previous Australian study by Kennedy NJ et al.

When a final comparison of BMI and SFT was done as independent markers of the above outcomes, SFT showed higher correlation coefficients for these variables ie, 0.454[PIH], 0.432[GDM], 0.226[preterm], 0.101 [postdates] and 0.377 [NICU admission], hence implying a stronger positive correlation of SFT with adverse maternal outcomes. The p values were lower for correlation of SFT suggesting greater statistical significance. This paralleled with the study done by Suresh A et al , which substantiated that SFT was a better predictor than BMI for adverse maternal outcomes [13].

8. Strengths and Limitations

The strengths of this study were that it focused on measurement of SFT by USG which is a simple and routine procedure done in pregnancy .It was easy to perform and cost effective. FT is non-invasive ,hence comfortable for the participants. MI and SFT have been studied separately but there is limited existing literature on a comparative evaluation of both. The limitations were – a long study period with a risk of patients being lost to follow up and observer variability in sonographic measurement of SFT. Also it would be challenging in a low resource set up.

9. Conclusion

We could draw a positive correlation between SFT and BMI hence establishing SFT was a maker of obesity. BMI showed a positive correlation with adverse pregnancy outcomes in mother as well as fetes, but SFT showed stronger and more statistically significant correlation for the same. Thus, we could rightly infer that SFT is a better independent predictor of obesity related adverse pregnancy outcomes. This opens huge possibilities for employing SFT as a surrogate marker for visceral obesity. Hence SFT can be used as a reliable, reproducible, and objective marker for obesity related risk modelling in pregnancies in the future.

References

1. Nicholas, L. M., & McMillen, I. C. (2016). The impact of maternal obesity and weight loss during the periconceptional period on offspring metabolism. Parental Obesity: Intergenerational Programming and Consequences, 133-161.
2. Bhurosy, T., & Jeewon, R. (2013). Pitfalls of using body mass index (BMI) in assessment of obesity risk. Current Research in Nutrition and Food Science Journal, 1(1), 71-76.
3. Kennedy, N. J., Peek, M. J., Quinton, A. E., Lanzarone, V., Martin, A., Benzie, R., & Nanan, R. (2016). Maternal abdominal subcutaneous fat thickness as a predictor for adverse pregnancy outcome: a longitudinal cohort study. BJOG: An International Journal of Obstetrics & Gynaecology, 123(2), 225-232.
4. Chu, S. Y., Callaghan, W. M., Kim, S. Y., Schmid, C. H., Lau, J., England, L. J., & Dietz, P. M. (2007). Maternal obesity and risk of gestational diabetes mellitus. Diabetes care, 30(8), 2070-2076.
5. Kansu-Celik, H., Karakaya, B. K., Tasci, Y., Hancerliogullari, N., Yaman, S., Ozel, S., & Erkaya, S. (2018). Relationship maternal subcutaneous adipose tissue thickness and development of gestational diabetes mellitus. Interventional Medicine and Applied Science, 10(1), 13-18.
6. Kennedy, N. J., Peek, M. J., Quinton, A. E., Lanzarone, V., Martin, A., Benzie, R., & Nanan, R. (2016). Maternal abdominal subcutaneous fat thickness as a predictor for adverse pregnancy outcome: a longitudinal cohort study. BJOG: An International Journal of Obstetrics & Gynaecology, 123(2), 225-232.
7. Khatibi, A., Brantsaeter, A. L., Sengpiel, V., Kacerovsky, M., Magnus, P., Morken, N. H., ... & Jacobsson, B. (2012). Pre-pregnancy maternal body mass index and preterm delivery. American journal of obstetrics and gynecology, 207(3), 212-e1.
8. Nohr, E. A., Bech, B. H., Vaeth, M., Rasmussen, K. M., Henriksen, T. B., & Olsen, J. (2007). Obesity, gestational weight gain and preterm birth: a study within the Danish National Birth Cohort. Paediatric and perinatal epidemiology, 21(1), 5-14.

9. Salihu, H., Mbah, A. K., Alio, A. P., Kornosky, J. L., Whiteman, V. E., Belogolovkin, V., & Rubin, L. P. (2010). Nulliparity and preterm birth in the era of obesity epidemic. The journal of maternal-fetal & neonatal medicine, 23(12), 1444-1450.
10. Räisänen, S., Gissler, M., Saari, J., Kramer, M., & Heinonen, S. (2013). Contribution of risk factors to extremely, very and moderately preterm births–register-based analysis of 1,390,742 singleton births. PLoS One, 8(4), e60660.
11. McDonald, S. D., Han, Z., Mulla, S., & Beyene, J. (2010). Overweight and obesity in mothers and risk of preterm birth and low birth weight infants: systematic review and meta-analyses. Bmj, 341.
12. Torloni, M. R., Betran, A. P., Daher, S., Widmer, M., Dolan, S. M., Menon, R., ... & Merialdi, M. (2009). Maternal BMI and preterm birth: a systematic review of the literature with meta-analysis. The Journal of Maternal-Fetal & Neonatal Medicine, 22(11), 957-970.
13. Suresh, A., Liu, A., Poulton, A., Quinton, A., Amer, Z., Mongelli, M., ... & Nanan, R. (2012). Comparison of maternal abdominal subcutaneous fat thickness and body mass index as markers for pregnancy outcomes: A stratified cohort study. Australian and New Zealand Journal of Obstetrics and Gynaecology, 52(5), 420-426.
14. Chen, C., Xu, X., & Yan, Y. (2018). Estimated global overweight and obesity burden in pregnant women based on panel data model. PloS one, 13(8), e0202183.
15. Kansu-Celik, H., Karakaya, B. K., Tasci, Y., Hancerliogullari, N., Yaman, S., Ozel, S., & Erkaya, S. (2018). Relationship maternal subcutaneous adipose tissue thickness and development of gestational diabetes mellitus. Interventional Medicine and Applied Science, 10(1), 13-18.