SERUM PROTEINS IN INFANTS

Pages with reference to book, From 251 To 255

Shaukat Ali Orakzai (Deptt. of Bio-chemistry, Ayub Medical College, Abbottabad.)
Khurshid Ahmed Siddiqui, Abdul Karim Saeed (Deptt. of Medicine7, Ayub Medical College, Abbottabad.)
Muhammad Ayub (Deptt. of Physiology, Ayub Medical College, Abbottabad.)

Abstract

Total serum proteins and its major fractions, albumin and globulins, were estimated in 700 infants from birth to 18 months of age, in relation to age, sex and dietary pattern. The values of total serum proteins and albumin showed a gradual increase with age. No difference was evident between two sexes. Serum globulins, however, were high at birth and showed a decrease at the age of 3 months, after which they increased and an adult level was attained at the age of 18 months.
Completely breast.fed infants had a significantly higher total serum proteins and albumin at the age of 3 and 6 months than artificially fed infants but no such difference was found in serum globulins level in same age groups (JMPA 37: 251 1987).

INTRODUCTION

Undernutrition is the primary cause of high rates of infant and child morbidity and mortality in developing countries. The adequacy of nutrition in infants is therefore, crucial to their well-being throughout life. Infants, adequately nourished, achieve a normal rate of physical and mental development whereas those inadequately nourished in respect to one or more nutrients, may experience stunted growth and other biochemical changes associated with undernutrition. In this respect the importance of proteins in world nutrition has been much emphasized during the last few decades with, of course, the identification of protein deficiency condition, Kwashiorkor, to which infants being weaned and young children aEe especially vulnerable. This form of malnutrition is probably the most serious cause of ill-health in underdeveloped regions of the world,
Moreover, the rapid accumulation of paediatric literature describing the occurrence in children of recognized clinical entity-congenital agammaglobulinemia[1,2] has stimulated further research into changes in serum proteins and its fractions, produced by other illnesses in patients in paediatric age group. To investigate changes in serum proteins in pathological states in infants and children it is necessary to first establish the normal range of values of serum proteins in healthy infants and children[3,4].
This communication presents data of serum protein and its fractions, albumin and globulins, in specified number of healthy infants and children from birth to 18 months. Moreover, the study is undertaken to establish a base-line for use in interpreting serum protein changes that may occur with age, sex and dietary pattern.

MATERIALS AND METHODS

The study includes data on the fractionation of serum proteins of 500 healthy infants and children at ages ranging from birth through 18 months. Random samples of 100 each of completely breast-fed and completely weaned infants at age of 3 and 6 months were also collected. Random samples of 100 adult males and females were collected and the values of total serum proteins, albumin and globulins were determined and used as standards for comparison. The data were collected during year 1984 — 1986. Although the subjects were apparently normal, the ‘normality’ of all subjects was checked by

determination of haemoglob in, erythrocyte sedimentation rate, and red and white cell count. If any of these values varied markedly from the accepted normal levels, the subjects were excluded from the study. Subjects with congenital diseases, skin infection or parasites in stools were excluded from the study. Those included in the study belong to average socio -economic group.

Blood samples were drawn by venipuncture and, after clotting, serum was immediately separated by centrifugation. When it was not possible to perform the tests immediately, the serum was stored by freezing for not more than 24 hours.

Total serum proteins were estimated by Biuret method[5], albumin by method of Daumas and Biggs[6] and total globulins by method of Goldenberg and Drewan'[7] A Commodore Model 8032 computer was used for analysis of data.

RESULTS

Data for total serum proteins, albumin and globulins in male and female infants are presented in Table I, II, and III.

TABLE – I

Total Serum Proteins (Gm. per dl.) in Male and Female Infants in relation to Age.

Age (Months)	Males			Females		
	No. of cases	Mean	SD	No. of cases	Mean	SD
New Born	25	6.38 (6.24 – 6.60)*	0.095	25	6.42 (6.30 – 6.60)*	0.084
3	42	6.63 (6.49 – 6.77)*	0.082	42	6.65 (6.52 – 6.88)*	0.087
6	38	7.01 (6.90 – 7.12)*	0.080	38	7.01 (6.89 – 7.16)*	0.081
9	32	7.18 (6.96 – 7.32)*	0.084	32	7.20 (6.98 – 7.32)*	0.081
12	40	7.29 (7.04 – 7.46)*	0.112	40	7.31 (7.12 – 7.50)*	0.097
15	31	7.38 (7.20 – 7.52)*	0.086	31	7.39 (7.28 – 7.52)*	0.073
18	42	7.49 (7.40 – 7.60)*	0.050	42	7.49 (7.39 – 7.58)*	0.050

* observed range

TABLE – II

Serum Albumin (Gm. per dl.) in Male and Female Infants in relation to Age.

Age (Months)	Males			Females		
	No. of cases	Mean	SD	No. of cases	Mean	SD
New Born	25	3.93 (3.77 – 4.24)*	0.099	25	3.95 (3.78 – 4.24)*	0.092
3	42	4.26 (4.08 – 4.49)*	0.083	42	4.27 (4.09 – 4.50)*	0.084
6	38	4.33 (4.14 – 4.52)*	0.098	38	4.32 (4.13 – 4.52)*	0.098
9	32	4.40 (4.08 – 4.82)*	0.142	32	4.41 (4.30 – 4.83)*	0.125
12	40	4.49 (4.16 – 4.72)*	0.124	40	4.49 (4.16 – 4.72)*	0.125
15	31	4.52 (4.44 – 4.63)*	0.057	31	4.51 (4.42 – 4.62)*	0.056
18	42	4.54 (4.30 – 4.68)*	0.068	42	4.53 (4.30 – 4.69)*	0.071

* observed range

TABLE III
Total Serum Globulins (Gm. per dl.) in Male and Female Infants in relation to Age.

Age (Months)	Males			Females		
	No. of cases	Mean	SD	No. of cases	Mean	SD
New Born	25	2.46 (2.40 – 2.50)*	0.032	25	2.49 (2.36 – 2.57)*	0.041
3	42	2.37 (2.30 – 2.47)*	0.047	42	2.37 (2.28 – 2.45)*	0.045
6	38	2.67 (2.52 – 2.85)*	0.081	38	2.69 (2.52 – 2.85)*	0.074
9	32	2.78 (2.40 – 3.00)*	0.148	32	2.79 (2.45 – 2.98)*	0.126
12	40	2.80 (2.46 – 3.04)*	0.154	40	2.81 (2.50 – 3.04)*	0.149
15	31	2.86 (2.76 – 2.94)*	0.043	31	2.88 (2.80 – 2.96)*	0.036
18	42	2.98 (2.80 – 3.10)*	0.072	42	2.97 (2.79 – 3.10)*	0.073

* observed range

The data from Table I shows that the values of total serum proteins undergo changes from birth through infancy, the mean value of total serum proteins at birth, being 6.38 ± 0.095 G/dl for males and 6.42 ± 0.084 G/dl for females. These values incrçase with age and a significant difference ($P < 0.001$) in the level of total serum proteins between new-born infants and infants of 6 months age is noted. This difference becomes more significant ($P < 0.0001$) between infants at birth and infants at the age of 18 months. A level of 7.49 ± 0.050 G/di for both male and female infants is attained at the age of 18 months, which is almost identical with the mean total serum proteins of 7.51 ± 0.098 G/dl of our adult value. No significant difference in total serum proteins is found between two sexes from birth through 18 months.

The data from Table II show that serum albumin in both sexes gradually increases with age. At birth, the mean serum albumin in male infants is 3.93 ± 0.099 G/dl and in female infants,3.95 ± 0.092 G/dl. A significant difference ($P < 0.001$)is observed between infants at birth and at the age of 18 months. A level of 4.52 ± 0.068 G/dl for males and 4.51 ± 0.056 G/dl for females is attained at age of 15 months which is identical to our adult level of 4.54 ± 0.070 G/dl.

When expressed as percentage of total proteins (Figure 1 and 2) mean values for serum albumin are fairly constant (60 to 64%) in both sexes. No significant variation in serum albumin level is found between two sexes throughout infancy.

The results from Table III show that at birth the mean value for serum globulins in male infants is 2.46 ± 0.032 G/dl and 2.49 ± 0.041 G/dl in females. This value falls significantly ($P < 0.001$) in both sexes at the age of 3 months. After this age the mean value slowly begins to rise, and at the age of 9 months, the

mean value for serum globulins significantly differs (P<0.00l) from the mean value at the age of 3 months in both sexes. The adult level of 2.99 ± 0.070 G/dl is attained at the age of 18 months in both sexes. No significant difference is observed between two sexes in any age group.
The mean values of serum globulins are found to be fairly constant (35 to 39%) when expressed as percentage of total proteins for all age groups in both sexes (Figure 1 and 2).

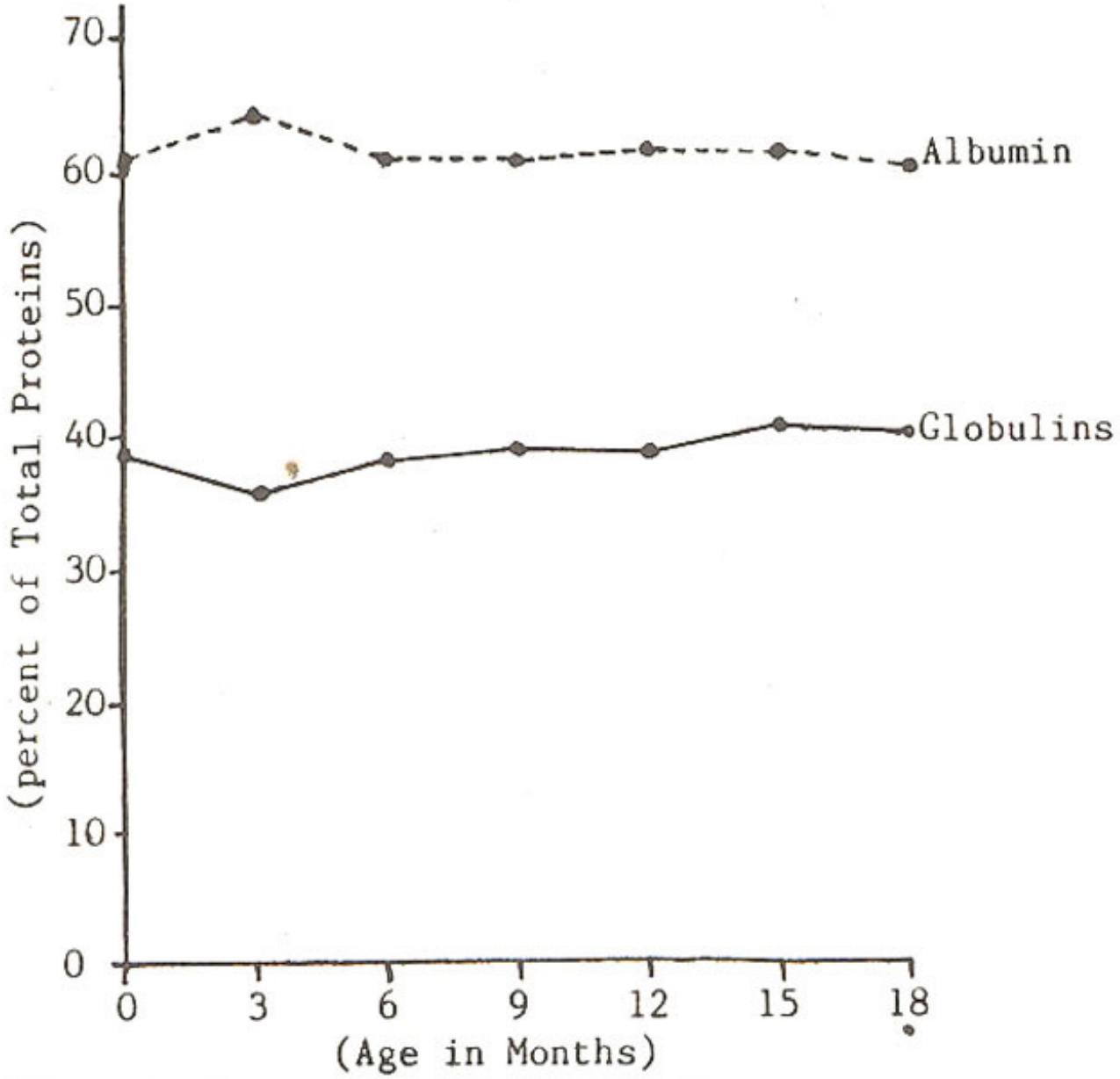

Figure 1. Mean value of Serum Albumin and Globulins expressed as percent of total proteins in males.

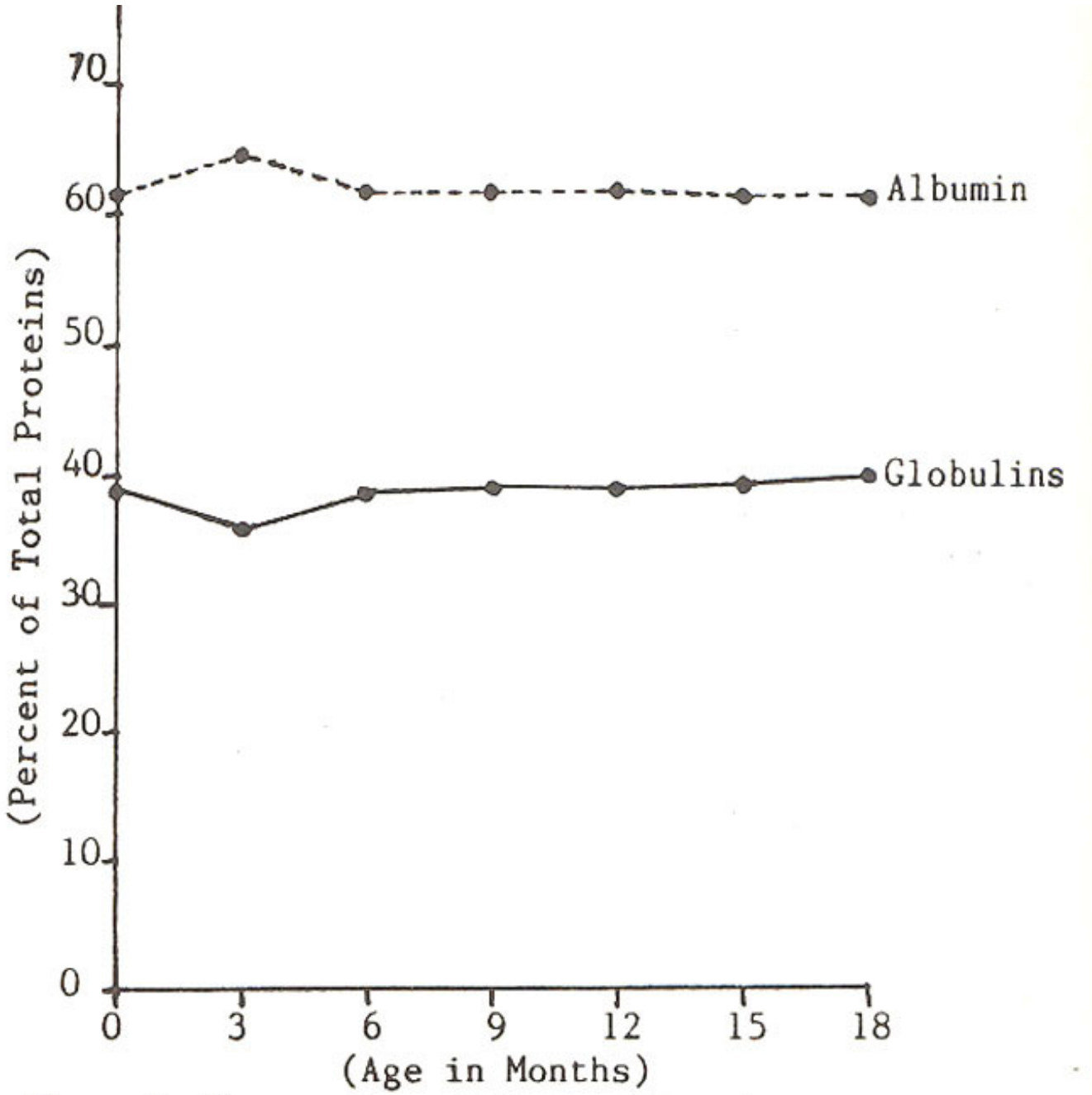

Figure 2. Mean value of Serum Albumin and Globulins expressed as percent of total proteins in Females.

TABLE – IV

Total Serum Proteins, Albumin and Globulins (Gm. per dl.) in Infants in relation to Age, Sex and Dietary pattern.

		MALES							
		Completely Breast-Fed				Completely Weaned			
Age (Months)	No. of cases	Protein Fraction	Mean	SD	No. of cases	Protein Fraction	Mean	SD	P value
		Total Proteins	6.63 (6.25 – 6.95)*	0.070		Total Proteins	6.52 (6.35 – 6.92)*	0.075	<0.05
3	25	Albumin	4.24 (3.78 – 4.49)*	0.050	25	Albumin	3.98 (3.54 – 4.12)*	0.061	<0.001
		Globulins	2.36 (2.32 – 2.48)*	0.039		Globulins	2.32 (2.30 – 2.48)*	0.042	N.S.
		Total Proteins	7.02 (6.68 – 7.39)*	0.081		Total Proteins	6.90 (6.66 – 7.05)*	0.08	<0.001
6	25	Albumin	4.32 (4.12 – 4.59)*	0.060	25	Albumin	4.20 (4.02 – 4.36)*	0.084	<0.001
		Globulins	2.69 (2.56 – 2.83)*	0.081		Globulins	2.64 (2.54 – 2.78)*	0.070	N.S.
		FEMALES							
		Total Proteins	6.63 (6.42 – 6.92)*	0.082		Total Proteins	6.47 (6.29 – 6.80)*	0.090	<0.001
3	25	Albumin	4.24 (3.86 – 4.36)*	0.065	25	Albumin	4.11 (3.72 – 4.28)*	0.074	<0.001
		Globulins	2.39 (2.30 – 2.52)*	0.052		Globulins	2.36 (2.24 – 2.48)*	0.048	N.S.
		Total Proteins	7.08 (6.84 – 7.42)*	0.071		Total Proteins	6.92 (6.72 – 7.11)*	0.072	<0.001
6	25	Albumin	4.33 (4.25 – 4.62)*	0.069	25	Albumin	4.21 (4.04 – 4.38)*	0.071	<0.001
		Globulins	2.71 (2.52 – 2.89)*	0.079		Globulins	2.72 (2.54 – 2.86)*	0.082	N.S.

* observed range N.S. = non-significant

Table IV presents the level of total proteins, albumin and globulins in serum of completely breast-fed and completely weaned male and female infants at the age of 3 and 6 months.

At 3 months the mean value of total serum proteins is significantly higher ($P < 0.05$ for males and $P < 0.001$ for females) in completely breast-fed than in completely weaned infants. This difference is also observed in infants at the age of 6 months ($P < 0.001$).

The mean value of albumin is 4.24 ± 0.05 G/dl in completely breast-fed infants at the age of 3 months in both sexes, whereas the mean value of albumin in completely weaned infants is 3.98 ± 0.06 G/dl for males and 4.11 ± 0.06 G/dl for females showing a significant difference ($P < 0.001$). This difference is also observed between two groups at the age of 6 months for both sexes.

No significant difference is found in the mean value of serum globulins between completely breast-fed and completely weaned male and female infants at the ages of 3 and 6 months.

DISCUSSION

This study reveals that the mean value of total serum proteins show variations with age. These results support the fmdings of Metcoff and Store[3], that the total proteins rise after birth, the adult level being attained by 15 to 18 months of age. In our study the adult level is reached at the age of 18 months in both sexes. The advantage of total proteins measurement, in serum, as a biochemical assessment of nutritional state in infants is that it is independent of sex, although total serum proteins concentration varies with age.

The albumin fraction shows no significant variations between two sexes. The results of our study support the findings of others[4,8,9], that the value of serum albumin varies with age. Mean absolute values for serum albumin in our findings reach adult levels at the age of 15 months in contrast to that reported by Trevorrow et al[10] who found that adult levels are reached some time between 6 and 12 months. This may be largely due to different socioeconomic factors. It is interesting to observe that the mean value for serum albumin, when expressed as percentage of total proteins, is! remarkably consistent (60 to 61%) for all age groups except at the age of 3 months where this value reaches 64.2% (Figure 1). The highest mean value of albumin at 3 months reflects a compensatory rise to offset the fall in total globulins. This is almost identical to the findings of Oberman et al[9]. The most striking changes, with age, are observed in the values of serum globulins. The level falls to the lowest at the age of 3 months in both sexes after which it begins to rise slowly until the adult level is achieved at the age of 18 months. These findings appear to be in agreement with those of Oberman et al[9]. The fall in the level of total globulins at the age of 3 months is attributable to the catabolism of one of the fractions of globulins —IgG, in view of its short biologic half life and initially low endogenous production. At the age of 3 to 4 months the infants are, therefore, more susceptible to disease since it is at this time that the immune system is depressed due to low immunoglobulins.

Total serum proteins and albumin levels significantly differ, for both sexes, between breast -fed and weaned infants at the age of 3 and 6 months, whereas no significant difference is found in the mean value of serum globulins. The difference in total proteins and albumin, in serum, may be due to the fact that the utilization efficiency of proteins of mother's milk by infants is assumed to be 100%, or due to low quality proteins in artificial feedings.

ACKNOWLEDGEMENT

We are thankful to Mr. Muhammad Ajmal, Computer Operator, Ayub Medical College, Abbottabad for painstaking job of data analysis.

REFERENCES

1. Bruton, O.C. Agammaglobulinemia. Pediatrics, 1952; 9:722.
2. Bruton, O.C., Apt, L., Gitlin, D. and Janesyay, C.A. Absence of serum gamma globulins. Am. J. Dis.Child., 1952;84:632.
3. Metcoff, J. and Stare, F.J. The physiologic and clinical significance of plasma proteins and protein metabolites. N. Engl. J. Med., 1947; 236:26.
4. Knapp, EL. and Routh, 1.1. Electrophoretic studies of plasma proteins in normal children. Pediatrics, 1949; 4:508.
5. Gornall, A.G., Bardawill, CJ. and David, M.M. Determination of serum proteins by means of Biuret reaction. J. Biol. Chem., 1949; 177:751.
6. Daumas, B.T. and Biggs, M.G. Determination of serum albumin, in standard methods in clinical chemistry. Edited by G.A. Cooper, New York, Academic Press, 1972, Vol.7, p. 175.
7. Goldenberg, H. and Drewes, P.A. Direct photometric determination of globulins in serum. Clin.

Chem., 1971; 17: 358.
8. Lubschez, R. Electrophoretic patterns in blood plasma and serum in normal children. Pediatrics, 1948; 2:570.
9. Oberman, J.w., Gregory, K.O., Burke, F.G., Ross, S. and Rice, E.C. Electrophoretic analysis of serum proteins in infants nd children. N. EngI. J. Med., 1956; 255:743.
10. Trevorrow, V., Kaser, M., Patterson, J.P. and Hill. R.M. Plasma albumin, globulin, and fibrinogen in healthy individuals from birth to adulthood. “Normal” values. J. Lab. Clin. Med., 1942; 27: 471.