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Estimation of Serum Albumin in Pregnant Women in Braithwaith Memorial Hospital, Rivers State, South- South Nigeria

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ABSTRACT: *Serum albumin also known as blood albumin is found in vertebrate blood. A test of serum albumin measures the amount of protein in the clear portion of the blood. The possible levels of serum albumin was determined in a group of pregnant women in their first, second and third trimesters including cases of preeclampsia. Forty five (45) blood samples from pregnant women were collection via venipuncture at the Braithwaite Memorial Hospital Port Harcourt using sterile 5ml syringes. Twenty (20) non-pregnant women blood samples were utilized as control. The Bromocresol green (BCG) binding method was employed. Descriptive statistics, variation plot, mean separation plot using Duncan Multiple Range Test and the single factor ANOVA were used for the analysis of data. Result inter alia revealed that mean values of serum albumin 3.62g/100ml, 3.42g/100ml and 3.25g/100ml correspond with first, second and third trimesters respectively. Preeclampsia and the non-pregnant cases had serum albumin level of 2.73g/100ml and 4.90g/100ml correspondingly. It was discovered that as the gestational age increases so the decrease in the mean serum albumin across the trimesters including preeclampsia cases except the non-pregnant cases. Also, the low level of serum albumin in the preeclampsia patients is a call for concern therapeutically. Thus, pregnant women are encouraged to visit healthcare facilities to ensure early diagnosis and prompt management to prevent morbidity and mortality associated with preeclampsia.*

KEYWORDS: Albumin, Albuminuria, Pregnant women, Serum, Preeclampsia, oedema.

INTRODUCTION

In most animals and plants tissues, proteins are found in blood serum. These proteins are soluble in salt free water, and are moderately soluble in concentrated salt solutions. Generally, in biochemistry, albumin is a simple form of protein that is soluble in water and can coagulate when heated. A good example of albumin includes ovalbumin from egg white, lactalbumin from milk and serum albumin from blood serum among others [1, 2 and 3]. Albumin belongs to a family of globular proteins, and the most common of it is the serum albumins [1 and 2]. They sum-up to about 55-60 % of the protein in human serum and thus ensure normal water balance between blood and tissues via osmotic mechanisms. They also functions as blood transport protein for less soluble substances that can bind to them [4, 3, 5, and 6]. More so, in the blood, albumin aids to prevent the escape of fluid into the body tissues. Albumin is made in the liver and quickly carried to the bloodstream. However, during starvation or liver and kidney disease including excessive burns, hypothyroidism, debilitating disease, malnutrition, polydipsia, protein losing enteropathy, liver disease, insufficient anabolic hormones, among others, loss or decrease of blood albumin could occur due to dropsy or edema. In addition, albumin in urine could be an indication of kidney disease [7, 18, 19 and 20]. More often, some people experience high levels of protein in their urine during pregnancy. When it's accompanied by high blood pressure, it's likely a sign of preeclampsia [21]. Also, in liver disorder (cirrhosis or viral hepatitis), albumin level may fall or rise. Albumin may be elevated in congestive heart failure, glucocorticoid excess, congenitally [18, 19 and 20]. Albumin in blood plasma differs from other blood proteins since they are not glycosynated [8 and 9].

According to [6], human albumin typologies include: (a). human serum albumin which is the main protein of human blood plasma and makes up around 50% of human plasma protein; binds water, cations (Ca^{2+}, Na^{+} and K^{+}), fatty acids, hormones, bilirubin, thyroxine “T4” and pharmaceuticals (including barbiturates) [10]. Its foremost role is to regulate the colloid osmotic-pressure [10 and 11], and the pH of a solution at which the net charge of a protein becomes zero (i.e. the isoelectric point of albumin) is 4.7 [12]; (b) the Alpha-fetoprotein which is a fetal plasma protein that binds various cations, fatty acids and bilirubin while (c) the Vitamin D-binding proteins that binds to Vitamin D and its metabolites, as well as to fatty acids. (d) The afamin which seemingly carries lapidated Wnt proteins and Vitamin E around [13]. (e) Extracellular matrix protein 1 is considered a less recognized albumin that regulates bone mineralization. Consequently, out of these five human albumin typologies, four are well recognized and are arranged on chromosome 4 region4q13.3 in a cycle manner and only the afamin is not well established [14].

Nonetheless, during conception, embryonic and fetal development including birth, the role of albumin is significant as several hormones causes marked changes in pregnant women. Several authorities have posited that decreased level of serum albumin occurs in the third trimester of pregnancy, which may be connected with increased maternal infant mortality and

morbidity [15, 16 and 17] (Table 1). During pregnancy, a potentially dangerous condition that causes high blood pressure (i.e., preeclampsia) could be inevitable. Thus, when high blood pressure in accompanied by high protein levels, preeclampsia is possibly diagnosed, while in some people, it can be diagnosed in the nonexistence of proteinuria. Medically, preeclampsia can be dangerous for both mother and child if it's not treated properly. It can cause placental abruption, fetal growth restriction, organ damage, premature birth, and other severe complications [21].

Table 1: Levels of Serum Albumin in Women (Reference Values during Pregnancy)

Unit	Non-pregnant Female	First Trimester	Second Trimester	Third Trimester
g/dL	4.1-5.3	3.1-5.1	2.6-4.5	2.3-4.2
g/L	41-53	31-51	26-45	23-42

Source:Pernatology.com

MATERIAL AND METHOD

Study Setting

The Braithwaite Memorial Hospital now known as Braithwaite Memorial Specialist Hospital, Port Harcourt, is located at the Old Government Reserved Area (GRA) in the Port Harcourt City Local Government Area of Rivers State. It is about 200-400m away from the Government House main Gate. Port Harcourt has a geographical coordinate of latitude and longitude 4.8396ºN4167 and 6.9112ºE respectively. It lies 9m above sea level with a tropical climate, and a substantial rainfall pattern in most months of the year. It also has a short dry season with little effect. The average annual temperature is 26.4ºC or 79.5ºF with precipitation of about 2708 mm or 106.6 inches per year. The most precipitation occurs in September with an average of 141 mm or 16.3 inches. The driest month is January with 36 mm or 1.4inch rainfall, and warmest month of the year occurs in February, with an average temperature of 26.70 ºC or 81.7ºF (en.climate-data.org).

Collection and Treatment of Sample

Blood samples via venepuncture of forty five pregnant women from the Braithwaite Memorial Hospital, Port Harcourt, were carried out using sterile 5ml syringes. Using clean plastic tubes, 3ml of blood sample were allowed to clot for 2hrs. It was dislodge with the aid of broomstick and centrifuged for 5mins. A Pasteur pipette was used to separate yellowish serum into fresh plastic tubes which was used to determining the patient's albumin level. The remaining 2ml of blood was turned into an anticoagulant bottle, and were properly mixed to

inhibit clothing. This was used in determining patient's haemoglobin level. A similar procedure was adopted with a group of female undergraduate students as a control.

Anthropometric Determination

Weight (kg) and height (m) of each subject were measured using weighing scales and standardized meter. Consequently, the Body Mass Index was computed (BMI) i.e. Kg/m.

Determination, Reagents and Procedure of Haemoglobin

Haemoglobin was determined by the cyanmethemoglobin method using the Drabkin's Solution. 0.2g of Potassium Cyanide (KCN), Sodium bicarbonate ($NaHCO_3$), 1.0g of Potassium Ferricyanide {$K_3Fe(CN)_6$}and 1000ml of distilled H_2O were utilized as reagents.

0.02ml of the whole blood was transferred into 4ml of Drabkin's solution. The sample was allowed to stand for at least 10 mins for colour development, and the absorbance was read at 540nm. The haemoglobin level (g/dl) was deduced from a standard chart.

Principle of Determination, Reagents and Procedure of Serum Albumin

Albumin has close affinity with Bromoscresol green (BCG). Thus, when serum or plasma containing albumin reacts with BCG, it forms a characteristic bluish green colour, which is read at wavelength of 628nm in a spectrophotometer.
The reagents are 0.01mol/l succinate buffer, pH 4.15, 11.8g of succinate acid, 0.60ml/mol BCG stock solution, 100mg/L sodium azide and 419g of BCG, working buffer per solution, 10.0gldl stock albumin standard and albumin working standard.

The stock albumin standard was diluted appropriately with 50mg/l with 100ml sodium azide to give solutions containing 1.0, 2.0, 3.0, 4.0, 5.0, and 6.0 albumin/100ml and store in refrigerator.

5.0ml of the working dye solution was pipetted into a series of numbered test tubes, one for each of the two albumin working standard and one for each unknown. 5.0ml of 0.075 molar succinate buffer pH 4.23 was pipetted into similar series of numbered test tubes to serve as blank. 25ml of each standard and each unknown were added to the appropriately numbered tubes in each series. The mixture were thoroughly mixed and allowed to stand for ten minutes at room temperature. Using a spectrophotometer at wavelength of 627nm, the absorbance of the test samples and standard were read. The blank was used to zero the instrument.

Computation

The level of albumin (gl/100ml) was calculated as:
Albumin (gl/100ml) A Sample x Conc. of Standard

A Standard

Where A = Absorbance; Concentration of standard = 0.060g/ml

Data Analysis

Statistical analyses were performed using IBM SPSS version 25.0. Percentage and Chi Square were used to analyze the research questions while Pearson's Product-Moment correlation was used to analyze the relationship between the prevalence and compliance to tuberculosis treatment over the graded period of study.

RESULT

Descriptive Statistics in Weight, Height, Body Mass Index (BMI) and Serum Albumin in Pregnant Women

There were variations in levels of the vital signs and blood samples of the pregnant women across trimesters. The highest body weight of 71.20 kg occurred in second trimester while the least (5.51kg) occurred at the Non-pregnant (Control) (Table 2). However, a weight of 69.00kg occurred at preeclampsia. A slightly elevated height of 1.74m was recorded in first trimester. The body mass index (BMI) of pregnant women also shows slight variation across the trimesters. The highest BMI (24.66) kgm^{-2} was recorded in the second trimester while the lowest of 23.13 kgm^{-2} was recorded in the first trimester. The non-pregnant had a BMI of 21.49kgm^{-2} (Table 1.2 and Figure 1).

Table 2: Descriptive Statistics of Weight (kg), Height (m), BMI (kg/m^2) and Serum Albumin (g/100ml), in Pregnant Women

Parameter	1st Trimester	2nd Trimester	3rd Trimester	Pre-eclampsia	Non pregnant
S. Albumin	3.62	3.42	3.25	2.73	4.90
HGB	9.50	8.96	8.93	9.27	12.41
BMI	23.13	24.66	23.86	25.87	21.49
Height	1.74	1.69	1.69	1.64	1.60
Weight	68.83	71.20	66.47	69.00	56.51

HGB=Haemoglobin (g/dl), BMI=Body Mass Index.

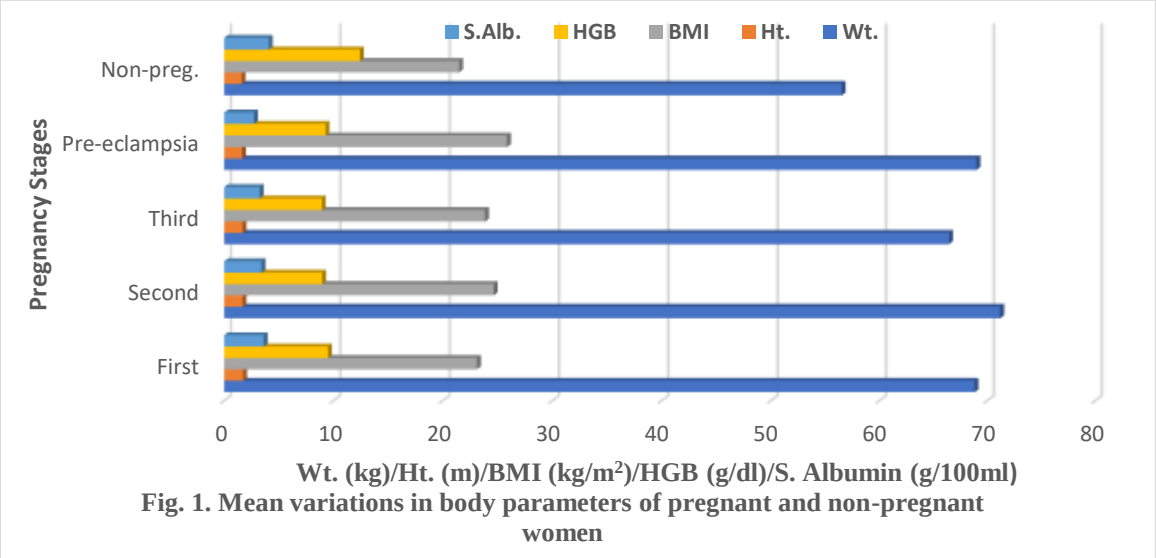

Fig. 1. Mean variations in body parameters of pregnant and non-pregnant women

Mean Separation of the Parameters [Weight, Height, Body Mass Index (BMI) and Serum Albumin] between Preeclampsia; 1, 2 and 3 Trimesters; and the Non-Pregnant Women.

A Post-hoc mean separation using Duncan Multiple Range across sample parameters in Pregnant Women revealed that there was significant difference in weight between first and second trimester (1/2 Trimester.) and second and third trimester (2/3 Trimester) respectively. Also, the observed spatial difference in height across sampled parameters occurred between first and second trimesters (1/2 Trimesters) including preeclampsia and the control (Non-pregnant) (Pre./Non-P) (Table 3). There was no spatial difference in the body mass index (BMI) across the various sample parameters at $P<0.05$ (Table 3). Furthermore, haemoglobin shows similarities across the three trimesters (1/2/3 Trimesters) i.e., no significant difference across trimesters whereas preeclampsia and non-pregnant women showed dissimilarities i.e., there was significance difference. Finally, the Serum albumin indicated both similarities and dissimilarities across sampled parameters. Similarity occurred between first and second trimester (1/2 Trimesters) while dissimilarities occurred between first/second Trimester and Third Trimester (1/2 and 3), 3 and preeclampsia, and preeclampsia and Non-pregnant women respectively (Table 3).

Table 3: Post-hoc Mean Separation using Duncan Multiple Range Test for Weight, Height, Body Mass Index (BMI) and Serum Albumin in Pregnant Women

Parameter	1st Trimester	2nd Trimester	3rd Trimester	Preeclampsia	Non pregnant
Weight	68.833[a]	71.200[b]	66.467[a]	69.00[b]	56.510[a]
Height	1.742[b]	1.689 [ab]	1.687[ab]	1.643[ab]	1.601[a]
BMI	23.133[a]	24.660[a]	23.860[a]	25.867[a]	21.490[a]
HGB	9.500[a]	8.960[a]	8.933[a]	9.267[a]	12.410[b]
S. Albumin	3.617[c]	3.420b[c]	3.247[b]	2.733[a]	4.085[d]

***Values with same superscript along same rows are not significantly different at P<0.05, S. Albumin=Serum Albumin, HGB=Haemoglobin.**

Variation of Preeclampsia, Gestation and Blood Pressure of Pregnant Women

The descriptive statistics of the preeclampsia, gestation and the blood pressure of pregnant women sampled indicated variations in weight, height, haemoglobin and serum albumin. At age 17, 24 and 32years, there were observed preeclampsia cases having a corresponding body mass index of (BMI) of 35.70kg/m^2, 21.60kg/m^2 and 20.30kg/m^2 respectively (Table 4). Amid these three ages, least Serum albumin of 2.70g/100ml was recorded in age 17years and 32years respectively while the greatest BMI of 2.80g/100ml was recorded in age 24 years. The aged 17years and 24years had blood pressure of 140/90mmhg correspondingly, with an indication of the presence of protein (proteinuria) while that of 32years had a blood pressure of 130/70mmHg with the presence of proteinuria. At the gestation period of 7months (3rd Trimester), serum albumin was 3.33g/100ml with a BMI of 14.90 kgm^{-2} whereas at 4 months gestation period (2nd Trimester), Serum albumin was 3.70g/100ml with a BMI of 30.50 kgm^{-2} congruently (Table 4).

Table 4: Values of Preeclampsia

Age (Yrs.)	GA (mo)	Weight (m)	Height (m)	BMI (kg/m^2)	Haemo-globin (g/dl)	Blood Pressure ((mmhg)	Urine Test	Serum Albumin (g/100ml)
19	7	50.00	1.83	14.90	9.30	130/90	-	3.33
33	4	81.00	1.63	30.50	9.70	140/90	-	3.70
17	PE	89.00	1.58	35.70	9.70	140/90	++	2.70
24	PE	64.00	1.72	21.60	9.40	140/90	++	2.80
32	PE	54.00	1.63	20.30	8.70	130/70	++	2.70

GA=Gestational Age, mo=Month, PE = Preeclampsia, BMI=Body Mass Index, Yrs.=Years, ++ = Present of Protein, - = Absent of Protein, + = Trace of Protein, 1-3 = 1st Trimester, 4-6 = 2nd Trimester, 7-9 = 3rd Trimester.

The test of homogeneity in mean variance of the BMI across the pregnant and non-pregnant women using the single factor analysis of variance (ANOVA) revealed significant heterogeneity {F $(_{1.321})$ > Sig. $(_{0.273})$} at P<0.05 (Table 5).

Table 5: ANOVA

		Sum of Square	df	Mean Square	F	Sig.
BMI	Between Groups	126.567	4	31.642	1.321	.273
	Within Groups	1412.882	59	23.947		
	Total	1539.449	63			

DISCUSSION

Serum albumin commonly called blood albumin in human is encoded by the ALB gene [22, 23 and 24]. Other mammalian albumins like bovine albumin are similar chemically. The liver produces serum albumins which are dissolved in blood plasma, containing about 55%, and the most abundant blood protein in mammals. Blood proteins serve as transport of lipids, hormones, vitamins and minerals, and also assist immune systems [25, 26, 27 and 28]. In the current study, there were significant heterogeneity among first, second and third trimesters including the non-pregnant women. 3.617g/100ml, 3.420g/100ml and 3.247g/100ml representing the first, second and third trimesters congruently whereas 4.90g/100ml represents non-pregnant women. However, this variability's were within the normal range of 3.1-5.1g/100ml. The current work corroborate with the views of [29, 30, 31 and 32] respectively. Again, Serum albumin decreases from 3.617g/dl (first trimester) to 3.420g/dl (second trimester) to 3.24g/dl (third trimester). The nexus for this decline as observed in this study is that at late pregnancy, there is an increase demand of food by the fetus as the baby gets older. The result obtained in this study is in agreement with [42] who maintained that the level of Serum albumin decreases in late pregnancy.

Hemoglobin carries oxygen and carbon dioxide via the red blood cells to other part of the body. It serves as a modulator of erythrocyte metabolism, oxidation as an onset of erythrocyte senescence and its implication in genetic resistance to malaria, enzymatic activities and interactions with drugs, and as source of physiological active catabolites [33]. During pregnancy, the volume of blood in the body increases and so does the amount of iron need [34]. The levels of hemoglobin during the first trimester of pregnancy are linked with risk of gestational diabetes mellitus, preeclampsia, and preterm birth in Chineese women [35].

Normal physiologic range for hemoglobin during pregnancy is 11.50 – 13.00 (13.50)g/dl according to [36]. The hemoglobin levels in the present study of 9.50g/dl (First Trimester), 8.96g/dl (Second Trimester) and 8.93g/dl (Third Trimester) were significantly low including that of the preeclampsia (9.27g/dl). Only the non-pregnant women fall on the normal range of 12.41g/dl. Iron deficiency could be responsible for this underlying influence and thus, corroborate with that of [36 and 37] correspondingly. Iron deficiency anaemia during pregnancy can make you feel weak and tired [36].

In pregnancy, preeclampsia is a hypertensive disorder connected to 2% to 8% of pregnancy-related complications worldwide [37 and 38]. The systolic and diastolic interface of 140mmHg is to 90mmHg parameter or more on two occasions of at least four (4) hours apart underscore the identification of preeclampsia [38, 39, 40 and 41]. In this study, samples number 32, 33 and 34 exhibited preeclampsia compliance with corresponding blood pressure of 140/90mmHg each. However, sample numbers 33 and 34 (i.e., patients) had presence of protein in their urine which could create more complication if not monitored and controlled.

The body mass index (BMI) is a person's weight expressed in kilogrammes (or pounds) all over the square of height in meters (or feet). A high body mass index can possibly indicate high body fatness [43]. BMI monitors for weight categories that could lead to health problems, but it does not diagnose the body fatness or health of an individual [43]. According [44], a BMI below 18.50 is under-weight; 18.50-24.9 is healthy weight, 2.50-29.9 is overweight and 30.00 and above is obesity. However, the study in-view indicated that the first trimester had BMI of 23.13kg/m^2, second trimester (24.66 kg/m2,), third trimester (23.86 kg/m^2), preeclampsia (25.87 kg/m) and non-pregnant women (21.49 kg/m^2) respectively. These values fall between the normal range and therefore define well-nourished pregnant and non-pregnant women according to [44 and 45].

SUMARRY OF FINDINGS

1. Serum albumin decreases as the gestation increases across trim esters
2. Albeit, serum albumin value in this study is low, but it is still found within the normal range values (3.1-5.1)g/100ml.
3. At third trimester, there is an increase demand of food by the fetus which implies that pregnant women at that stage needs more nutritious diet (healthy food) to create a balance.
4. Hemoglobin values outside the normal range are associated with complications during pregnancy and with growth retardation of the fetus.
5. The normal physiologic range for hemoglobin during pregnancy is 11.5-13.0 (13.5) g/dl.

6. During pregnancy, there are characteristics changes in the hemoglobin and hematocrit values.
7. Preeclampsia is a hypertensive disorder connected to 2% to 8% of pregnancy-related complications worldwide that need monitoring and control whenever it is observed in the pregnant women.

CONCLUSION

The study has made known that serum albumin decreases from 3.617g/dl (first trimester) to 3.420g/dl (second trimester) to 3.24g/dl (third trimester). This relationship implied that the gestational period of a woman affects the metabolism of albumin in particular, and other food taken in general. Therefore, it is essential that pregnant women supplement their diet with protein and iron as revealed by the results from the hemoglobin concentration. The very low level of serum albumin (2.73g/dl) in preeclampsia patients signals a course for concern medically.

RECOMMENDATION

1. A balance diet is need more by pregnant women mostly at the third trimester to cushion the effect of fast developing baby on the mother.
2. Pregnant women should be encouraged to take good nutritional diet that will not only satisfy their taste but also the healthy status of their fetus.
3. Early diagnosis and prompt management are essential to prevent morbidity and mortality associated with preeclampsia.
4. Iron therapy or routine iron supplementation can influence its incidence of hemoglobin deficiency.
5. There should be continuous education and sensitization awareness campaign of women mostly pregnant mothers to attend antenatal services to ascertain their health or medical condition at all time.

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COMPETING INTEREST

Authors have declared that no competing interests exist.

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