ORIGINAL ARTICLE

ASSOCIATION OF LIPID PROFILE WITH BODY FAT PERCENTAGE AND BMI IN SECOND TRIMESTER OF PREGNANCY

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ABSTRACT

Background: Variations in lipid profile are associated with body fat and BMI. In pregnancy, there is an increased demand of nutrients, especially for fats, for fetal development and its growth, which may disturb lipid metabolism. The objective of this study was to find out the associations between maternal body fat percentage (fat%) and BMI with lipid profile during second trimester of pregnancy.

Methods: A cross sectional study was designed on pregnant women of second trimester. These patients were recruited from gynae OPD during their antenatal checkup. After an informed consent Fasting blood samples were taken, BMI and body fat was calculated using Omron 308C body fat analyzer. Serum was extracted and lipid profile was analyzed on automated spectrophotometer analyzer at 546nm wavelength.

Results: A total of 84 patients were selected. Cholesterol was highest in younger age (<20). TGs were generally high in all age groups. Patients with low BMI (less than 18), had normal lipid profile, whereas, normal and high BMI patients had high cholesterol, TGs, LDL, HDL and VLDL. Obese had higher values for TGs, HDL, and VLDL with cholesterol on the upper limit. Cholesterol, in obese patients with very high body fat percentage, was not found elevated, but the results were not statistically significant. However, patients with body fat values as low, normal and high, all had high levels of cholesterol TGs, HDL and VLDL, statistically showing no difference.

Conclusion: Lipid profile and BMI were found independent variables having no association with body fat percentage during second trimester of pregnancy.

Keywords: Pregnancy; Body Fat; Body Mass Index; Dyslipidaemia; Hypertriglyceridaemia; Lipid; Triglycerides.

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INTRODUCTION

Pregnancy, a time of increased demands for the growth and development of fetus, creates profound changes in the female body. These changes are for buildup of metabolic fuels, which may bring about alteration in lipid profile due to hormonal changes throughout pregnancy in different trimesters.[1] Increase in insulin secretion leads to excessive storage of glycogen in tissues as well as increase in storage of fat and decrease in lipolysis in the adipose tissue.[2] From the second trimester onwards adjustments in fuel comes about in maternal metabolism which spares glucose for the utilization of fetus, increases fatty acids concentration in plasma leading to complications like Gestational Diabetes and pre-eclampsia.[3] Although the exact mechanism how these complications affect the outcome of fetus is yet to be fully understood, there is increasing evidence that factors associated with mother, such as BMI, eating habits or social behavior or physical activity, can affect both the mother as well as growth of fetus.[4]

Lipid variation can be influenced by social status, diet and ethnic differences during second trimester

of pregnancy and is required to be studied in low socioeconomic strata of developing countries like Pakistan. Changes with gestational age of total serum cholesterol, triglycerides (TGs), low-density lipoprotein (LDL) and high-density lipoprotein (HDL) are not well described during the second trimester of pregnancy.[5] These variables increase markedly during pregnancy, but there is a lot of variation in these studies.[6-9] It has been observed that disturbance in lipid metabolism of the pregnant female, especially which alter theatherogenic lipid profile are amongst the factors, which have been found involved in starting pathological processes.[10] Therefore, during pregnancy it is important to investigate the associations between body fat, BMI and lipid profile. This study was designed to investigate the associations between maternal body fat percentage and BMI with lipid profile during second trimester of pregnancy of females of low socioeconomic strata.

METHODOLOGY

This cross sectional study was conducted at Dr. Ziauddin Hospital Karachi Pakistan. A total of 84 women between 24 to 28 weeks of conception were recruited from the gynaecology and obstetrics department coming for regular antenatal check-ups from August 2018 to March 2018. Prior to sample collection, the study approval was sort from the Ziauddin University Ethics Review Committee. All patientswere provided informed, written consent and lab results.

All the women before enrolment were asked to sign a written informed consent. A detailed antenatal history was taken regarding parity, gestational complications and family history of gestational diabetes, eclampsia and pre-eclampsia. Women having comorbid before pregnancy like thyroid disorder, type 2 diabetes, renal disorders etc., twin pregnancy and dropouts were excluded.

Using height in feet and inches and weight in pounds, body fat% and BMI by OMRON hand held body analyser model HBF-306C using Bioelectrical Impedance Method. After 12-hours of fasting 10cc of venous blood for lipid profile was collected under aseptic precautions. It was determined using Merck's automated spectrophotometer analyzer at 546nm wavelength. The patient's lipid profile valueswere compared with the values recommended by National Cholesterol Education Program's (NCEP's) ATPIII (Adult Treatment Panel III) guidelines for managing cholesterol in adults.

All the statistical analysis were done using SPSS version 20. The quantitative variables were presented as mean and standard deviation in tables and graph. One way ANOVA was used for calculating p value at confidence level 95%.

RESULTS

A total of 84 patients were included in the study who were in their second trimester of gestation. Means of baseline characteristics are given in Table 1. The mean age of patients was found to be statistically significant.

Table 1: Baseline Characteristics of study participants.

	Mean	Std. Deviation	p-Value
Age in years	25.43	5.511	0.001
Gestational weeks	27.33	2.58	0.067
Total Lipids	907.19	107.73	0.475
Cholesterol	214.82	44.25	0.119
TGs†	178.17	53.74	0.695
HDL†	51.73	10.51	0.512
LDL†	129.93	41.24	0.30
VLDL†	35.63	10.75	0.695

**p value <0.05 (One way Anova)*
†Triglycerides, Low-density lipid, high-density lipid, very low-density lipid

Means and standard deviation of lipid profile compared with age, BMI and body fat% are shown in Table 2.

Mean Age Compared with Mean Lipid Profile: Mean cholesterol levels were generally high in all age groups but younger age group had the highest levels. Mean TGs levels were found to be highest in age groups between 20 to 30 and above 30. HDL and VLDL levels were high in all the age groups. Mean LDL values were normal in younger age groups. The means age and lipid profile of the patients were found to be statistically insignificant (Table 2).

Mean BMI with Mean Lipid Profile: Patients with low BMI (less than 18), had normal lipid profile except LDL, whereas, normal and overweight BMI patients had high cholesterol, TGs, LDL and VLDL. Obese had higher values for TGs, LDL and VLDL with cholesterol on the upper limit. The results were found to be statistically insignificant (Table 2, Figure 1).

Mean Body Fat% with Mean Lipid Profile: Mean cholesterol levels were found elevated in patients having low, normal and high body fatpercentage. These results were not statistically significant. Whereas, in general, patients had high levels of cholesterol, Triglycerides, LDL and VLDL irrespective of their low or normal or high body fat percentages (statistically not significant). However, levels of LDL were found statistically significant (0.03) in all categories of body fat groups. Obese patients having high

body fat% had only high level of TGs and VLDL whereas cholesterol, HDL and LDL were found to be within normal limits but p value is statistically insignificant (Table 2).

Table 2: Comparison of lipid profile with age, BMI and body fat%.

	LIPID PROFILE					
PARAMETERS	**Total Lipids mg/dl**	**Cholesterol mg/dl**	**TGs mg/dl**	**HDL mg/dl**	**LDL mg/dl**	**VLDL mg/dl**
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
AGE (N)						
>20 (22)	922.73 ± 118.52	227.41± 52.72	166.18± 40.29	55.82± 10.02	40.76± 47.96	33.24± 8.06
20-30 (49)	901.31 ± 109.28	210.51± 41.41	181.59± 56.83	49.85± 10.68	126.44± 38.24	36.32± 11.37
>30 (13)	903.08 ± 85.54	209.77 ± 37.73	185.54± 61.99	51.92± 9.34	124.74± 39.97	37.11± 12.40
p value	0.74	0.302	0.47	0.085	0.36	0.47
BMI* (N)						
Low**(3)	816.00 ± 28.36	180.00 ± 13	151.33± 11.02	48.57± 8.45	118.40± 41.26	30.27± 2.20
Normal**(43)	924.70 ± 112.74	221.33 ± 44.26	183.81± 59.75	54.51± 9.73	132.47± 40.36	36.76± 11.95
Overweight**(23)	898.43 ± 107.24	217.00 ± 46.30	161.70± 34.21	48.09± 11.45	138.83± 40.03	32.34± 6.84
Obese**(15)	888.67 ± 96.27	199.80 ± 41.21	192.60± 60.27	50.00± 10.19	111.28± 43.44	38.52± 12.05
p value*	0.28	0.21	0.22	0.09	0.21	0.22
BODY FAT%						
Low†(20)	895.80 ± 121.16	210.50 ± 51.71	174.70± 51.43	51.15± 12.45	129.61± 48.93	34.94± 10.29
Normal†(39)	922.59 ± 104.42	223.08 ± 40.24	176.82± 55.83	53.09± 10.74	135.94± 34.66	35.36± 11.17
High†(19)	904.63 ± 97.76	214.21 ± 42.62	176.53± 46.89	48.89± 8.34	132.75± 41.03	35.31± 9.38
Very high†(6)	853.17 ± 117.04	177.50 ± 34.86	203.67± 73.63	53.83± 8.23	82.93± 31.46	40.73± 14.73
p value*	0.48	0.12	0.70	0.51	0.03	0.70

p value < 0.05 (one way Anova)
***BMI: Body mass index, Low: less than18.5, Normal: 18.5-24.9, Overweight 25- 29.9, Obese: greater than 30.*
†Body fat%:- Low: <21, Normal: 21-32.9, High: 33-38.9, Very high: 39 and above

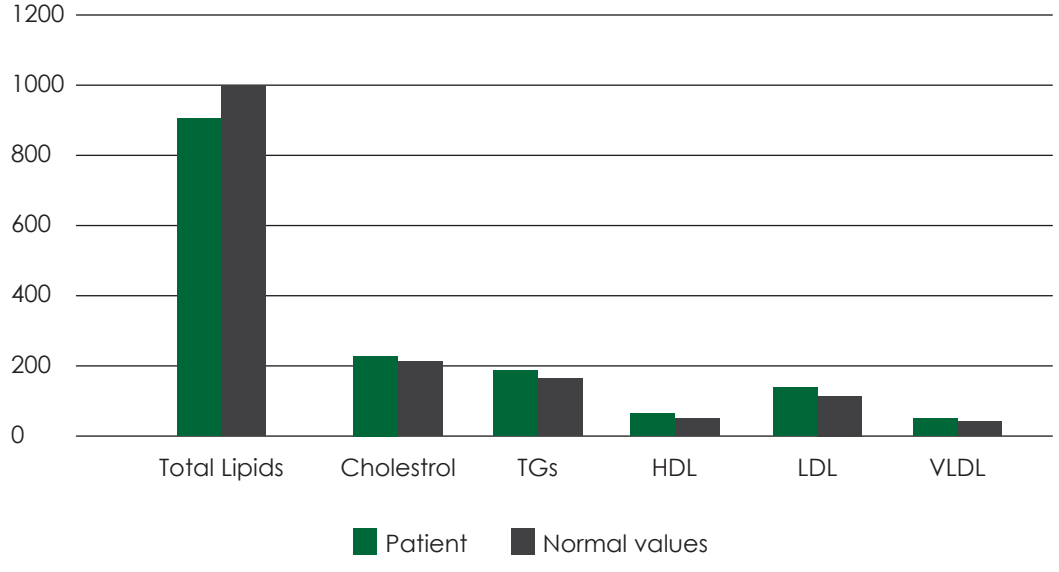

Figure 1: Comparison of subject's lipid profile with normal values according to Adult Treatment Panel III of National Cholesterol Education Program (NCEP).

DISCUSSION

In this study, 38 (41%) pregnant females were overweight to obese. During pregnancy, maternal weight gain is physiological and is due to extra deposition of proteins, fats and water in the intracellular compartment to cope with increasedmetabolic demands imposed by pregnancy. In response to increased requirements the maternal body switches over from carbohydrate utilization to fat mobilization facilitated by insulin resistance and increase in hormonal concentration plasma of lipolytic activity.[11, 12]

In this study, the cholesterol levels were found highest in young mothers less than 20 years, during their second trimester. Studies show that significant higher expression of proprotein convertase subtilisin/kexin type [9] (PCSK9), in placenta lowers the transportation of cholesterol to fetus.[13] PCSK9 is a protein that binds to the LDL receptor and blocks the transportation of lipids, including cholesterol.[14] Generally, it is believed that as the maternal serum cholesterol increases cholesterol transportation to the fetus increases. Since Cholesterol is vital for the development of normal fetus, e.g., membranes, hormones, brain etc. therefore, fetus fulfills its requirement through endogenous synthesis and exogenous transfer from mother.[15] Thus it can be anticipated that the transfer of the cholesterol from mother to the fetus circulation may be need based and is altered in case of maternal hypercholesterolemia.

Obese pregnant women had higher values for TGs, LDL and VLDL with cholesterol on the upper limit. The results were found to be statistically insignificant (Table 2). Patients with low BMI (less than 18), had normal lipid profile except LDL, whereas, normal and overweight BMI patients had high cholesterol, TGs, LDL and VLDL. Lipid abnormalities, mostly elevated levels of TG, TC, LDL, and VLDL are present in pre-eclamptics. High TG levels and maternal obesity are associated with preeclampsia among pregnant women in the Cape Coast Metropolis.[16] An assessment of all lipid fractions among three age groups of pregnant women; up to 20-years, 20-30-years and 31-years and above, no statistically significant differences were found. This shows that there is probably no age-related effect on lipid metabolism in the women in their second trimester. A similar study from Nigeria on evaluation of predisposition of pregnancy to atherosclerosis, showed similar age related results and concluded that with even significantly increase in plasma lipids, normal pregnancy in Nigerian women does not appear to be at risk.[17]

In this study we observed that patients (3.5%) with low BMI (less than 18), had normal lipid profile, whereas, normal (51%), overweight (27%) and obese (18%) had high cholesterol, TGs, HDL, LDL and VLDL. Studies have shown that during pregnancy too high or too low BMI can lead to complications in mothers. A study conducted in Scotland on 109,592 pregnant women analyzed BMI dividing it into five groups, underweight (BMI <18.5), normal weight (BMI 18.5-24.9), overweight (BMI 25-29.9), obese (BMI 30-35) and severely obese (BMI >35). The study concluded that risk of maternal complications increases when BMI increases. Very obese women are three times more at risk of hypertension and gestational diabetes. Moreover, the study also showed all increase weight categories in comparison to maternal normal weight, are more at risk of hospital admissions, in duration as well as number of times. In contrast to 8% risk for admission in normal women, the risk substantially increased for overweight, obese and severely obese, 16%, 45% and 88% respectively.[18]

CONCLUSION

Lipid profile and BMI were found independent variables having no association with body fat% during second trimester of pregnancy.

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CONFLICT OF INTEREST

There was no conflict of interest among the authors.

ETHICS APPROVAL

The study approval was sort from the Ziauddin University Ethics Review Committee (ref. code 0080218HRPHYSIO).

PATIENTS CONSENT

Verbal and written informed consent was obtained from all patients.

AUTHOR'S CONTRIBUTION

Hira Attique conceived the idea, did bench work, wrote the manuscript, Moazam Shahid helped in sampling and bench work, Leena Hani helped in sampling and bench work, Rehana Rahman helped in designing of the project, Shahina Ishtiaq facilitated in and data collection, Syed Tousif Ahmed overall supervised the project and finalized the manuscript.

REFERENCES

1. Mankuta D, Elami-Suzin M, Elhayani A, Vinker S. Lipid profile in consecutive pregnancies. Lipids Health Dis. 2010;9(1):58.

2. Parchwani D, Patel D. Status of lipid profile in pregnancy. Natl J Med Res. 2011;1(1):10-2.
3. Freinkel N. Effects of the conceptus on maternal metabolism during pregnancy. Nat Treat Diabetes. 1965;8:679-91.
4. Brett KE. Maternal Phenotype, Directly Measured Physical Activity and Associations with Placenta Nutrient Transport Related Gene Expression: Université d'Ottawa/University of Ottawa; 2015.
5. Pusukuru R, Shenoi AS, Kyada PK, Ghodke B, Mehta V, Bhuta K, et al. Evaluation of lipid profile in second and third trimester of pregnancy. J Clin Diagn Res. 2016;10(3):QC12.
6. Brizzi P, Tonolo G, Esposito F, Puddu L, Dessole S, Maioli M, et al. Lipoprotein metabolism during normal pregnancy. Am J Obstet Gynecol. 1999;181(2):430-4.
7. Wiznitzer A, Mayer A, Novack V, Sheiner E, Gilutz H, Malhotra A, et al. Association of lipid levels during gestation with preeclampsia and gestational diabetes mellitus: a population-based study. Am J Obstet Gynecol. 2009;201(5):482. e1-. e8.
8. Piechota W, Staszewski A. Reference ranges of lipids and apolipoproteins in pregnancy. Eur J Obstet Gynecol Reprod Biol. 1992;45(1):27-35.
9.Herrera E. Metabolic adaptations in pregnancy and their implications for the availability of substrates to the fetus. Eur J Clin Nutr 2000;54(S1):S47.
10. Jin W-Y, Lin S-L, Hou R-L, Chen X-Y, Han T, Jin Y, et al. Associations between maternal lipid profile and pregnancy complications and perinatal outcomes: a population-based study from China. BMC Pregnancy Childbirth. 2016;16(1):60.
11. Butte NF. Carbohydrate and lipid metabolism in pregnancy: normal compared with gestational diabetes mellitus. Am J Clin Nutr. 2000;71(5):1256S-61S.
12. Homko CJ, Sivan E, Reece EA, Boden G. Fuel metabolism during pregnancy. Semin Reprod Endocrinol. 1999 Jun (Vol. 17, No. 02, pp. 119-125). Copyright© 1999 by Thieme Medical Publishers, Inc.
13. Zhang R, Dong S, Ma W-w, Cai X-p, Le Z-y, Xiao R, et al. Modulation of cholesterol transport by maternal hypercholesterolemia in human full-term placenta. PLoS One. 2017;12(2):e0171934.
14. Weinreich M, Frishman WH. Antihyperlipidemic therapies targeting PCSK9. Cardiol Rev. 2014;22(3):140-6.
15. Herrera E. Lipid metabolism in pregnancy and its consequences in the fetus and newborn. Endocrine. 2002;19(1):43-55.
16. Ephraim RK, Doe P, Amoah S, Antoh E. Lipid profile and high maternal body mass index is associated with preeclampsia: A case-control study of the Cape Coast Metropolis. Ann Med Health Sci Res. 2014;4(5):746-50.
17. Neboh EE, Emeh JK, Aniebue UU, Ikekpeazu EJ, Maduka IC, Ezeugwu FO. Relationship between lipid and lipoprotein metabolism in trimesters of pregnancy in Nigerian women: Is pregnancy a risk factor? J Nat Sci Biol Med. 2012;3(1):32.
18. Denison FC, Norwood P, Bhattacharya S, Duffy A, Mahmood T, Morris C, et al. Association between maternal body mass index during pregnancy, short-term morbidity, and increased health service costs: a population-based study. BJOG. 2014;121(1):72-81; discussion 2.