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Association of increased high-sensitivity C-reactive protein and dyslipidemia with pregnancy induced hypertension

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Abstract
Background: Incidence of pregnancy induced hypertension is increasing and it is most common medical complication of pregnancy. Measurement of the level of hs CRP, serum lipid profile can be used as predictor of the disease. The present study is aimed to evaluate the relationship of High-Sensitivity serum C-reactive protein and lipid profile in women with pregnancy induced hypertension.
Methods: This was a case-control study among purposively selected pregnant women attending inpatient and outpatient department of Obstetrics and Gynecology, Sir Salimullah Medical College and Mitford Hospital, Dhaka from March 2019 to February 2020. A total 120 singleton pregnant women between 18-35 years of age were included in this study after 20 weeks of gestation. Among them 60 diagnosed pregnancy-induced hypertension and rest of the 60 normotensive pregnant women were considered as case and control respectively. After taking consent, data were collected from patients on variables of interest using the predesigned semi-structured questionnaire by interview, observation, relevant clinical examination and laboratory investigation of the participants. Their serum hs-CRP and serum lipid profile level were measured. Analysis was done using the analytic software SPSS v26.0.
Results: Among the case 30.0% with serum hs-CRP level ≥ 9.66 mg/dl had 3.24 times more chance to develop pregnancy induced hypertension. Mean serum hs-CRP level, total cholesterol, LDL and triglyceride was 6.98±4.21, 261.13±68.62, 183.76±66.51 285.98±125.61 respectively among cases compared to 5.26±2.72, 220.46±54.16, 121.90±33.36, 189.03±64.38 among control and all the parameters were significantly high in cases. There was significant positive correlation found with increased systolic blood pressure, diastolic blood pressure and higher level of serum hs-CRP level, total cholesterol, LDL and triglyceride.
Conclusion: HS-CRP, serum total cholesterol, serum LDL, serum triglycerides were significantly higher among women with pregnancy induced hypertension. Odds Ratio of developing Pregnancy Induced Hypertension is also significantly more with patient having dyslipidemia and high hs-CRP. Thus, the measurement of the level of hs-CRP, serum total cholesterol, serum LDL, serum triglycerides can be used as predictor of the disease.

Keywords: C-reactive protein, high-sensitivity, dyslipidemia, pregnancy, hypertension

Introduction

Pregnancy Induced Hypertension is most common medical complication of pregnancy and its incidence is increasing worldwide. It complicates about 6-10% of pregnancies. 20% of all maternal death occurs in our country due to preeclampsia and eclampsia and is the second cause of maternal death [1]. According to the WHO, Pregnancy Induced Hypertension is one of the main causes of maternal, fetal and neonatal mortality and morbidity [2]. It is the most common cause of maternal death in Europe [3]. In a retrospective study over the period 2000-2009 in a tertiary center in India, PIH was the third cause of maternal death [4]. Pregnancy-induced hypertension (PIH) is a hypertensive disorder in pregnancy that occurs as a direct result of a gravid state after 20 weeks of pregnancy in the absence of other causes of elevated blood pressure (BP ≥140/90 mm of Hg) measured 2 times with at least 4 hours interval. PIH includes (1) Gestational hypertension; (2) Pre-eclampsia and (3) Eclampsia. Pre-eclampsia is a multisystem disorder characterized by new onset of hypertension and proteinuria after 20 weeks of gestation.

In the absence of proteinuria, additional features that contribute to diagnosis are thrombocytopenia, renal insufficiency, impaired liver function, pulmonary edema, cerebral or visual symptoms [5]. When pre-eclampsia becomes complicated by convulsion it is termed as eclampsia. Several hypotheses have been proposed but the causes of hypertension during pregnancy remain unclear. Among the many proposed causes of preeclampsia some are immunological derangement (a maternal immune reaction to paternal antigen in the placenta), genetic factors, increased insulin resistance, and subsequent oxidative stress with associated endothelial dysfunction [6]. There is evidence suggesting that pregnancy itself stimulates the maternal inflammatory response [7]. There is also increasing evidence that it is a systemic inflammatory disorder as an acute phase response induced by pro-inflammatory cytokines (Interleukin 1,6, Tumor Necrosis Factor etc.) secreted from the inflamed tissue. CRP is synthesized in response to these cytokines from Liver. C-reactive protein (CRP) is a hepatically derived classical acute phase reactant and it is an objective and sensitive index of overall inflammatory activity [8]. The most important feature in toxemia of pregnancy is hypertension which is supposed to be due to vasospastic phenomenon in kidney, uterus, placenta, and brain [9]. Altered lipid synthesis leading to decreased PGI2:TXA2 ratio is also supposed to be an important way of pathogenesis in pregnancy induced hypertension. Thus, abnormal lipid metabolism seems important in the pathogenesis of PIH. A little work has been done in this regard in Bangladesh where PIH is a major health problem in pregnancy. Therefore taking the above mentioned fact into consideration the study was designed to determine the hs C-reactive Protein conc. and serum lipid profile in women with pregnancy induced hypertension after 20 weeks gestation with age group between 18-35 and compare it with normotensive pregnant women of same age group and gestation to ascertain whether these parameters were associated with Pregnancy Induced Hypertension.

Methodology

Study design: This was a case-control study.

Place of the study: This study was carried out in indoor and outdoor department of Obstetrics and Gynecology, Sir Salimullah Medical College and Mitford Hospital, Dhaka, Bangladesh

Study period: From March 2019 to February 2020.

Study population: The study population was 18-35 years old pregnant women after 20 weeks of gestation.

Case: Women with pregnancy-induced hypertension with age 18-35 years after 20 weeks of gestation. Case includes-Gestational hypertension, Pre-eclampsia and Eclampsia.

Control: Pregnant normotensive women with same age group and gestation.

Sample size determination

To calculate the sample size following formula will be followed. So, 53 is minimum sample size in each group. But for determination of sample size, if variability increases sample size should also be increased. As this study includes more variables so for better statistical result sample size is increased to 60 in each group. 60 patients with pregnancy induced hypertension with age between 18-35years after 20 weeks of gestation (case). 60 pregnant normotensive patients with same age and gestation (Control).

Inclusion criteria

- **For case:** Pregnant women after 20 weeks of gestation with age group 18-35 years diagnosed as pregnancy-induced hypertension.
- **For control:** Pregnant normotensive women with the same above-mentioned age and gestation.

Exclusion criteria for both group

- Women in labor.
- Women with ruptured membranes.
- Women with multiple pregnancies.
- Women with Molar pregnancy.
- Pre-existing hyperlipidemia before 20 weeks of pregnancy.
- Women receiving any drug that interferes with serum lipid profile.
- Smoker and alcoholic women.
- History of receiving aspirin or any other medication known to interfere with inflammation.
- Auto immune disease.
- Medical disease like DM, chronic hypertension, renal disease, thyroid disease.
- Mistaken date.
- Obesity.

Study procedure

All the pregnant mothers fulfilling the inclusion attending at obstetrics department were enrolled in the study by purposive sampling. After obtaining an informed written consent 120 subjects were grouped into 2 groups according to criteria. Case were 60 patients with pregnancy induced hypertension which includes pre-eclampsia (N=21), eclampsia (N=20), and gestational hypertension (N=19). Control were 60 normotensive pregnant women with blood pressure < 140/90 mm of Hg without any signs of pre-eclampsia. Blood pressure was measured by standard procedure with sphygmomanometer. Korotk off phase-1 (1st beat heard) and phase-v (disappearance of sound) were used for systolic and diastolic blood pressure. It was measured on right arm, sitting comfortably, legs uncrossed with back and arm supported or lying on her back 45 degrees to horizontal. In both cases occluded brachial artery was kept at the level of the heart. Proteinuria is measured by Dipstick method, when proteinuria found ≥1+ in collected urine sample then diagnosis of preeclampsia was established. After taking all aseptic precaution the blood samples were collected from median antecubital vein into two separate red top vacutainer blood collection tube. Then it was kept stand for about 45 minutes at room temperature to allow complete clotting and clot retraction, then sera were separated as quickly as possible and centrifugation was done for 5-10 minutes at 3000 rpm. Component of lipid profile was measured using automated analyzer and hs-CRP was measured by Latex turbidimetry method with hs-CRP latex reagent by Atellica CH Analyzer. Normal reference values of serum total cholesterol, triglycerides, HDL, LDL and hs-CRP during pregnancy were taken from [10]. The following precautions were taken while sampling the blood as far as possible:

1. Preferably the patient was fasting for overnight for at least 12 hours.
2. It was made sure that the patient was not receiving any drug that interferes with serum lipid levels or their estimation.
3. The patient was afebrile for the last one week.

4. The patient was on near normal diet.

All the above precautions cannot be applied strictly in cases of eclampsia due to inherent difficulties associated in such cases.

Data collection

Detailed Obstetric and medical history and clinical examinations were done in all study subjects. Data was collected from the patient on variables of interest using the preformed structured questionnaire. For each and every subject separate data sheet was used. With all aseptic precaution blood samples were collected after overnight fasting from median antecubital vein. Then the serum hs-C-reactive Protein and lipid profile were measured.

Data analysis

Statistical analyses were carried out by using Windows based Statistical Package for Social Sciences (SPSS-26). For continuous variables distribution was expressed by mean and standard deviation. Mean comparison between two groups was done by unpaired t-test. For qualitative variables distribution was expressed by frequency and their percentages. Chi square test was done to see the significance of difference between two groups. Scatterplot diagram was used to show the relationship with blood pressure and biochemical variables. ANOVA test was carried out to compare means between 4 groups and to see relationship with the pregnancy induced hypertension. Cut-off values were used according to the literatures. The p value <0.05 was considered as statistically significant.

Results

The hospital-based case control study was carried out for evaluation of High-Sensitivity C-reactive Protein and Serum Lipid profile in women with Pregnancy Induced Hypertension. This study was carried out in the Department of Obstetrics and Gynecology of Sir Salimullah Medical College & Mitford Hospital, Dhaka. Case were pregnant women (60 respondents) diagnosed as PIH and Control were normotensive pregnant women (60 respondents). Findings of the study are presented by graphs and tables.

Table 1: Categorization of the respondents according to their socio demographic characteristics (case=60, control=60)

Sociodemographic characteristics	Case		Control		P-Value
	N	%	N	%	
Age of the respondents					
Up to 20 years	7	11.7	8	13.3	0.926[a]
21-30 years	38	63.3	36	60.0	
More than 30 years	15	25.0	16	26.7	
Mean ± SD	27.07±5.23		26.73±5.01		0.722[b]
Educational qualification					
Below SSC	36	60.0	46	76.7	0.077[a]
SSC and above	24	40.0	14	23.3	
Occupation					
Housewife	53	88.3	59	98.3	0.061[c]
Service	7	11.7	1	1.7	
Monthly family income					
Low income (<6,833)	8	13.3	18	30.0	0.064[a]
Lower middle income (6,833-26,900)	40	66.7	35	58.3	
Upper middle income (26,901-83,167)	12	20.0	7	11.7	
Area of residence					
Urban	10	16.7	2	3.3	0.002[a]
Semi-urban	22	36.7	40	66.7	
Rural	28	46.7	18	30.0	

[a] Chi-square test was done to measure the level of significance.
[b] Unpaired t-test was done to measure the level of significance
[c] Fisher's Exact test was done to measure the level of significance.

Case: Pregnant women with Pregnancy Induced Hypertension
Control: Pregnant women without Pregnancy Induced Hypertension

Table-1 shows mean (±SD) age of the respondents of case (27.07±5.23) years and control (26.73±5.01) years groups was almost similar. Majority of the respondents both in case (60.0%) and control (76.7%) groups were educated below SSC level. Most of them were housewife (case vs control: 88.3% vs 98.3%) and belonged from lower middle-class family. All these findings were statistically non-significant (p≥0.05). A significant finding was observed in regards of area of residence where majority among case came from rural (46.7%) area and among control more than half came from semi-urban (66.7%) area (P=0.002).

Table 2: Categorization of the respondents according to past medical history (case=60, control=60)

Past medical history	Case		Control		P-Value
	N	%	N	%	
H/O GDM					
Yes	3	5.0	1	1.7	0.619[c]
No	57	95.0	59	98.3	
H/O preeclampsia					
Yes	6	10.0	4	6.7	0.496[a]
No	54	90.0	56	93.3	
H/O of IUD					

Yes	3	5.0	1	1.7	0.619[c]
No	57	95.0	59	98.3	
H/O birth weight > 4kg					
Yes	1	1.7	0	0.0	0.315[c]
No	59	98.3	60	100.0	

[a] Chi-square test was done to measure the level of significance.
[c] Fisher's Exact test was done to measure the level of significance

Table-2 shows non-significant findings in regards of past medical history of respondents among case and control.

Table 3: Categorization of the respondents according to family history (Case=60, Control=60)

Family history	Case		Control		P-Value
	N	%	N	%	
Family H/O DM					
Yes	21	35.0	24	40.0	0.572[a]
No	39	65.0	36	60.0	
Family H/O HTN					
Yes	25	41.7	24	40.0	0.853[a]
No	35	58.3	36	60.0	
Family H/O renal disease					
Yes	1	1.7	0	0.0	0.315[c]
No	59	98.3	60	100.0	

[a] Chi-square test was done to measure the level of significance.
[c] Fisher's Exact test was done to measure the level of significance

Table-3 states that among case 21 (35.0%) and among control 24 (40.0%) had positive family history of DM. Among case 25 (41.7%) and among control 24 (40.0%) had positive family history of HTN. Among case (1.7%) and among control none of the respondents (0.0%) had positive family history of renal disease.

Table 4: Categorization of the respondents according to present medical condition (case=60, control=60)

Present medical condition	Case		Control		P-value
	n	%	n	%	
Oedema					
Yes	46	76.7	40	66.7	0.224[a]
No	14	23.3	20	33.3	
Proteinuria					
Yes	40	33.3	0	0.0	<0.001[a]
No	20	66.7	60	100.0	
IUGR					
Present	9	15.0	4	6.7	0.142[a]
Absent	51	85.0	56	93.3	

[a] Chi-square test was done to measure the level of significance.
The figure within parentheses indicates in percentage.

Table-4 states that among the case 40 (33.3%) had positive history of proteinuria and none (0.0%) of the control had positive history of proteinuria. This finding was statistically significant (<0.001).

Table 5: Distribution of the respondents according to lipid profile and C reactive protein (Case=Mean ± SD, Control=Mean ± SD)

Lipid profile and C reactive protein	Case (Mean ± SD)	Control (Mean ± SD)	P-value
Serum Total Cholesterol	261.13±68.62	220.46±54.16	<0.001 [b]
Serum HDL	45.86±15.25	54.06±12.03	<0.001 [b]
Serum LDL	183.76±66.51	121.90±33.36	<0.001 [b]
Serum Triglycerides	285.98±125.61	189.03±64.38	<0.001 [b]
hs-CRP	6.98±4.21	5.26±2.72	0.009 [b]

[b] Unpaired t-test was done to measure the level of significance

Table-5 denotes mean serum total cholesterol (261.13±68.62), serum LDL (183.76±66.51), serum triglycerides (285.98± 125.61) and CRP (6.98±4.21) were higher in case compared to that in control (220.46±54.16), (121.90±33.36), (189.03±64.38) and (5.26±2.72) respectively. Mean serum HDL was lower in case (45.86±15.25) compared to that in control (54.06±12.03). All these findings were statistically significant (p≤0.05).
Table-6 describes the comparison of lipid profile and C-reactive protein among groups-preeclampsia, eclampsia, gestational HTN and normotensive pregnant, which were statistically significant (p≤0.05).

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Table 6: Comparison of lipid profile and hs-CRP among the different categories of PIH (Preeclampsia=21, Eclampsia=20, Gestational HTN=19) and control=60

Lipid profile and CRP	Preeclampsia (Mean ± SD)	Eclampsia (Mean ± SD)	Gestational HTN (Mean ± SD)	Control (Mean ± SD)	P-value
Cholesterol	252.4±59.6	292.3±72.1	237.8±65.1	220.4±54.1	<0.001 [d]
HDL	48.9±14.9	35.9±11.6	52.5±14.0	54.0±12.0	<0.001 [d]
LDL	183.6±72.1	193.5±75.8	173.5±49.2	121.9±33.3	<0.001 [d]
S. TG	189.0±64.3	286.2±116.0	353.0±123.9	215.1±101.3	<0.001 [d]
hs-CRP	6.7±3.9	8.2±4.6	5.9±3.9	5.2±2.7	0.011 [d]

[d] ANOVA test was done to measure the level of significance

Table 7: Odds ratios (OR) and 95% confidence interval of hypercholesterolemia in PIH.

Serum Cholesterol	Case		Control		χ2 value	p-value	OR (95% CI)
	N	%	N	%			
≥ 299 mg/dl	35	58.3	19	31.7	8.62	0.003	3.02 (1.43-6.38)
<299 mg/dl	25	1.7	41	68.3			

[a] Chi-square test was done to measure the level of significance.
CI= Confidence interval
Cut off values were taken from Abbasi-Ghanavati, *et al.* [10]

Table-7 shows among the case 58.3% and among control 31.7% had serum cholesterol ≥ 299 mg/dl and respondents with serum cholesterol ≥ 299 mg/dl had 3.02 times more chance to develop pregnancy induced hypertension which was statistically significant (p=0.003).

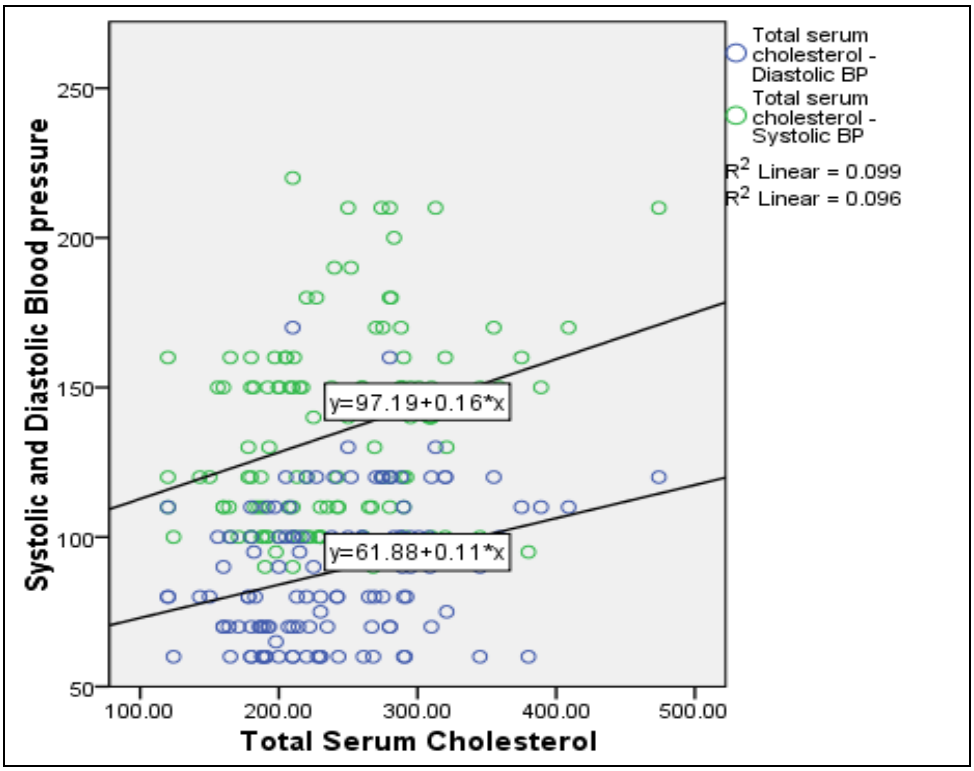

Fig 1: Scatterplot diagram showing correlation of cholesterol level with blood pressure in pregnant women (p=0.001).

Figure 1 shows a positive correlation of cholesterol level with blood pressure (p=0.001).

Table 8: Odds ratios (OR) and 95% confidence intervals (CI) of decreased HDL in Pregnancy Induced Hypertension

Serum HDL level	Case		Control		χ2 value	P-VALUE	OR (95% CI)
	N	%	N	%			
< 52 mg/dl	9	15.0	2	3.3	4.90	0.027	5.11 (1.05-9.78)
≥ 52 mg/dl	51	85.0	58	96.7			

[a] Chi-square test was done to measure the level of significance.
CI= Confidence interval
Cut off values were taken from Abbasi-Ghanavati *et al.* 10].

Table-8 shows among case 15.0% and among control 3.3% had serum HDL < 52mg/dl and respondents with serum HDL < 52 mg/dl had 5.11 times more chance to develop pregnancy induced hypertension which was statistically significant (p=0.027).

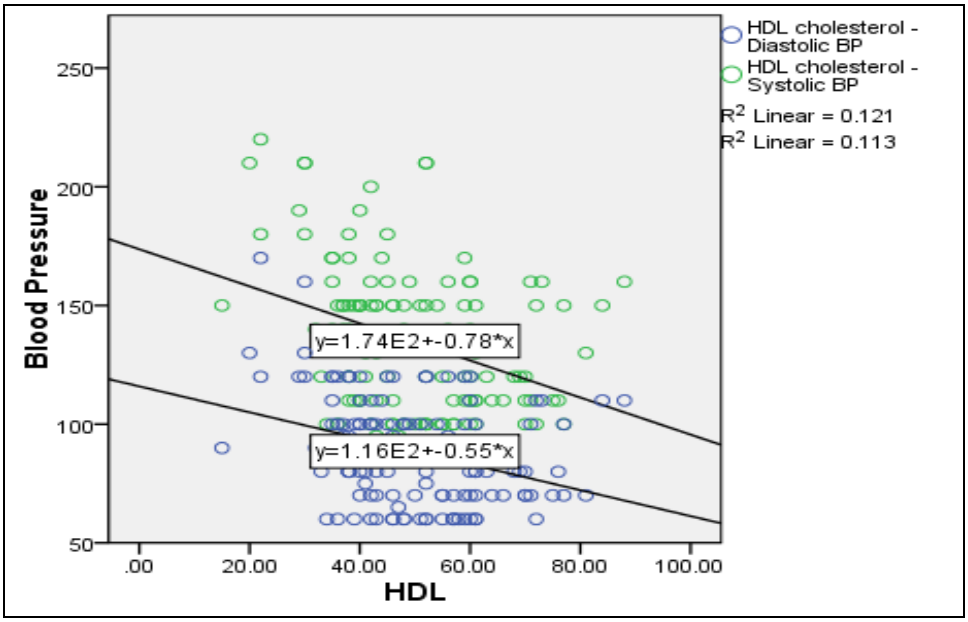

Fig 2: Scatterplot diagram showing correlation of HDL level with blood pressure (p=0.001).

Figure 2 shows a negative correlation of serum HDL level with systolic blood pressure and diastolic blood pressure respectively (p=0.001).

Table 9: Odds ratios (OR) and 95% confidence intervals (CI) of increased serum LDL level in Pregnancy Induced Hypertension

Serum LDL level	Case		Control		χ2 value	P-Value	OR (95% CI)
	N	%	N	%			
≥ 184 mg/dl	37	61.7	7	11.7	32.29	<0.001	10.18 (4.73-16.32)
< 184 mg/dl	23	38.3	53	88.3			

[a] Chi-square test was done to measure the level of significance.
CI= Confidence interval
Cut off values were taken from Abbasi-Ghanavati *et al*. [10]

Table-9 states that among case 61.7% and among control 11.7% had serum LDL level ≥ 184 mg/dl and respondents with serum LDL level ≥ 184 mg/dl had 10.18 times more chance to develop pregnancy induced hypertension which was statistically significant (p<0.001).

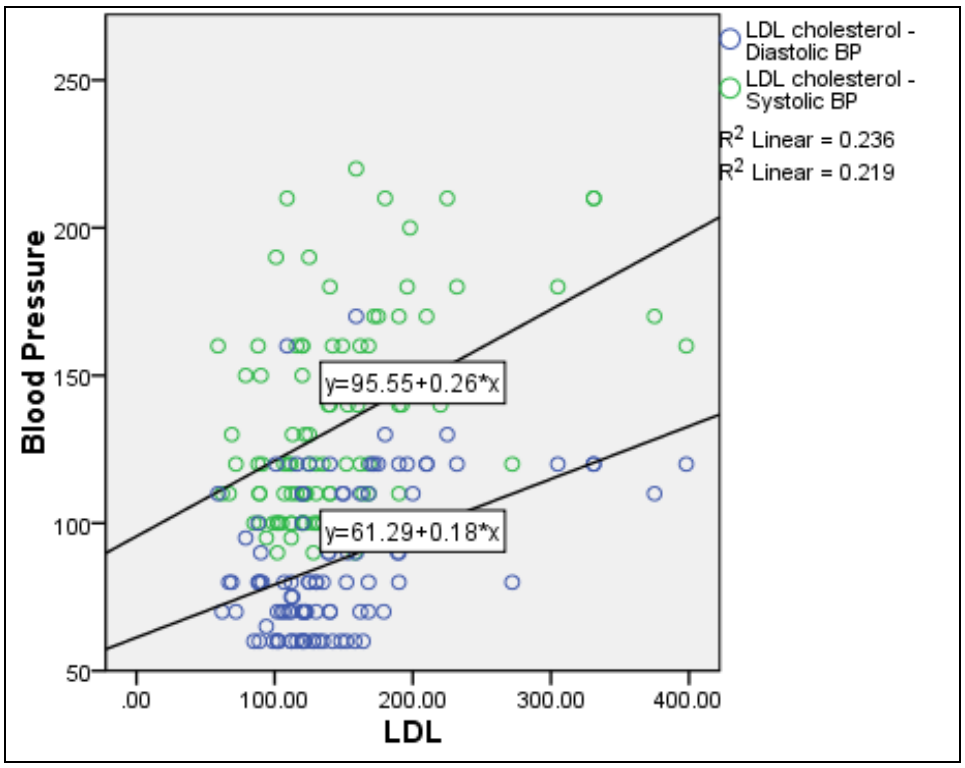

Fig 3: Scatterplot diagram showing correlation of LDL level with systolic blood pressure and diastolic blood pressure respectively (p=0.001).

Figure 3 shows a positive correlation of LDL level with systolic blood pressure and diastolic blood pressure respectively (p=0.001).

Table 10: Odds ratios (OR) and 95% confidence intervals (CI) of hypertriglyceridemia in pregnancy induced hypertension

Serum TG level	Case	Control	χ2 value	P-Value	OR (95% CI)
≥ 382 mg/dl	41 (68.3)	23 (38.3)	10.84	0.001	3.47 (1.63-7.37)
< 382 mg/dl	19 (31.7)	37 (61.7)			

[a] Chi-square test was done to measure the level of significance.
CI= Confidence interval.

Table-10 shows that among case 68.3% and among control 38.3% had serum TG level ≥ 382 mg/dl and respondents with serum TG level ≥ 382 mg/dl had 3.47 times more chance to develop pregnancy induced hypertension which was statistically significant (p=0.001).

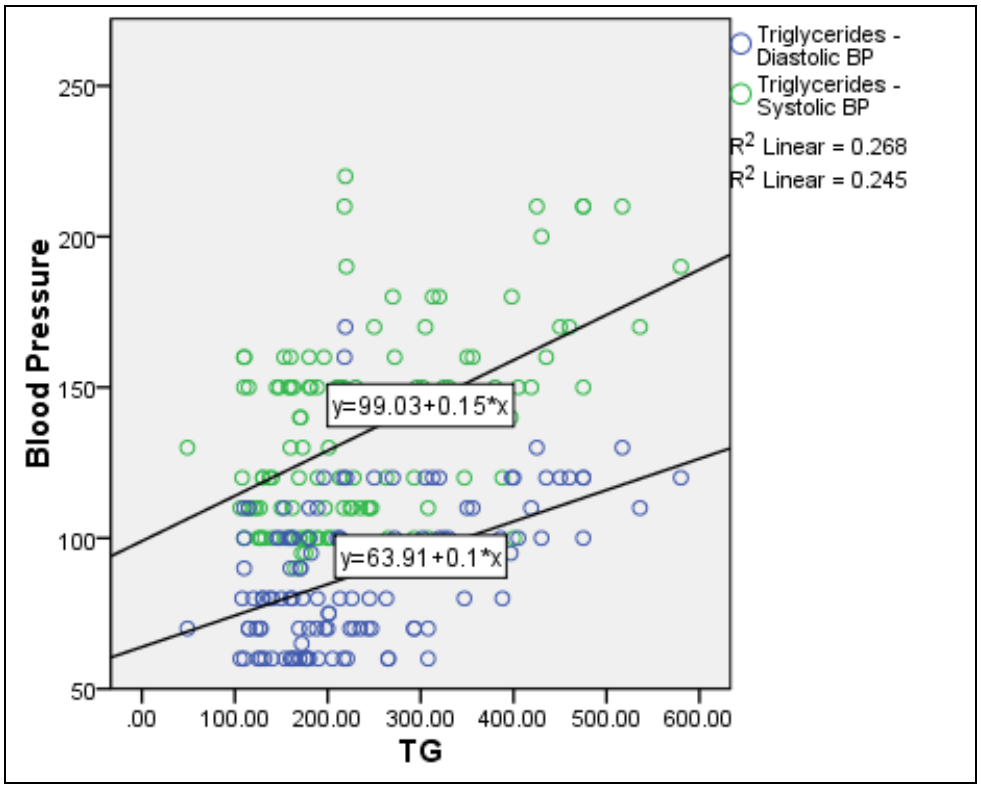

Fig 4: Scatterplot diagram showing correlation of TG level with systolic blood pressure and diastolic blood pressure respectively (p=0.001).

Figure 4 shows a positive correlation of TG level with systolic blood pressure and diastolic blood pressure respectively (p=0.001).

Table 11: Odds ratios (OR) and 95% confidence intervals (CI) of increased hs-CRP in Pregnancy Induced Hypertension.

Serum hs-CRP	Case	Control	χ2 value	p-value	OR (95% CI)
≥ 9.66 mg/l	18 (30.0)	7 (11.7)	6.11	0.013	3.24 (1.24-6.49)
< 9.66 mg/l	42 (70.0)	53 (88.3)			

[a] Chi-square test was done to measure the level of significance.
CI= Confidence interval.
The figure within parentheses indicates in percentage.

Table-11 states that among the case 30.0% and among control 11.7% had serum hs-CRP level ≥ 9.66 mg/l and respondents with serum hs-CRP level ≥ 9.66 mg/l had 3.24 times more chance to develop pregnancy induced hypertension which was statistically significant (p<0.013).

Figure 5 shows a positive correlation of high sensitivity CRP level with systolic blood pressure, and diastolic blood pressure, respectively (p=0.001).

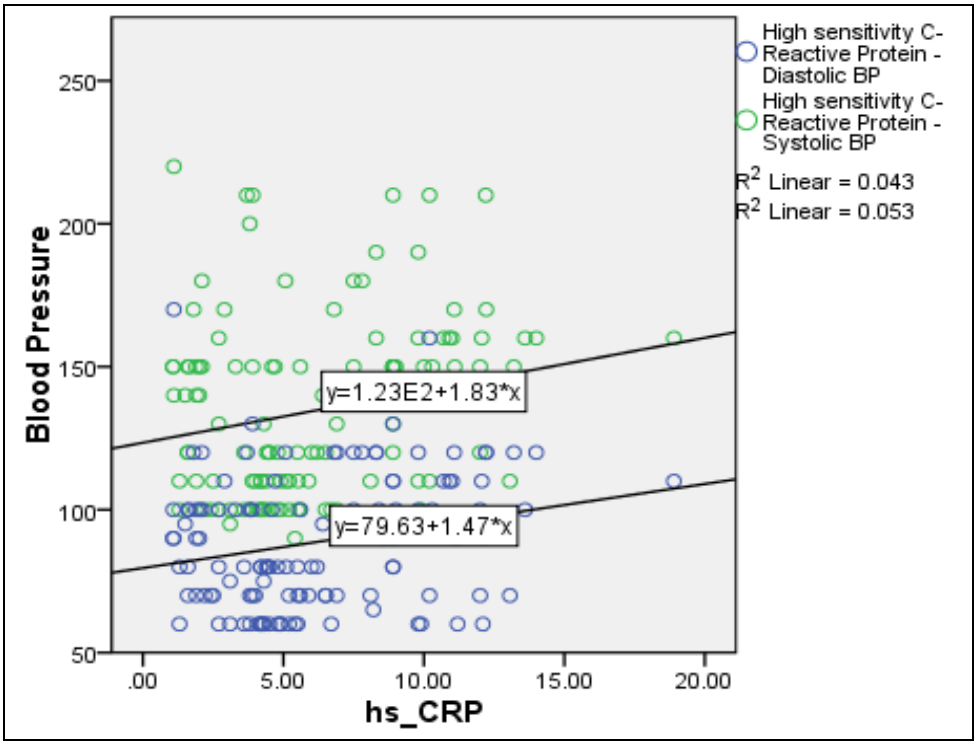

Fig 5: Scatterplot diagram showing correlation of hs-CRP level with systolic blood pressure and diastolic blood pressure respectively (p=0.001).

Discussion

This case control study was carried out to determine the association of high sensitivity C-reactive protein and Lipid profile in women with Pregnancy Induced Hypertension (PIH) and normotensive pregnant women. A total of 120 pregnant women in their 2nd half of pregnancy between the ages of 18-35 years, attending at department of Obstetrics and Gynaecology, Sir Salimullah Medical College & Mitford Hospital, Dhaka who fulfilled the inclusion criteria were enrolled in this study. They were divided into two groups, case: Pregnant women (60 respondents) diagnosed as PIH and control: normotensive pregnant women (60 respondents). In present study, mean (±SD) age of the respondents of case (27.07±5.23) years and control (26.73±5.01) years, were almost similar. The age difference was statistically not significant (p=>0.05) between two groups. In a study by Rout and Mahalik *et al*. [11], mean age in study group with gestational hypertension was 27.41 compared to 26.19 years in control group with pregnant normotensive women. Another study Mandal *et al*. [12] where mean age in study group was 29.42 years and the mean age in control group was 25.96 years. A study found that mean age was 24.10±4.70 years in preeclampsia and 24.80±4.02 years in normal pregnancy there was no difference between two groups Das *et al*. [13] All these studies are similar with present study. Majority of the respondents both in case (60.0%) and control (76.7%) were educated below SSC level Most of them were housewife (case vs control: 88.3% vs 98.3%) and belonged from lower middle-class family. All these findings were statistically non-significant (p ≥ 0.05). A significant finding was observed in regards of area of residence where majority among case came from rural (46.7%) area and among control more than half came from semi-urban (66.7%) area (p=0.002). A study conducted by Koppula and Sawant, demonstrated that 97% of case belonged to the rural background, and most of them were literate (71.33%). 52% belonged to Class I status. Sociodemographic parameters and PIH showed no association in another study conducted by Koppula and Sawant *et al*. [14] which did not fully support present study and these dissimilarities might be due to geographical variation and small sample size. In present study among the case (33.3%) had positive history of proteinuria and in control where none (0.0%) of the respondents had positive history of proteinuria. This finding was statistically significant (p<0.001). In a similar study Stepan *et al*. demonstrated patients with proteinuria showed the highest blood pressure value. [15] In this study mean serum total cholesterol (261.13±68.62), serum LDL (183.76±66.51), serum triglycerides (285.98±125.61) and CRP (6.98±4.21) were higher in cases compared to that in control group (220.46±54.16), (121.90±33.36), (189.03±64.38) and (5.26±2.72) respectively. Mean serum HDL was lower in case (45.86±15.25) compared to that in control (54.06±12.03). All these findings were statistically significant (p≤0.05). The significantly high levels of TG and cholesterol with significantly low HDL-c could reflect a compromised vascular function. These explanations agree with a study by Catarino *et al* [16] who reported that preeclampsia is associated with an enhanced hyperlipidemia which seems to have a negative impact on fetal lipid profile as reflected by an atherogenic LDL-c/HDL-c ratio and higher TG level. A study conducted by Das *et al* [13] showed that in preeclamptic group mean TG 212.75±50.29 mg/dl was increased significantly than other parameter compared to mormotensive pregnant 185.60±40.67mg/dl. Among the case 58.3% and among control 31.7% had serum cholesterol ≥ 299 mg/dl and respondents with serum total cholesterol ≥ 299 mg/dl had 3.02 times more chance to develop pregnancy induced hypertension which was statistically significant (p=0.003). Among the case 15.0% and among control 3.3% had serum HDL < 52 mg/dl and respondents with serum HDL <52 mg/dl had 5.11 times more chance to develop pregnancy induced hypertension which was statistically significant (p=0.027). Among the case 61.7% and among control 11.7% had serum LDL level ≥ 184 mg/dl and respondents with serum LDL level ≥ 184 mg/dl 10.18 times more chance to develop pregnancy induced hypertension which was statistically significant (p<0.001). Among the case 68.3% and among control 38.3% had serum TG level ≥ 382 mg/dl and respondents with serum TG level ≥ 382 mg/dl 3.47 times more chance to develop pregnancy induced hypertension which was statistically significant (p=0.001). A study conducted by Farag *et al* [17] showed

significant increase of CRP, TG, Cholesterol and LDLc in women who developed PIH compared with normotensive a pregnant woman which was similar with present study. Another study also supports the findings of present study where mean values of triglyceride (TG), total cholesterol (TC) and low-density lipoprotein-cholesterol (LDL-c) were significantly higher in pre-eclamptic women as compared with normotensive pregnant women (TG = 229.61±88.27 and 147.00±40.47, TC = 221.46±45.90 and 189.67±39.18, LDL = 133.92±38.77 and 112.41±36.08, VLDL = 41.44±19.68 and 26.64±7.87), respectively. The serum high density lipoprotein cholesterol (HDL-c) level was lower, but it is not statistically significant (HDL-c = 51.02±16.01 and 61.80±25.63) in pre-eclamptic women as compared with controls Tesfa *et al.* [18] Present study showed positive correlation of triglyceride (TG), total cholesterol (TC) and low-density lipoprotein-cholesterol (LDL-c) level with systolic blood pressure and diastolic blood pressure which was statistically significant (p=0.001). Previous studies demonstrated that high triglyceride (TG), total cholesterol (TC) and low-density lipoprotein-cholesterol (LDL-c) `levels strengthened the association between high blood pressure (BP) Satoh *et al.* [19] In present study among the case 30.0% and among control 11.7% had high sensitivity CRP ≥ 9.66 mg/l and respondents with high sensitivity CRP ≥ 9.66 mg/l had 3.24 times more chance to develop pregnancy induced hypertension which was statistically significant (p=0.013). Similar finding was observed in a study conducted by Ertas *et al* [7] where high sensitivity CRP ≥ 9.66 mg/l found associated with pregnancy induced hypertension. Wolf *et al*., (2001) in a prospective case-control study reported that women with CRP conc.≥4.1mg/l experience a 3.5-fold increased risk of preeclampsia as compared with women whose CRP conc. were less than 1.1 mg/l. All these studies support present study. Present study demonstrates positive correlation between hs-CRP and systolic and diastolic blood pressure which is statistically significant (p=0.001). Mirzaie *et al* [20] also found that there was a positive correlation between serum CRP level and systolic and diastolic blood pressure. In another study serum CRP concentration was found to be significantly higher (p=0.001) in pre-eclamptic patient (2.10±1.36 mg/l) than in the normal pregnant women (0.39±0.09 mg/l) Das *et al*. [21] Fatemeh M *et al*. and Ahmed k *et al* [22, 23] conducted their studies in Iran and Egypt respectively and both found positive correlation between serum CRP and systolic (p=<0.005) and diastolic blood pressure (p=<0.005). Thus, considering the result of present study correlating with other study of various country of world, this can be easily concluded that raised CRP and component of lipid profile are significantly play important role in pathogenesis of Pregnancy Induced Hypertension, but to find out causative factors behind this change, further studies need to be carried out.

Conclusion

In conclusion, based on the results presented in this study we found that high hs-CRP and dyslipidemia were associated with pregnancy induced hypertension.

Recommendation

There is limited number of studies conducted to see the relationship of High-Sensitivity serum C-reactive protein and dyslipidemia in women with pregnancy induced hypertension. So, in the light of these observations, it is suggested that further prospective studies are needed to reach exact conclusions about the performances of these markers in identifying relation of high hs-CRP and dyslipidemia with PIH. Following recommendations are proposed for further studies

- Similar type of study can be done with large sample size.
- Study should be conducted with random sampling techniques.
- Further national multicenter prospective studies can be done.
- Lipid profile and C-reactive protein can be monitored from early pregnancy.
- Knowledge from such studies may contribute to developing behavioral and medical intervention aimed at reducing the occurrence of such complication. Chapter-7.

Limitation of the study

Although optimal care had been tried by the researcher in every steps of the study, but there were some limitations.

- Study was conducted in a single hospital. So, the study population might not represent the whole community.
- The sample was taken purposively. So, there may be chance of bias which can influence the results.
- Sample size was small.
- Limited resources and facilities.
- The present study was done in short period of time.
- The present study was done in late pregnancy only.

Conflict of Interest:
Not available

Financial Support:
Not available

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