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Association of Hypoalbuminemia in Preeclampsia with Maternal and Perinatal Outcomes

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ABSTRACT

Background: Preeclampsia-eclampsia (PE) accounts for 18% of maternal mortality globally, with a frequency of 5–10%. Increased capillary permeability brought on by proteinuria and endothelial degradation reduces albuminemia in PE. Interstitial edema and a drop in blood volume are caused by a reduction in colloid osmotic pressure (PCO), which activates the renin-angiotensin-aldosterone pathway.

Aim: To analyze and appraise the outcomes for mothers and babies in preeclampsia (PE) based on serum albumin levels.

Patients and Methods: At Al Hussein University Hospital, a prospective cross-sectional study was carried out from June to December of 2023. 100 pregnant women with preeclampsia participated in the study. The women were split into two groups: group A had mild hypoalbuminemia with an albumin value of ≤25g/L and group B had severe hypoalbuminemia.

Results: There was significant difference in mild hypoalbuminemia at different times regarding serum albumin that was lower at 35 weeks than 26 weeks and 6-9 weeks and dipstick albuminuria that was higher at 35 weeks than 26 weeks and 6-9 weeks. Also, there was significant difference in severe hypoalbuminemia group at different times regarding serum albumin that was lower at 35 weeks than 26 weeks and 6-9 weeks and dipstick albuminuria that was higher at 35 weeks than 26 weeks and 6-9 weeks.

Conclusion: Pregnancy should be closely monitored for severe hypoalbuminemic pre-eclampsia since it is linked to a higher risk of negative outcomes for both the mother and the newborn than mild hypoalbuminemic pre-eclampsia.

Keywords: Hypoalbuminemia, Preeclampsia, Maternal.

INTRODUCTION

Preeclampsia (PE) complicates 2–5% of pregnancies and is a major cause of maternal and newborn mortality and morbidity [(1)]. Traditionally, proteinuria (PE) is a clinical diagnosis made in women with pregnant hypertension; it is linked to higher rates of morbidity and mortality in the mother or newborn as compared to those without PE [(2)]. Pre-eclampsia is associated with risk factors such as diabetes mellitus, obesity, older age, and history of hypertension [(1)]. Additionally, it occurs more frequently in first-time pregnancies and twin pregnancies. Among other things, the placenta's aberrant blood vessel creation is the fundamental process. Most instances have a diagnosis before to birth. Pre-eclampsia can sporadically start in the postpartum period. While in the past the diagnosis could only be made if there was protein in the urine and high blood pressure, other definitions now include hypertension along with any related organ dysfunction. Prenatal care frequently screens for pre-eclampsia. [(3)]. Hypoalbuminemia and severe PE are frequently present together, and we speculate that hypoalbuminemia could be a marker of the severity of PE. Intravascular dehydration results from hypoalbuminemia, which is primarily caused by systemic small vessel spasm, increased angiotensin secretion, and increased permeability of vascular endothelial cells. These factors cause a large amount of liquid and proteins to leak out of tissue clearance and a loss of a large amount of plasma proteins, particularly serum albumin. Dehydration within the bloodstream might hasten the development of intravascular lesions, which are hypothesized to be a risk factor for hemolysis, increased liver enzymes, low platelet count (HELLP) syndrome, and acute fatty liver of pregnancy. Furthermore, a decrease in hepatic blood flow results in a decrease in albumin synthesis. In two recent investigations, the PE group showed signs of hypoproteinemia during pregnancy in the second trimester prior to the emergence of clinical symptoms. The authors propose that maintaining appropriate blood protein levels throughout the early stages of pregnancy may help avoid PE[(4)]. PE is thought to be the cause of about 50,000 maternal fatalities worldwide each year [(5)]. PE typically occurs in conjunction with other main causes of unfavorable outcomes, such as intrauterine growth restriction (IUGR), placental abruption, and occasionally the necessity for iatrogenic preterm birth [(6)].

Because there is a substantial correlation between proteinuria and the onset of preeclampsia or other syndromes, researchers are interested in the urine protein level of pregnant women [(7,8)]. Plasma volume expansion affects blood biomarker levels in pregnant women. Hypoproteinemia in pregnancy can have a wide range of causes, such as increased kidney clearance, hemodilution, and increased protein consumption for the benefit of the fetus and mother's organs [(9)].

So, we aimed to analyze and appraise the outcomes for mothers and babies in preeclampsia (PE) based on serum albumin levels.

PATIENTS AND METHODS

At Al Hussein University Hospital, a prospective cross-sectional study was carried out from June to

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December of 2023. 100 pregnant women with preeclampsia participated in the study. The women were split into two groups: group A had mild hypoalbuminemia (n = 28) with an albumin value of ≤25g/L and group B had severe hypoproteinemia (n = 72). In this study, a blood albumin concentration of less than 25 g/L was considered severe hypoalbuminemia.

The International Society for the Study of Hypertension in Pregnancy's guidelines for PE definition, blood pressure ≥ 140/90 mmHg on two separate occasions at least four hours apart, and mother age between 20 and 35 years old were the inclusion criteria.

Criteria for diagnosis of severe preeclampsia [10]:

After twenty weeks of gestation, the following symptoms were diagnosed in previously normotensive women:

- Systolic blood pressure ≥160 mmHg or diastolic blood pressure ≥110 mmHg plus proteinuria with or without signs and symptoms of significant end-organ dysfunction.
- Systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg and one or more of the following signs and symptoms of significant end-organ dysfunction:
  1. A recent beginning of a visual or neurological disorder, such as photopsia (light flashes) or scotomata (dark patches or gaps in the visual field).
  2. A severe headache that worsened and persisted despite analgesics, which the patient regarded as the worst headache she had ever had.
  3. A different mental state.
  4. Serum transaminase concentration ≥2 times the upper limit of normal for a particular laboratory, or both; severe, ongoing right epigastric or upper quadrant discomfort that is not responsive to medicine and cannot be explained by any other diagnosis.
  5. Edema of the lungs.
  6. Progressive renal insufficiency (concentration of serum creatinine doubled in the absence of other renal disorders; serum creatinine >1.1 mg/dL).
  7. Platelet count of less than 100,000/microliter.

Exclusion criteria included preexisting proteinuria, essential hypertension, kidney and liver illnesses, twin pregnancies, and other chronic conditions that affect mothers, such as diabetes, autoimmune diseases, and other conditions.

All cases were subjected to detailed history, general and local examination and baseline investigations that included proteinuria assessment by Dipstick screening test: Mission® Expert Urinalysis Strips ACON Laboratories, Inc. Germany, were used to detect proteinuria in a urine sample at the pre-labor room. Spot urine protein: A 5 ml random spot urine sample was collected at the pre-labor room. The sample was analyzed immediately after collection, or stored in aliquots at 4°C until analysis. If particulates were present, the sample was centrifuged and the clear supernatant was used for the assay. Analysis was performed using Cobas® 6000 analyzer. Roche Diagnostics international Ltd., Switzerland. Complete blood count (CBC): 3 mL whole blood EDTA sample was collected at the pre-labor room for CBC analysis that was repeated daily until discharge. Sysmex XN-1000™, Japan, Hematology Analyzer was used. Liver and kidney function tests: 3 cm venous blood was collected at the pre-labor room. Using a Beckman AU640 Clinical Analyzer, serum levels of alanine aminotransferase (ALT), aspartate aminotransferase (AST), creatinine, and uric acid were measured. Serum albumin levels were estimated between weeks 6 and 9 of gestation, at weeks 26 and 35 of gestation, and at each of those times.

The following factors were taken into account while evaluating the maternal outcomes: ascites, oligohydramnios, thrombocytopenia, abruption placenta, eclampsia, HELLP syndrome, hypertension, abnormal liver function, and abnormal renal function.

Neonatal outcomes were assessed based on the following criteria: fetal growth restriction (FGR, defined as actual birth weight below 10% for gestational age), preterm delivery (between 28 and<37 weeks gestation, spontaneous or iatrogenic), and perinatal mortality.

Ethical consideration:

Institutional Review Board approval was attained. Every case received informed permission detailing the purpose and nature of the clinical investigation, the possible risks and rewards of participating in the study, and the subjects' rights as research participants. The subject gave her consent to participate in the clinical trial prior to being admitted, following an intelligible explanation of the study's purpose, scope, and potential outcomes. The participant provided written consent after reading an informed consent statement that was completed in Arabic, had all locally required information, and named the individuals who had informed them.

The personally dated signatures of the participant and the individual leading the informed consent discussions at the moment of consent verified the participants' consent. The written informed consent form and the material provided to participants were presented and explained orally in front of an unbiased witness if the subject was illiterate. Until valid consent was obtained, the investigator did not perform any specific actions needed just for the clinical trial.

This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical Analysis

Versions 8 of Graph Pad Prism and SPSS software (USA) were used to examine the data. The categorical data were presented as number and % and were compared by Fisher exact test and chi square test. Quantitative data were presented as mean ± standard deviation (SD) and were compared, if between 2 groups, by the independent t test and if among more than 2 groups, by one-way ANOVA test followed by Tukey's test as a post-hoc test. At $P<0.05$, the significance level was determined.

RESULTS

Regarding age and BMI, there was no discernible difference between the two groups. (Table 1).

Table (1): Socio-demographic characteristics of the studied groups

Variables	Mild hypoalbuminemia (n=28)	Severe hypoalbuminemia (n=72)	t	P value
Age (years)	28.9 ± 2.5	29.1 ± 2.5	-0.42	0.67
BMI (kg/m$^{2)}$	29.2 ± 2.6	28.7 ± 2.96	0.71	0.47

BMI: Body mass index, Data are represented as mean ± SD, Data were analyzed using independent t test

Regarding prior abortions, delivery methods, platelets <100,000, aberrant hepatic and renal functions, HELLP syndrome, abruptio placenta, ascites, eclampsia, and oligohydramnios, there was no discernible difference between the two groups. Severe hypoalbuminemia was significantly different from mild hypoalbuminemia in terms of gestational age and birth weight, with the former being lower. Additionally, there was a noteworthy distinction between severe and mild hypoalbuminemia in terms of SBP and DBP, with the former being greater (Table 2).

Table (2): Pregnancy outcome of the studied groups

Variables	Mild hypoalbuminemia (n=28)	Severe hypoalbuminemia (n=72)	t/X^2	P value
Gestational age at delivery (weeks)	37.7 ± 1.16	36.08 ± 1.19	6.4	<0.0001*
Previous abortions	8 (29%)	22 (31%)	X^2= 0.04	0.84
Mode of deliveries **CS** **NVD**	 24 (86%) 4 (16%)	 65 (90%) 7 (10%)	X^2=0.43	0.51
SBP mmHg	150.6 ± 3.9	161.7 ± 4.62	-11.1	<0.0001*
DBP mmHg	95.4 ± 2.1	106.9 ± 4.02	-14.3	<0.0001*
Birth weight (g)	2955 ± 182.8	2426.3 ± 135.1	15.8	<0.0001*
Platelets less than 100000	1 (4%)	7 (10%)	X^2= 1.04	0.3
Abnormal liver function	2 (7%)	12 (17%)	X^2= 1.5	0.22
Abnormal renal function	3 (11%)	20 (28%)	X^2=3.3	0.61
HELLP syndrome	1 (4%)	3 (4%)	X^2= 0.01	0.89
Abruptio placenta	1 (4%)	6 (8%)	X^2=0.7	0.4
Ascites	1 (4%)	10 (14%)	X^2= 2.1	0.13
Eclampsia	0 (0%)	3 (4%)	Fisher	0.56
Oligohydramnios	2 (7%)	5 (7%)	X^2=0.001	0.97

Data are represented as mean ± SD or number (%). Data were analyzed using independent test t or chi square test (X^2) and Fisher's exact test.

Regarding FGR and perinatal death, there was no discernible difference between the two groups. NICU hospitalization and premature birth were significantly more common in severe hypoalbuminemia than in mild hypoalbuminemia (Table 3).

Table (3): Short-term neonatal outcome of the studied groups

Variables	Mild hypoalbuminemia (n=28)	Severe hypoalbuminemia (n=72)	X^2	P value
NICU admission	4 (14%)	31 (43%)	X^2= 7.3	0.007*
FGR	2 (7%)	15 (21%)	X^2= 2.6	0.1
Preterm birth	6 (21.4%)	43 (59.7%)	X^2= 11.8	<0.001*
Perinatal death	0 (0%)	6 (8%)	Fisher	0.18

Data are represented as number (%). Data were analyzed using chi square test (X^2) or Fisher exact test

When comparing the laboratory results between the two groups at 6–9 weeks gestation, there was no discernible difference (Table 4).

Table (4): Laboratory data among the studied groups at 6 – 9 weeks of gestational age

Variables	Mild Hypoalbuminemia (n=28)	Severe hypoalbuminemia (n=72)	t	P value
Hb (g/dl)	11.04 ± 0.85	11.03 ± 0.76	0.03	0.97
PLT x10^3/µL	299.6 ± 68.02	310.4 ± 64.5	-0.74	0.45
Uric acid (mg /dl)	4.4 ± 1	4.3 ± 0.82	0.19	0.84
Serum creatinine (mg /dl)	0.76 ± 0.11	0.77 ± 0.13	-0.59	0.55
Serum albumin (g /dl)	3.7 ± 0.2	3.7 ± 0.18	0	1
Dipstick Albuminuria Nil	28 (100%)	72 (100%)	0	1
ALT (u/l)	26.3 ± 6.3	26.1 ± 4.0	0.2	0.88
AST (u/l)	27.2 ± 6.4	26.6 ± 5.9	0.6	0.65

Data are represented as mean ± SD or number (%). Data were analyzed using independent test t or chi square test (X^2)

There was no significant difference between both groups regarding laboratory data at 26 weeks of gestational age except serum albumin that was lower in severe hypoalbuminemia than mild hypoalbuminemia and dipstick albuminuria that was higher in severe hypoalbuminemia than mild hypoalbuminemia (Table 5).

Table (5): Laboratory data among the studied groups at 26 weeks of gestational age.

Variables	Mild hypoalbuminemia (n=28)	Severe hypoalbuminemia (n=72)	t	P value
Hb (g/dl)	10.7 ± 0.81	10.5 ± 0.75	1.2	0.2
PLT x10^3/µL	314.3 ± 64.4	298.8 ± 59	1.14	0.25
Uric acid (mg /dl)	4.6 ± 0.92	4.4 ± 0.8	0.82	0.4
Serum creatinine (mg /dl)	0.82 ± 0.22	0.86 ± 0.21	0.84	0.4
Serum albumin (g /dl)	3.3 ± 0.15	2.8 ± 0.17	12.5	<0.0001*
Dipstick Albuminuria **0** **1** **2**	 11 (39%) 17 (61%) 0 (0%)	 0 (0%) 33 (46%) 39 (54%)	Fisher	<0.0001*
ALT (u/l)	25.7 ± 5.1	25.8 ± 5.6	0.08	0.93
AST (u/l)	25.9 ± 4.7	27.2 ± 4.9	1.2	0.23

Data are represented as mean ± SD or number (%). Data were analyzed using independent test t or chi square test (X^2)

There was no significant difference between both groups regarding laboratory data at 35 weeks of gestational age except HB and serum albumin that were lower in severe hypoalbuminemia than mild hypoalbuminemia and dipstick albuminuria that was higher in severe hypoalbuminemia than mild hypoalbuminemia (Table 6).

Table (6): Laboratory data among the studied groups at 35 weeks of gestational age

Variables	Mild hypoalbuminemia (n=28)	Severe hypoalbuminemia (n=72)	t	P value
Hb (g/dl)	10.4 ± 0.82	9.8 ± 0.65	3.8	<0.0001*
PLT x10^3/µL	287.5 ± 53.4	280.6 ± 50.2	0.06	0.54
Uric acid (mg /dl)	4.4 ± 0.71	4.5 ± 0.85	-0.61	0.53
Serum creatinine (mg /dl)	0.9 ± 0.16	0.95 ± 0.17	1.3	0.18
Serum albumin (g /dl)	2.7 ± 0.15	2.2 ± 0.1	20.04	<0.0001*
Dipstick Albuminuria **1** **2** **3**	 4 (14%) 20 (72%) 4 (14%)	 0 (0%) 0 (0%) 72 (100%)	Fisher	<0.0001*
ALT (u/l)	29.6 ± 5.5	30.4 ± 6.7	0.5	0.57
AST (u/l)	31.1 ± 5.6	31.4 ± 6.1	0.22	0.82

Data are represented as mean ± SD or number (%). Data were analyzed using independent test t or Fisher exact test

There was significant difference in mild hypoalbuminemia between laboratory data at different times regarding HB and serum albumin that were lower at 35 weeks than 26 weeks and 6-9 weeks and dipstick albuminuria that was higher at 35 weeks than 26 weeks and 6-9 weeks (Table 7).

Table (7): Laboratory data among mild hypoalbuminemia at different time intervals

Mild hypoalbuminemia (n=28)					
Variables	**6-9 weeks**	**26 weeks**	**35 weeks**	**F**	**P value**
Hb (g/dl)	11.04±0.85	10.7±0.81	10.4±0.82a	3.3	0.03*
PLT x10^3/µL	299.6±68.02	314.3±68.4	287.5±43.4	0.93	0.39
Uric acid (mg /dl)	4.4 ± 1	4.6±0.92	4.4 ± 0.71	0.48	0.61
Serum creatinine (mg /dl)	0.76 ± 0.11	0.82±0.22	0.9 ± 0.16	2.18	0.12
Serum albumin (g /dl)	3.7 ± 0.2	3.3±0.15a	2.7±0.15ab	225.2	<0.0001*
Dipstick Albuminuria **0** **1** **2** **3**	 28 (100%) 0 (0%) 0 (0%) 0 (0%)	 11 (39%) 17 (61%) 0 (0%) 0 (0%)	 0 (0%) 4 (14%) 20 (72%) 4 (14%)	X^2=101.2	<0.0001*
ALT (u/l)	26.3 ± 6.3	25.7 ± 5.1	29.6 ± 5.5	1.12	0.32
AST (u/l)	27.2 ± 6.4	25.8 ± 1.7	31.1 ± 2.6	1.84	0.16

Data are represented as mean ± SD or number (%), Data were analyzed using ANOVA test or chi square test (X^2), a: significant difference with 6-9 weeks, b: significant difference with 26 weeks

There was significant difference in severe hypoalbuminemia group between laboratory data at different times regarding HB and serum albumin that were lower at 35 weeks than 26 weeks and 6-9 weeks and creatinine, dipstick albuminuria, ALT and AST that were higher at 35 weeks than 26 weeks and 6-9 weeks (Table 8).

Table (8): Laboratory data among severe hypoalbuminemia at different time intervals

Severe hypoalbuminemia (n=72)					
Variables	**6-9 weeks**	**26 weeks**	**35 weeks**	**F**	**P value**
Hb (g/dl)	11.03±0.76	10.5±0.75a	9.8 ± 0.65 ab	47.5	<0.0001*
PLT x10^3/µL	310.4±64.5	298.8 ± 79	288.6 ± 90.2	1.37	0.25
Uric acid (mg /dl)	4.3 ± 0.82	4.4 ± 0.8	4.5 ± 0.85	0.74	0.47
Serum creatinine (mg /dl)	0.77 ± 0.13	0.93±0.1a	1.06 ± 0.48 a	12.4	<0.0001*
Serum albumin (g /dl)	3.7 ± 0.18	2.8±0.17 a	2.2 ± 0.1 ab	1748.2	<0.0001*
Dipstick Albuminuria					
0	72 (100%)	0 (0%)	0 (0%)		
1	0 (0%)	33 (46%)	0 (0%)	X^2=432	<0.0001*
2	0 (0%)	39 (54%)	0 (0%)		
3	0 (0%)	0 (0%)	72 (100%)		
ALT (u/l)	26.1 ± 4.2	25.8 ± 6.1	33.4 ± 4.7 ab	8.15	<0.0001*
AST (u/l)	26.6 ± 4.1	27.2 ± 4.05	31.4 ± 1.1 a	3.68	0.02

Data are represented as mean ± SD or number (%), Data were analyzed using ANOVA test or chi square test (X^2), a: significant difference with 6-9 weeks, b: significant difference with 26 weeks.

DISCUSSION

Preeclampsia (PE) complicates 2–5% of pregnancies and is a major cause of maternal and newborn mortality and morbidity. In contrast to pregnant hypertension, proteinuria (PE) is clinically identified in women with gestational hypertension and is linked to higher rates of morbidity and mortality in the mother or newborn. However, a number of studies have demonstrated that proteinuria does not significantly indicate worse outcomes for mothers and newborns [(11-13)].

In the past, a diagnosis could only be made if there was protein in the urine and high blood pressure; some definitions additionally include hypertension and any related organ dysfunction. Prenatal treatment frequently screens for pre-eclampsia [(14,15)].

Furthermore, a number of studies have revealed no correlation between the severity of preeclampsia and the degree of proteinuria or blood albumin levels, nor between the outcomes of pregnancies in patients with preeclampsia and these variables. It is evident that there is ongoing debate over the diagnostic and assessment of preeclampsia in relation to proteinuria and blood albumin levels [(16,17)].

The aim of this research was to analyze and appraise the perinatal and maternal outcomes in preeclampsia (PE) based on serum albumin levels. We demonstrated that there was no discernible difference in age or BMI between the two groups.

According to **Kamel *et al.*** [(13)] the mean maternal age was 34.66 ± 4.52 years in the moderate group and 34.33 ± 5.02 years in the severe group with non-statistically significant alterations, which is consistent with our findings. Furthermore, **Chen *et al.*** [(18)] demonstrated that there was no statistically significant difference in the two groups of pregnant women's age or BMI (P = 0.17 and 0.23, respectively).

We showed that severe hypoalbuminemia was associated with a higher risk of abruptio placenta, ascites, eclampsia, oligohydramnios, method of delivery, platelets <100,000, abnormal liver and renal functions, and previous abortions more than mild hypoalbuminemia but there was no statistically significant difference between the two groups. Severe hypoalbuminemia was significantly different from mild hypoalbuminemia in terms of gestational age and birth weight, with the former being lower. Additionally, there was a noteworthy distinction between severe and mild hypoalbuminemia in terms of SBP and DBP, with the former being greater.

Chen *et al.* [(18)] demonstrated that women with severe hypoproteinemia (SHP) gave birth over 1.5 weeks earlier than the MHP group (P < 0.01), which is consistent with our findings. The rate of spontaneous delivery was lower and the proportion of CS was higher (P = 0.04 and 0.04, respectively) in the SHP group. In the SHP group, severe hypertension was more common than in the MHP group (P = 0.01). Compared to women in the MHP group, women with SHP were more likely to present with ascites, abruptio placenta, and abnormal hepatic or renal function (P < 0.05).

Furthermore, it was demonstrated by **Kamel *et al.*** [(13)] that women with severe hypoproteinemia gave birth approximately 1.5 weeks earlier than those in the group with mild hypoproteinemia (P = 0.006). 15 (39.5%) cases in the mild group and 1 (8.3%) case in the severe group with vaginal delivery were included in their analysis. Additionally, there were reminder cases with CS connected with 10 (43.5%) cases of urgent CS and 5 (45.5%) cases, with statistically significant differences, as well as reminder cases with CS linked with elective CS.

The rate of spontaneous delivery was lower and the proportion of CS was higher (P= 0.04 and 0.04, respectively) in the SHP group. The mean highest systolic blood pressure during the course of disease was 152 ± 12.5 mmHg in mild cases versus 163 ±10 mmHg in severe cases and diastolic blood pressure was 95±9.8 mmHg versus 106± 11.8 mmHg, respectively, with statistical significant differences. In the SHP group compared to the MHP group, severe hypertension was more common (P= 0.008). There was significant decreased of poor maternal outcomes. SHP was found to be a highly significant risk factor for poor maternal outcomes (P= 0.005).

The results of the current study are also consistent with the research by **Al-Jameil *et al.* [19],** which found that women with severe hypoalbuminemia gave birth nearly 1.5 weeks earlier than those with mild hypoalbuminemia. Both studies demonstrated a significant difference in the gestational age of delivery between the two groups.

According to **Pramana *et al.* [20]**, preeclampsia with severe hypoalbuminemia was linked to a markedly higher risk of low-birth-weight neonates and preterm labor.

According to **Hendrson *et al.* [21]** there was no discernible difference in aberrant renal function between the two groups. Additionally, they did not demonstrate any discernible differences between FGR and aborptio placenta.

Compared to the normoalbuminemic/clinically insignificant hypoalbuminemics subgroups, **Amadi and Amadi[22]** demonstrated that the clinically significant hypoalbuminemics had higher proportions of those with maternal acute kidney injury, sepsis/infection, intensive care unit (ICU) admission, and emergency cesarean sections (p<0.05). When systolic blood pressure, alanine aminotransferase/lactate dehydrogenase activities, plasma creatinine, qualitative dipstick proteinuria, and platelet count were adjusted for, the clinically significant hypoalbuminemic HELLP cases had a higher risk of acute kidney injury (OR:8.456;95%CI: 6.854-11.345), sepsis/infection (OR:4.346;95%CI:2.761-6.709), maternal intensive care unit admission (OR:6.412; 95%CI:4.356-8.104), and emergency cesarean sections (OR:2.308; 95%CI:1.206-3.896) than the normoalbuminemic/clinically insignificant hypoalbuminemic cases.

Chronic fetal hypoxia is the outcome of increased resistance to blood flow from the mother to the fetus caused by placental vascular spasm in PE. Furthermore, loss of the mother's proteins is linked to PE. Low birth weight and intrauterine growth restriction can result from these causes [23,24].

We proved that there was no discernible difference in FGR or perinatal death between the two groups. When comparing the two groups, there was a notable difference in the rates of preterm delivery and NICU admission, with severe hypoalbuminemia being associated with a greater rate than mild hypoalbuminemia

Chen *et al.* [18] demonstrated that the short-term neonatal outcome was worse in the SHP group, which is consistent with our findings. The SHP group had an average birth weight of 2498.1 ± 866.5 g, which was significantly lighter than the MHP group's average birth weight of 2940.1 ± 768.0 g. Preterm births, admissions to the Neonatal Intensive Care Unit, and FGR were more common among the neonates of the SHP group's mothers (P < 0.01). A univariate logistic regression analysis was carried out to better elucidate the relationships between SHP PE and CS, poor maternal and newborn outcomes. According to the findings, SHP was a significant risk factor for poor maternal outcomes (OR 5.83, 95% CI 3.32–10.24), poor newborn outcomes (OR 4.43, 95% CI 2.57–7.62), and CS (odds ratio [OR] 2.99, 95% confidence interval [CI] 1.13–7.91) in women with PE.

Furthermore, **Kamel *et al.* [13]** demonstrated that there was a statistically significant difference between moderate and severe cases in terms of the considerable decrease in poor newborn outcomes. Neonatal outcomes showed that SHP was a significantly significant risk factor (P= 0.040). According to their study, the severe group experienced a statistically significant rise in preterm births when compared to the mild cases, and the severe cases also showed a highly statistically significant increase in fetal growth limitation. The results of the newborns in the SHP group were not as good as those in the MHP group, with a significant difference in preterm delivery (P=0.035) and a highly significant difference in FGR (P= < 0.001).

Furthermore, compared to the normoalbuminemic and clinically insignificant hypoalbuminemic groups, **Amadi and Amadi[22]** demonstrated that the progeny of individuals with clinically significant hypoalbuminemia had greater rates of preterm births, intrauterine growth restriction, birth asphyxia, and admission to the special care baby unit (SCBU) (p<0.05). After adjusting for systolic blood pressure, alanine aminotransferase/lactate dehydrogenase activities, plasma creatinine, qualitative dipstick proteinuria, and platelet count, the offspring of the clinically significant hypoalbuminemic cases also had an increased risk of preterm delivery (OR:6.843;95%CI: 4.346- 8.766), intrauterine growth restriction (OR:3.408;95%CI:2.166-4.988), birth asphyxia (OR:5.233;95%CI:3.764-7.412), and admission to the special care baby unit (OR:2.077;95%CI:1.106-3.674)..

We demonstrated that, with reference to laboratory results at 6–9 weeks gestational age, there was no discernible difference between the two groups. With the exception of serum albumin, which was lower in severe hypoalbuminemia than moderate hypoalbuminemia, and dipstick albuminuria, which was

higher in severe hypoalbuminemia than mild hypoalbuminemia. There was no discernible difference between the two groups' laboratory results at 26 weeks of gestational age.

Only serum albumin and Hb, which were lower in severe hypoalbuminemia than mild hypoalbuminemia, and dipstick albuminuria, which was higher in severe hypoalbuminemia than mild hypoalbuminemia, were significantly different between the two groups in the current study when it came to laboratory data at 35 weeks of gestational age.

By comparing laboratory data collected at different dates, we were able to demonstrate a substantial difference in moderate hypoalbuminemia. Specifically, we found that dipstick albuminuria was higher at 35 weeks compared to 26 weeks and 9 weeks, and that serum albumin and Hb were lower at 35 weeks. Also, we demonstrated that there was significant difference in severe hypoalbuminemia group between laboratory data at different times regarding serum albumin and Hb that was lower at 35 weeks than 26 weeks and 6-9 weeks and dipstick albuminuria, creatinine, ALT and AST that was higher at 35 weeks than 26 weeks and 6-9 weeks.

Brown [25] discovered that the maternal serum albumin level can be utilized to predict the severity of preeclampsia, which is consistent with our research. While not all investigations supported this hypothesis, **Brown *et al.*** [26] also demonstrated a substantial correlation between severe preeclampsia and perinatal death and low serum albumin levels.

Serum albumin levels were found by **Gojnic *et al.*** [27], to be connected with the severity of preeclampsia**.** All patients with severe preeclampsia had values <3.0 g/dL. Additionally, they said that hypoalbuminemia can be recognized as an early indicator of preeclampsia developing.

In comparison to the normoalbuminemic/clinically insignificant hypoalbuminemic subgroups, **Amadi and Amadi**[22] demonstrated that the clinically significant hypoalbuminemics had lower plasma albumin levels and lower platelet counts, but higher mean systolic blood pressure (SBP), alanine aminotransferase (ALT)/lactate dehydrogenase (LDH) activities, plasma creatinine, and qualitative dipstick proteinuria (QDP) levels ($p<0.05$).

Furthermore, there was a highly significant (P value 0.001) difference in platelet concentration (thrombocytopenia) between the two groups in the **Hendrson *et al.*** [21] investigation. But in our investigation, there was no discernible difference between the two groups' platelet concertation (thrombocytopenia).

In contrast to our findings, **Kamel *et al.*** [13] demonstrated that, in the mild group as compared to the severe group, there was a statistically significant decrease in abnormal liver and renal functions, ascites, and placental abruption. Moreover, there was a negligible drop in oligohydramnios, thrombocytopenia, HELLP syndrome, and eclampsia in the moderate case group compared to the severe group. Compared to the MHP group, women with SHP were more likely to exhibit abnormal liver or/and renal function, ascites, and abruptio placenta. This discrepancy could result from various sample sizes, inclusion and exclusion standards, and laboratory methods used in test measurement.

According to **Martell-Claros *et al.*** [28] 13 patients (11 of whom got PE) had hypoalbuminemia, or plasma albumin levels below 3 g/dl. The development of PE was observed to have an RR 1.8 (95% CI:1.01–3.2, $p = 0.036$) for albuminemia values less than 3.3 g/dl in the multivariate regression adjustment binary logistics analysis. The offspring of these expectant mothers had lower birth weights (319 gr, $p < 0.004$) and lower gestational ages (36.7 ± 3 vs. 38 ± 2.4; $p < 0.002$) at delivery.

CONCLUSION

Pregnancy should be closely monitored for severe hypoalbuminemia pre-eclampsia since it is linked to a higher risk of negative outcomes for both the mother and the newborn than moderate hypoalbuminemia pre-eclampsia.

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