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Plasma Total Protein and Albumin Assessment amongst Apparently Healthy Young Adults of Niger Delta University

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***Abstract*— The aim of this research was to assess the synthetic function of the liver amongst apparently healthy students of Niger Delta University. An analytical cross-sectional study on 102 individuals (55 males and 47 females) between ages 20-40 was conducted. An interviewer-administered questionnaire was used to collect data on the socio-demographic characteristics and probable risk factors of disease. Blood specimen was collected for measurement for total protein and albumin concentration. Result revealed that the female albumin and total protein value was found higher than the male value with a mean ± standard deviation of 39.47±1.16 and 67.98±8.16 (female) and 38.55±7.21 and 67.75±10.02 (male) but was not statistically significant at p<0.05. The albumin and total protein value of individuals between 20-30 years was higher than the albumin and total protein value of individuals between 31-40 years. The result also showed majority of the respondents were within the normal laboratory reference ranges for albumin (35-50g/L) and total protein (62-80g/L). In conclusion, these results indicates hepatic synthetic function amongst majority of the studied respondents.**

***Index Terms*— Plasma Total Protein, Plasma Albumin, Hepatic synthetic function.**

I. INTRODUCTION

The liver is an organ found in vertebrates which function to detoxify various metabolites, synthesize proteins, regulate glycogen storage, decompose red blood cells and produce biochemical molecules such as hormones etc.[1] In humans, the liver is located in the right upper quadrant of the abdomen, below the diaphragm. Also, the liver a highly specialized tissue consisting of mostly hepatocytes regulates a wide variety of high-volume biochemical reactions, including the synthesis and breakdown of small and complex molecules, many of which are necessary for normal vital functions. [2] The liver is formed by parenchymal cells (hepatocytes and bile ducts cells) and non-parenchymal cells (sinusoidal endothelial cells, Kupffer cells, and hepatic stellate cells) that together synchronize the vital functions in liver homeostasis. The production of plasma proteins is a major specialized function of the liver, plasma proteins representing roughly one-fifth of the hepatocytes' protein synthetic activity. The liver carries out metabolism of carbohydrate, protein and fats .[2] Some of the enzymes and the end products of the metabolic pathway may be useful as biochemical marker of liver dysfunction such as serum bilirubin, plasma proteins, alanine amino transferase, aspartate amino transferase, ratio of aminotransferases, alkaline phosphatase, gamma glutamyl transferase, 5′ nucleotidase, ceruloplasmin, α-fetoprotein. The liver plays the major role in producing proteins that are secreted into the blood, including major plasmaproteins, factors in hemostasis and fibrinolysis, carrier proteins, hormones, prohormones and apolipoproteins.[3]

Total Protein concentration reflects all of the different proteins in plasma with the exception of those that are consumed in clot formation, such as fibrinogen and the clotting factors. Over 1000 individual proteins have been characterized in serum.[2] Most are not biochemically pure proteins, but are proteins combined with other substances. The plasma proteins, albumin, alpha and beta globulins, clotting factors, carrier proteins, hormonal factors, growth factors, bile acids, cholesterol and phospholipids are the major biomolecules synthesized by the liver.[4] The plasma proteins include albumin, globulin and fibrinogen fractions. The different plasma proteins can be separated by electrophoresis or their speed of sedimentation.The globulin fraction is comprised of α-globulins (haptoglobin), β-globulins and ¥-globulins (immunoglobulins).Albumin, fibrinogen, the α-globulins and most of the β- globulins are synthesised in the liver, while the ¥-globulins are produced as a result of antigenic stimulation of plasma cells and B lymphocytes in lymphoid tissue.[4]Plasma proteins serve different functions, including transport of lipids, hormones, vitamins and minerals and in the functioning of the immune system.[5]Fatty acids and bilirubin are transported mainly by albumin, whereas cholesterol and phospholipids are carried by the lipoproteins present in β-globulins which also transport fat-soluble vitamins (A, D, K, and E).[6] In addition to lipids, plasma proteins also transport several metals and other substances α2-Globulins transport copper (Ceruloplasmin), bound hemoglobin (haptoglobin) and thyroxine (glycoprotein) and non-heme iron is transported by transferrin present in β-globulin fraction. Calcium, Magnesium, some drugs and dyes, and several cations and anions are transported by plasma albumin. Plasma proteins also function to control oncotic pressure, and promote inflammation and the complement cascade.[7] Changes in plasma protein levels are due mostly to changes in albumin concentration. Plasma protein concentrations result

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in a variety of clinical signs and systemic effects and are associated with a number of disease processes.[7] Plasma proteins exert an osmotic pressure of about 25 mm of Hg and therefore play an important role in maintaining a proper water balance between the tissues and blood. Plasma albumin is mainly responsible for this function due to its low molecular weight and quantitative dominance over other proteins. During the condition of protein loss from the body as occurs in kidney diseases, an excessive amount of water moves to the tissues producing edema. Plasma proteins are indispensable for maintaining many important functions of living cells as in the buffering action of various body fluids and blood coagulation. They help in maintaining the pH of the body by acting as ampholytes. At normal blood pH, they act as acids and accept cations.[8]The Prothrombin present in α2-globulin fraction and fibrinogen, participate in blood clotting process[6] Plasma protein may be useful in nutritional assessment acting as a source of protein for the tissues, whenever the need arises. Plasma protein markers, most notably albumin, have demonstrated significant value in assessing nutritional status and predicting outcomes in the setting of patients considered for elective surgery.[9] Unfortunately the value of serum protein levels as indicators of nutritional status is extremely limited during the acute-phase response to injury, inflammation, infection, and surgical stress.

Plasma Albumin: This is the most abundant class of plasma proteins (2.8 to 4.5 gm/100ml) with highest electrophoretic mobility.[10] It is soluble in water and is precipitated by fully saturated ammonium sulfate. Albumin is synthesized in the liver and consists of a single polypeptide chain of 610 amino acids having a molecular weight of 69,000 kda. It is rich in some essential amino acids such as lysine, leucine, valine, phenylalanine, threonine, arginine and histidine. The acidic amino acids like aspartic acid and glutamic acid are also concentrated in albumin. The presence of these residues makes the molecule highly charged with a positive and negative charge. Besides having a nutritive role, albumin acts as a transport carrier for various biomolecules such as fatty acids, trace elements, and drugs. Another important role of albumin is in the maintenance of osmotic pressure and fluid distribution between blood and tissues. Albumin is a family of globular proteins, the most common of which are the serum albumins..[11] All the proteins of the albumin family are water-soluble, moderately soluble in concentrated salt solutions, and experience heat denaturation. Albumin is commonly found in blood plasma and differ from other blood proteins in that they are not glycosylated. Substances containing albumin, such as egg white, are called albuminoids. A number of blood transport proteins are evolutionarily related, including serum albumin, alpha-fetoprotein, vitamin D-binding protein and afamin. Albumin binds to the cell surface receptor albondin. Serum albumin is the main protein of human blood plasma. They serve as carriers for molecules of low water solubility this way isolating their hydrophobic nature It binds lipid-soluble hormones, bile salts,unconjugated bilirubin, cations (such as Ca^{2+}, Na^{+} and K^{+}), fatty acids(apoprotein),transferin, thyroxine (T4) and pharmaceuticals (including drugs like barbiturates,warfarin, phenobutazone, clofibrate and phenytoin). The normal range is 3.5 to 5.5 g/dL or 35-55 g/liter..[11] This range may vary slightly in different laboratories.. Its main function is to regulate the oncoticpressure(colloid osmotic pressure) of blood. The isoelectric point of albumin is 4.9..[11] Plasma albumin is the most abundant blood protein and is produced in the liver, it normally constitutes about 50% of human plasma protein.Plasma albumin is seldom decreased in acute hepatitis, because of its long circulating half-life of.21days. Abnormally high albumin levels are seldom clinically important [12]. Decreased serum albumin usually indicates liver disease of more than 3 weeks duration. Increased serum albumin levels are seen only with dehydration or after excessive albumin infusion.

The abnormalities of the plasma proteins are likely to cause more or less functional disorders of the living cell. The pathology of tissues may be reflected in plasma protein changes..[13] Changes in plasma protein concentration are extremely valuable to evaluate the pathophysiological background of an individual especially as it relates to liver function.[14] Majority of adults including student in the health sector are either not aware of their current health status or have poor health seeking behaviour. Disturbances in biochemical metabolism predispose most people to high risk of morbidity and mortality either from functional disorders or resultant hepatic failure. These conditions would have been prevented by early detection. Therefore this study will not only be useful in assessing morbidities like hepatic failure but will create awareness as to modifying lifestyles and engaging in preventive measures aimed at retarding and forestalling complications associated with hepatic synthetic failure.

II. METHODOLOGY:

A. Participants: This was a cross-sectional study carried out amongst the students of the College of Health Sciences, Niger Delta University, Bayelsa State from August to November 2019.The study was approved by our institutional research and ethics committee after explaining the objectives and benefits of the study. Written and informed consent was sought and obtained from each participant before the study. A total of 102 apparently healthy students of the Niger Delta University Bayelsa state, aged within 20-40years were recruited into the study. This was done due to the proximity of investigators and easy contact to the referral hospital for further treatment of cases that may be discovered during survey. No participant was under any form of medication likely to influence any of the parameters under investigation. A general examination was carried out on each participant to rule out fever or jaundice. Structured questionnaire was used in the collection of selected demographic data which includes age, sex and history of alcohol abuse/medications. Pregnant individuals and those

with acute/chronic diseases were excluded from the study.

B. Sample collection: An overnight fast and the avoidance of caloric and caffeinated drink was advised, after which about 3mls of venous blood was collected into a lithium heparin anticoagulant bottle. The blood specimen was centrifuged at 3500rpm and supernatant plasma collected. The plasma samples was stored at 2-8^{0}C until ready for analysis. All analysis were done within 24hrs of sample collection at room temperature. The preanalytical, analytical and post analytical phases of analysis were controlled throughout the study.

C. Method: Plasma total protein and Albumin were determined manually by Turbidimetric[15]and Bromocresol Green method [16]respectively.

Statistical Analysis:

The statistical analysis of raw data obtained was done using SPSS version 23 software application. The frequency of risk factors was analysed by tables and graphical representation. Comparison of groups was done by one way ANOVA and results were expressed as mean± Standard Deviation (SD). Probability or P-value will be set at 0.05 or 5% confidence interval.

III. RESULTS

The result of the present study are presented in table 1, 2, 3 and 4. Table 1 shows the demographic characteristics of studied participants. A total of 102 respondents which comprises of 55 males and 47 females were interviewed. The age groups was between 20-30 and 31-40 years. Majority of the respondents 99(97%) were aged between 20-30 years which comprises of 53(53.54%) for males and 46(46.46%) for females. Only 3(3%) of respondents were between 31-40 years which comprises of 1(33.33%) for male and 2 (66.67%) for female..

Table 1: Demographic characteristics of studied participants

		AGE GROUP	
GENDER	**N (%)**	**20-30**	**31-40**
		N (%)	**N (%)**
MALE	55 (53.92)	53 (53.54)	1 (33.33)
FEMALE	47 (46.08)	46 (46.46)	2 (66.67)
TOTAL	**102 (100)**	**99**	**3**

Table 2 shows the gender relationship of respondents with albumin and total protein level. The female albumin value was found higher than the male value with a mean ± standard deviation of 39.47±1.16 (female) and 38.55±7.21 (male) respectively(p-value was 0.54), Similarly, the female total protein values was higher than the male total protein value with a mean ± standard deviation of 67.98±8.16 (female) and 67.75±10.02 (male) respectively (p-value was 0.91) However, the gender differences in both albumin and total protein were not statistically significant.

Table 2: Comparison of gender of respondents with Albumin and Total protein

Parameter	gender	Mean±SD	SEM	p-value	Remark
Albumin (g/L)	male (n)	38.55±7.21	0.97	0.54	NS
	female (n)	39.47±1.16	1.16		
Total Protein (g/L)	male (n)	67.75±10.0	1.35	0.91	NS
	Female (n)	67.98±8.16	1.19		

Key:SD= Standard deviation, SEM= Standard Error of Mean, S=Statistically significant(p<0.05,) NS = Not Statistically significant

Table 3 compared of age group distribution of respondents with albumin and total protein levels. The albumin value of respondents between 20-30 years was found higher than the albumin value of respondents between 31-40 years with a mean ± standard deviation of 38.21±2.41 (20-30 years) and 34.33±2.52 (31-40 years) respectively with a p-value of 0.56.Similarly, the total protein values of respondents between 20-30 years was higher than the total protein value

of respondents between 31-40 years with a mean ± standard deviation of 68.00±2.41 (20-30) and 65.33±9.07 (31-40) respectively (p-value = 0.89). which shows that the result was not statistically significant. However, the age group differences in both albumin and total protein were not statistically significant.

Table 3: Comparison of Age group distribution with Albumin and Total Protein level

Parameter	Age group	Mean±SD	SEM	P-value	Remark
Albumin (g/L)	20-30	38.21±2.41	0.96	0.56	NS
		34.33±2.52			
	31-40		0.72		
Total Protein (g/L)	21-30	68.00±2.41	1.32	0.89	NS
		65.33±9.07			
	31-40		1.28		

Key:SD= Standard deviation, SEM= Standard Error of Mean, S=Statistically significant(p<0.05,) NS = Not Statistically significant

Table 4 compared the albumin and total protein levels with their standard reference ranges. The laboratory reference ranges for this study was 35-50g/L for albumin and 62.80g/L for total protein level. When compared to the laboratory reference ranges for albumin, a high number of respondents (77) fell with normal reference range with a mean ± Standard deviation of 39.79±2.82, while 23 respondents were below the normal reference range with a mean ± Standard deviation of 30.54 ± 3.81 and 2 respondents were higher than the normal reference range with a mean ± Standard deviation of 62.50±13.45. P-value was 0.63.Similarly, for the total plasma protein, a high number of respondents (79) fell within the normal reference range with a mean ± Standard deviation of 69.68±4.47, while 17 respondents were below the normal reference range with a mean ± standard deviation of 52.53 ±5.32 and 6 respondents were higher than the normal reference range with a mean ± Standard deviation of 85.29±4.35 with a p-value of 0.94, which shows that these differences were not statistically significant.

Table 4: Comparison of albumin and total protein level with standard reference ranges

Parameters (g/L)		N	Mean±SD	SEM	P-value	Remark
Albumin (g/L)	Normal	77	39.79±2.82	0.92		
			30.54±3.81		0.63	NS
	Low	23	62.50±13.4	0.81		
	High	2		1.12		
Total Protein (g/L)	Normal	79	69.68±4.47	1.30		
			52.53 ±5.32		0.94	NS
	Low	17	85.29±4.35	1.02		
	High	6		1.48		
Total		**102**				

Reference ranges: Albumin =35-50g/L Total protein = 62-80g/L

IV. DISCUSSION

Plasma proteins including albumin are indispensible in maintaining many important functions of living cells. They are produced by the liver such that changes in their concentration are extremely valuable in the evaluation of the pathophysiological background of an individual. The results obtained from measurement of these parameters under study were done using similar analytical methods and units of measure as those in literature with quality control measures assured[15,16].Age and sex estimation and variation in serum albumin and total plasma levels serve as useful biochemical marker of hepatic function.[17] When there is decreased level of albumin greater than 21days (its half life), then liver disease may be implicated.[12]

In this study, the female albumin and plasma levels were observed to be higher than their male counterparts but not significant statistically. This result is in agreement with Ohwada et al[18] who revealed significantly higher albumin levels in women than men as in 23.8% and 11.8% of them respectively. The reverse was seen in a population study in Kenya[19] and by Joven et al[20] where male plasma protein were found to be higher than females. The not statistically significant gender difference in this study is however of no known clinical consequence.

When age groups were compared, higher values of albumin and plasma protein were observed in the 20-30year age group than 31-40years group. This corresponds to report by Sative et al[21] who showed lower albumin and total protein levels in older age groups. Contrary to this was previous study by Larsliad et al[22] who reported that majority of respondents had elevated protein with increasing age, this was attributed to a probable reduction in glomerular filtration rate.

From our study,77 (75%) and 79(77%) of participants had within normal reference values in terms of albumin and total plasma protein levels respectively. This is in keeping with

reports by kasia et al[23] where in majority of health workers studied (90%) and (52%) were within normal reference values in terms of albumin and total plasma protein levels respectively. This study also corroborates with that of Akinosun et al[24] amongst health workers of UCH and petrol attendants in Ibadan metropolis where majority of them had normal liver function test.

Surfice it to say that both plasma protein and albumin levels showed similar variation in the studied respondents especially with respect to age and sex and supported by previous studies. This could be attributable to the fact that changes in plasma protein levels are often due to changes in albumin concentrations since it constitutes over 50% of the total plasma protein physiologically.Geyer et al.[7]

V. CONCLUSION

The high level of normalcy in terms of albumin and total plasma protein values in the studied participants indicates a healthy population with low risk of hepatic dysfunction.

VI. RECOMMENDATION

Estimation of reference range for age and sex should be suggested and regular screening exercise should be advocated to detect those that may be at risk of hepatic dysfunction.

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