PATTERN OF SERUM TOTAL PROTEINS AND FRACTIONS DURING PREGNANCY AND PUERPERIUM AMONG URBAN AFRICAN AND ASIAN WOMEN

by

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SUMMARY

Patterns of change in the levels of serum total proteins and fractions during pregnancy and puerperium were studied longitudinally among urban African and Asian women living in Nairobi. It was observed that the mean serum total proteins dropped significantly during pregnancy. The mean albumin concentration among African and Asian subjects was significantly different in the non-pregnant state. But, by 26 weeks of gestation the mean levels in both groups had dropped to a value lower than that observed in the non-pregnant state. The difference between the two groups no longer remained significant. α_1, α_2 and ß globulin fractions were found to increase during pregnancy. A significant reduction was observed in the globulin fraction among the Africans.

Dedication

We would like to appreciate the considerable effort put in by the late Mr. Eddie Lacke. He was responsible for the biochemical analysis. Prior to his untimely passing away he had embarked on this data analysis and compilation. We feel highly obliged to him for his contribution and hope that we have done justice to this paper in the manner in which he would have liked it in print.

Introduction

A number of investigations have been made of changes in serum proteins during normal pregnancy and puerperium. It is obvious when reviewing the subject that many inconsistencies in trends, actual values and interpretation of data exist. Table I gives a summary of some literature on serum protein changes during pregnancy. It shows that several investigators have found a lowered serum total protein concentration during pregnancy. However, it is not until one considers changes in total proteins and fractions together that disagreements arise.

For this reason, it was considered to be of value to study changes in serum total proteins and fractions among African and Asian subjects in the context of a longitudinal pregnancy study carried out

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Methodology

(i) *Subjects*: The pregnant subjects were selected from ante-natal clinics of The Aga Khan Hospital, Nairobi. They were screened to meet the following criteria:

(i) duration of pregnancy of 26 weeks or less,
(ii) parity of 4 or less,
(iii) free of medical and obstetric complication and
(iv) singleton pregnancies only.

The non-pregnant non-lactating women were part of a control group for the longitudinal survey and were healthy women selected from the family planning clinics of the same hospital.

(ii) *Research Design*: Non-fasting blood samples were collected from the pregnant women at 26 weeks and 37 weeks of gestation. All samples were stored in a refrigerator and centrifuged within 24 hours. Serum was dispensed in small glass tubes and was stored at-18°c until analysed.

(iii) *Laboratory Technique*: The serum total proteins were measured by the Biuret technique using the reagent of Weichselbaum. Protein fractions were studied by paper chromatography.

Results

It can be seen from Table II that there were no significant differences between the three groups for the total protein value in the non-pregnant state or at 26 and 37 weeks of pregnancy.

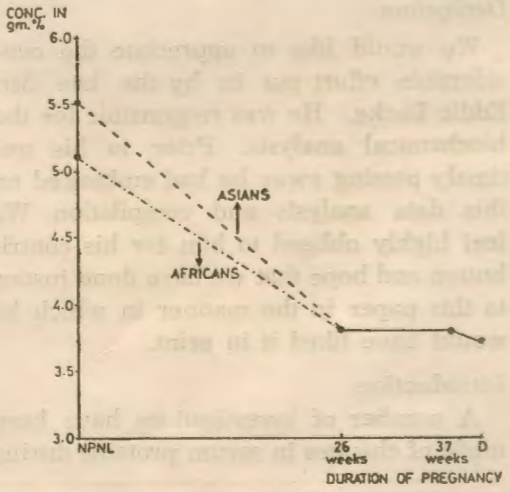
On comparing the non-pregnant values with those obtained at 26 weeks of gestation, a decrease in the levels of serum total proteins can be observed in all three groups. These values were found to remain almost constant at the times of measurements among all women.

No differences were found in the protein fractions of the Asian vegetarian and non-vegetarian groups at the given stages of pregnancy. Hence, the two Asian groups have been merged into one group and the values are compared with the African group.

With reference to figure (i); the African women had a significantly lower albumin level than the Asian women in the non-pregnant state. On comparing the values at 26 weeks of gestation, there was a drop in the albumin level in both the groups, such that the absolute values obtained were now similar; 3.9 gm%. Then, the albumin level for both the groups remained almost constant from 26 weeks through 37 weeks upto delivery.

Figure (ii) illustrates the change observed in α globulin fraction during pregnancy in both groups. The African

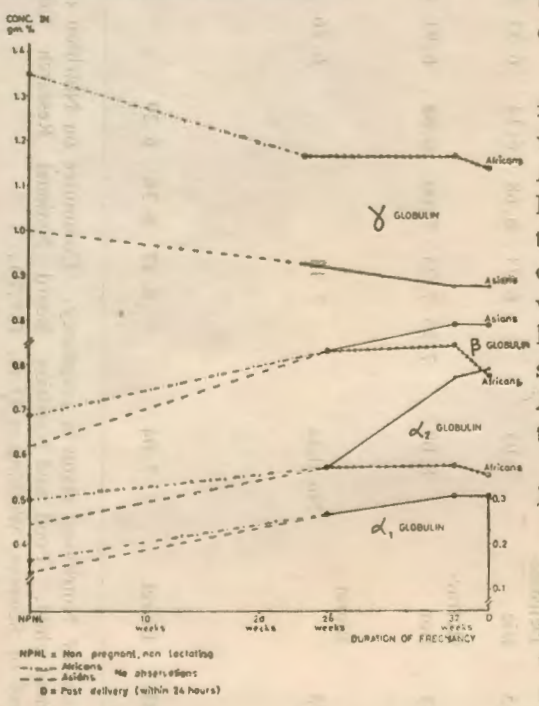
FIGURE (i) CHANGE IN SERUM ALBUMIN LEVELS DURING PREGNANCY



NPNL = Non pregnant non lactating
No observations
D = Post delivery (within 24 hours)

women had a significantly higher value of α globulin as compared to the Asian women, and this difference remained at every stage of examination. The mean α globulin fraction levels remained unaltered in both the groups during the periods of observation in pregnancy.

FIGURE (ii) CHANGES IN GLOBULIN FRACTIONS DURING PREGNANCY



Mean α_1 globulin levels of both groups are also illustrated in figure (ii). In the non-pregnant state, the African women had a significantly higher α_1 glibulin level than the Asian women. At 26 weeks of pregnancy these differences were merged. An increase in α_1 globulin fraction was observed in both groups at 26 and 37 weeks of gestation and these increased levels remained at delivery.

With reference to figure (ii) the α_2 globulin levels among African and Asian women in the non-pregnant state were similar. At 26 weeks of pregnancy the values were still similar and both groups showed a statistically significant increase in the α_2 globulin fraction of protein. The levels of the two groups were statistically different at 37 weeks of pregnancy, since amongst the Asians the values of α_2 globulin increased from 26 to 37 weeks of pregnancy and then levelled off. Amongst the African group the values remained constant at these times of measurement.

In figure (ii) the change in ß globulin fraction is compared. ß globulin fraction was significantly lower amongst the Africans in the non-pregnant state. The levels increased with pregnancy in both the groups such that similar values were obtained for both the groups at 26 and 37 weeks of pregnancy. After delivery the levels remained similar to the values observed during pregnancy amongst the Asians but dropped significantly amongst the Africans.

Discussion

Serum total proteins: With reference to Table I; it is well documented that in normal pregnancy the serum total proteins decrease significantly below normal non-pregnant levels (De'Alvarez 1961; MacDonald and Good 1971; Hytten and Lind 1973). Our findings are in agreement with these reports in that by 26 weeks of pregnancy, the serum total protein levels had fallen; these levels persisted throughout pregnancy. The values observed during the first 24 hours after delivery were similar to levels observed during pregnancy and significantly lower than the concentrations observed in the non-pregnant group. The exact physiological mechanism involved in the lowering of serum total proteins is not clear yet.

Protein fractions: The difference in serum protein patterns among the African

TABLE I

*Serum Total Protein in Pregnancy**

References	Type of study	No. of subjects	Method of estimation	Serum Total Protein (g/100 ml) at week of Pregnancy									
				Non-pregnant	4–8	9-12	13-16	17-20	21-24	25-28	29-32	33-36	37-40
Von Studnitz (1955)	Cross-sectional Partly	101	Kjehldahl	7.1	7.1	7.0	6.8	6.6	6.6	6.5	6.6	6.6	6.8
MacGillivray and Tovey (1957)	Longitudinal Partly	13	Kjehldahl	7.3			7.3		6.8		6.6		6.6
Oe Alvarez *et al* (1961)	Longitudinal	28	Biuret	7.18	7.27	6.61	5.62	5.59	5.74	5.96	6.01	5.74	5.90
Reboud *et al* (1967)	Cross-sectional	135	Densimetric	7.03		6.73	6.68	6.14	6.33	5.94	6.27	6.13	6.13
Kruglov (1967)	Longitudinal	103	Refraction	8.09	7.33	7.23	7.00	6.88	6.91	6.94	6.96	7.07	7.20
Wilken and Schwebke (1968)	Longitudinal	75	Biuret	No data		7.13			6.76		6.74		6.72
Robertson (1969) and personal communication	Longitudinal	83	Biuret	7.04		6.47	6.36	6.29		6.26	6.23	6.19	6.24

*Source: Laboratory Indices of Nutritional status in pregnancy. Committee on Nutrition of mother and pre-school child. Food and Nutrition Board National Research Council. National Academy of Sciences, Washington D.C. (1978).

TABLE II
Serum Total Protein Changes During Pregnancy and Puerperium

State of pregnancy		Serum total proteins gms/100 ml African	Asian Vegetarian	Asian Non-vegetarian	"F" Value
Non-pregnant Non-lactating	N	32	31	26	
	Mean	7.8	7.8	7.8	
	S.D.	0.6	0.5	0.5	0.06
	A/G ratio	2.0	2.5	2.3	
26 weeks of pregnancy	N	49	21	27	
	Mean	6.7	6.7	6.6	
	S.D.	0.7	0.4	0.6	0.11
	A/G ratio	1.4	1.5	1.4	
37 weeks of pregnancy	N	49	21	27	
	Mean	6.7	6.8	6.8	
	S.D.	0.6	0.5	0.5	0.32
	A/G ratio	1.3	1.3	1.3	
Post-Delivery (within 24 hrs.)	N	49	21	20	
	Mean	6.6	6.6	6.5	
	S.D.	0.7	0.5	0.7	0.26
	A/G ratio	1.4	1.3	1.4	

A/G ratio—Albumin/globulin ratio.

and Asian non-pregnant subjects may be due to genetic factors, diet or exposure to sertain disease.

Albumin concentrations: By 26 weeks of gestation the albumin levels in both the groups had dropped significantly and remained lower than the non-pregnant values throughout pregnancy and during puerperium. The constant value reached by the albumin concentration after 7th month of pregnancy confirms the findings of MacGillivray and Tovey (1957), Pabby (1960) and several other investigators (2) and fails to support those authors who found a continuous fall.

Plasma volume increases during normal pregnancy by 40-50% (Hytten and Chamberlain 1980). It has been suggested that the total amount of circulating albumin is unchanged, so that the apparent decrease in albumin concentration is proportionate to an increase in plasma volume.

Globulin concentrations: It is clear that the total amount of blood globulin increases markedly during normal pregnancy (De'Aloare *et al* 1961; Pabby 1960). The amount of circulating ß globulin, for example, may double but why the different protein fractions do not increase to the same extent still remains obscure.

(i) α_1, α_2 *and* ß *globulins*: A statistically significant increase was found in these fractions among both African and Asian subjects. These increase in the concentrations agree with the findings of MacGillivray *et al* (1957), Pabby (1960) and Pfau (1954) among caucasian

women. Malik (1979) studied levels of protein fractions among Indian women and found that in normal pregnancy there was a rise in total globulin levels which was attributed to an increase in α_1 andß fractions, with a drop in α_2 levels.

The possible reason for increase in α_1, a_2 and ß globulin fractions of protein may be related to their known functions. Plasma proteins act as carriers for metabolic products or raw materials and it seems reasonable to assume that changes in the total amount of any protein fraction is in response to a demand for increased functional capacity. For example, α and ß globulins are supposed to be carriers for steriods and iron and copper (Hytten and Chamberlain 1980). The last two items are necessary for foetal development and there are large increases in both types and amounts of steriod hormones which are produced during pregnancy and which are transported by the plasma proteins and eventually excreted.

(ii) *α globulin*: The pattern of change of α globulin fraction of protein among the African and Asian groups was found to be similar. There was a fall in α globulin levels which is in agreement with the reports of Pabby (1960) and Pfau (1954) for caucasian women and Malik (1979) who studied Indian women.

The reason given for this drop is that neither the foetus nor the placenta can synthesise α globulin. The depression in the levels found in the mother may be partly due to a transplacental transfer to the foetus. This, together with the total metabolic stress of pregnancy may result in an inability of the mechanism for α globulin and total protein synthesis to maintain non-pregnancy levels.

Thus, regarding levels of serum total proteins and fractions during pregnancy certain speculations can be made and some general observations as to the mechanisms involved are apparent, but much detailed work remains before we can comprehend adequately the meaning of known and some unknown blood proteins in pregnancy or indeed in any physiologic stress.

Acknowledgement

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