

Relationship of Serum Retinol, β -Carotene and Serum Proteins in Women at Postpartum from Different Age and Socioeconomic Groups

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ABSTRACT

Serum studies in 153 randomly selected lactating women of three socioeconomic (low, middle and high) groups with monthly income up to Rs. 4000, Rs. 4001 to 10000 and above Rs. 10000 respectively and age groups (below 25, 26-32 and above 33 years) of Faisalabad, Pakistan, revealed an overall concentration of retinol and β -carotene to be 52.48 ± 0.91 and 186.34 ± 51.37 $\mu\text{g/dL}$, respectively. The retinol and β -carotene showed significant difference between socioeconomic (SES) groups. The level significantly declined with the decline in SES. Serum retinol showed significantly higher values in older than in younger mothers. However, serum β -carotene showed non-significant difference between age groups. The serum total proteins, albumin (A), globulin (G) and A/G ratio during the present study was 5.26 ± 0.91 g/dL, 3.14 ± 0.42 g/dL, 2.11 ± 0.49 g/dL and 1.55 ± 0.41 respectively. The total proteins, A, G and A/G ratio showed non-significant difference between age groups while the total proteins, A and G showed significant difference between low and high SES groups. The A/G ratio revealed significantly higher values in middle socioeconomic group. The serum total proteins, A and G were found to be positively correlated with serum retinol and β -carotene while A/G ratio showed negative correlation with the above mentioned parameters.

Key Words: Serum; β -carotene; Serum retinol; Socioeconomic

INTRODUCTION

Measurement of serum retinol and β -carotene reflects the nutritional and health status. Serum β -carotene levels provide an accurate estimation of recent regular carotene consumption where as retinol levels reflect an individual's Vitamin-A status, only when liver Vitamin-A stores are severely depleted or excessively high (Olson, 1984). The simultaneous measurement of both the parameters presents better picture of Vitamin-A status of the individual (Tarwotjo *et al.*, 1982).

Vitamin-A has been reported to affect the protein metabolism as it is evident from experimental works that vitamin-A increases the protein and glycogen content of blood (Kudryavtseva & Dinamika, 1972). Mejia and Arroyave (1983) reported that retinol and retinol binding protein were significantly and positively correlated with total protein and albumin. Burri *et al.* (1990) found that the concentrations of total protein, albumin and retinol binding protein were significantly decreased by protein energy malnutrition. They also found that protein intake was more critical than energy intake for retinol binding status. McLaren and Goodman (1976) also reported the association of retinol binding protein and prealbumin with Vitamin-A and Xerophthalmia. Sherwani *et al.* (1980) have reported that total proteins were found to be

significantly lower in Vitamin-A deficient rats as compared to rats on Vitamin-A supplemented diet.

Vitamin-A status of women at postpartum has not been studied thoroughly in local population. Levels of serum Vitamin-A and total proteins in mothers of different SES and ages, is not known. Assuming nutritional deprivation, particularly of Vitamin-A, the more likely cause of poor health status and higher child mortality, it was felt informative to investigate the prevailing situation. The present study was therefore, carried out to achieve the following objective to investigate the health status of mothers with reference to serum Vitamin-A and serum protein levels.

MATERIALS AND METHODS

The study involved 153 women delivered in the five hospitals of Faisalabad including Allied Hospital, District Headquarter Hospital and National Hospital, Aziz Fatima Hospital and Social Security Hospital. Blood samples were collected from peripheral veins of the subjects within 48 hours of the delivery. The blood was allowed to clot to get serum, which was transferred to a dry, coloured and stoppered vial and stored at -20°C . The sampling was done during the period, May-August. These women were divided in three SES groups (low, middle and high),

each comprising 51 women on the basis of monthly income. Each SES was further divided into three age groups (women below 25, 26–32 and above 33 years of age).

Different parameters included for this study were, determination of serum retinol, β -carotene, total proteins, A, G and A: G ratio. Serum retinol and β -carotene were estimated by the method of Neelds and Pearson (1963). Serum total proteins were determined following the method described by Oser (1976) where as serum albumin was determined by the method of Varley *et al.* (1980). Globulin was calculated by difference, subtracting A from total protein as shown below: The data thus obtained on these parameters were subjected to GLM (General Linear Model for factorial experiments) by using Minitab computer software package. The means were compared by Tukey's test for confidence interval by using one way analysis of variance by using same statistical package. Correlation coefficients among different parameters were also worked out by using Minitab (10.2) computer software package (Anonymous, 1994).

RESULTS AND DISCUSSION

Mean serum retinol level observed in the present study was 52.48 ± 0.86 $\mu\text{g/dL}$, (Table I). Non pregnant and non-lactating women have been reported to contain 57 $\mu\text{g/dL}$ (Helen *et al.*, 1954) and 49 $\mu\text{g/dL}$ (Underwood *et al.*, 1970). As low as 40.3 $\mu\text{g/dL}$

serum retinol has been reported in lactating mothers in developing countries where as higher values (58 $\mu\text{g/dL}$) were reported for developed countries (Newman, 1994). Sudanese mothers, however had 63.01 $\mu\text{g/dL}$ retinol (El-karib *et al.*, 1988). The difference in different studies could be due to the difference of season of study, number of observations and nutritional SES.

During the present study it was observed that 11.1% of the mothers had as low as 35 $\mu\text{g/dL}$ and 22.2% as 44 $\mu\text{g/dL}$ Vitamin-A. These values are close to those reported for lactating mothers (40.3 $\mu\text{g/dL}$) in developing countries (Newman, 1994). The Vitamin-A availability over the past two decades had slight upward trend in Asia and it had been remarked that it would take many years to reach the average requirement (Ali, 1993).

Average serum β -carotene levels observed during the present study was 186.34 ± 51.37 $\mu\text{g/dL}$, (Table I). The reported values were 137.1 and 101.2 $\mu\text{g/dL}$ for developing and developed countries respectively (Newman, 1994). In England mean values for β -carotene were reported to be 131 $\mu\text{g/dL}$ (leither *et al.*, 1960) and those reported for American females were 113 $\mu\text{g/dL}$ (Underwood *et al.*, 1970).

The serum retinol/ β -carotene values in lactating mothers vary significantly in different SES. The levels significantly declined with decrease of SES. The intake of Vitamin-A and other nutrients also showed a declining trend with the decline in SES.

Table I. Mean serum retinol and β -carotene levels ($\mu\text{g/dL}$) in women of different ages and socioeconomic status

SES	Age groups (years)			Overall mean \pm SE
	Below 25	26–32	33 & above	
		Retinol		
	e	d	c	C
Low	35.38	44.43	50.95	43.59 ± 7.70
	c	d	a	B
Middle	49.79	44.87	65.79	53.48 ± 10.32
	b	a	b	A
High	58.03	66.95	56.14	60.38 ± 6.15
	B	AB	A	
Overall mean \pm SE	47.75 ± 10.71	52.08 ± 11.47	57.63 ± 7.25	52.48 ± 0.86
		β-carotene		
	e	e	e	C
Low	141.36	142.07	130.67	137.63 ± 11.61
	d	e	c	B
Middle	175.84	135.08	208.91	173.63 ± 34.44
	a	a	b	A
High	252.59	256.75	234.29	247.89 ± 13.93
Overall mean \pm SE	190.07 ± 48.74	177.69 ± 59.76	191.25 ± 47.17	186.34 ± 51.37

Different capital letters on overall means for SES and age groups and small letters on means of SES x age show significant ($P < 0.01$) differences.

Table II. Mean serum total protein, albumin, globulin levels (g/dL) and A / G ratio in women of different ages and socioeconomic status

SES	Age groups (years)			Overall mean±SE
	Below 25	26–32	33 & above	
		Total protein		
Low	c 4.60	bc 4.94	ab 5.33	B 4.96±0.51
Middle	a 5.37	c 4.54	bc 5.06	B 4.99±0.82
High	a 5.77	a 5.89	a 5.82	A 5.83±0.36
Overall mean±SE	5.25±0.84	5.12±0.65	5.41±0.6	5.26±0.71
		Albumin		
Low	c 2.63	bc 2.94	ab 3.15	A 2.91±0.00
Middle	ab 3.30	bc 2.95	a 3.39	AB 3.18±0.09
High	a 3.46	a 3.53	bc 2.97	A 3.32±0.00
Overall mean±SE	3.13±0.52	3.14±0.41	3.14±0.37	3.14±0.42
		Globulin		
Low	c 1.97	c 2.00	bc 2.18	B 2.05±0.20
Middle	bc 2.06	d 1.59	cd 1.66	B 1.78±0.49
High	bc 2.31	b 2.36	a 2.84	A 2.51±0.41
Overall mean±SE	2.12±0.47	1.99±0.39	2.24±0.00	2.11±0.49
		Albumin / globulin ratio		
Low	c 1.34	c 1.47	c 1.44	B 1.42±0.10
Middle	bc 1.69	ab 1.98	a 2.01	A 1.89±0.55
High	c 1.50	c 1.49	d 1.09	B 1.36±0.29
Overall mean±SE	1.51±0.26	1.64±0.41	1.51±0.57	1.55±0.41

Different capital letters on overall means for SES and age groups and small letters on means of SES x age show significant ($P < 0.01$) differences.

About 33% of mothers belonging to low SES are having levels known to be just adequate for non-lactating, non-pregnant women and presenting the risk of deficiency (NRC, 1989). Significantly higher values of serum retinol observed in mothers of middle and high SES are indicative of better dietary situation as compared to the low SES. Serum β -carotene levels as observed during the present study, were much higher than the reported values for developing and developed countries. The average serum carotene level of lactating women from developing countries was about 35 percent above the average from developed countries (Newman, 1994). The present study revealed that the average serum carotene values were about 84 percent above the average for developed countries. Seasonal availability of carotene-rich foods might have played a role in this case. The present study was conducted during the period between May -August. The ample supply of mangoes and apricot available

during this period, at much cheaper rates might have contributed towards higher levels of serum β -carotene.

A tendency towards an increase in serum retinol levels with increase in age has been noted during the present study. This may provide the reserve in health and disease during later years of life (Moore, 1937). The influence of age on Vitamin-A levels is also known to be consistent towards the extreme of old age (Ibrahim, 1977). Same trend has also, been noted by Ahmad (1997). Mothers belonging to age group 26–32 years, in middle SES, however exhibited significantly lower serum retinol levels as compared to the younger (below 25 years). Low levels of serum retinol concentration in this group might also be related with the low albumin levels ($r = 0.41, p < 0.05$). Mejia and Arroyave (1983) reported that retinol and retinol binding protein were significantly and positively correlated with serum albumin.

The serum total proteins levels determined within 48 hours in mothers during the present study

ranged from 3.81 to 7.51 G/dL, (Table II). The levels reported for normal healthy women are 6.0–8.0 G/dL (Benington *et al.*, 1970), 5.8–7.8 G/dL (Passmore & Eastwood, 1979), 7.38 G/dL (Hashmi *et al.*, 1992) and 7.66–7.97 G/dL (Aziz *et al.*, 1988). A lower concentration of serum total protein can be attributed to the stress of pregnancy, specially at parturition. Benjamin (1978) also reported low serum total protein concentrations during pregnancy and lactation. The serum total protein showed a positive correlation with the serum retinol ($r=0.21$) and serum β -carotene ($r=0.086$).

Significantly lower values for serum total protein were observed in mothers under low and middle than in high SES. This may be related to quantitatively low and qualitatively inferior food consumption at middle and low SES. The possible reason could be the low energy intake, which might be more critical in this case. The other possibility could be consumption of low quality proteins (Garg *et al.*, 1988).

There was an increasing trend in serum total protein concentration with an increase of age of mothers from 26 to 33 years and above, although the differences were non-significant (Benjamin, 1978). Dimopoulos (1970) also showed a gradual increase in serum total protein with increase in age. Vijayalakshami and Sarala (1987) also reported increase in serum total protein with advancing age. Sharma and Mahajan (1987), while making biochemical assessment of protein-calorie mal-nutrition reported similar effect of age on serum total proteins. In mothers belonging to middle SES, the effect of age seems to be curtailed by significantly lower values for serum total protein in age group 26–32 years, as compared with younger group (below 25 years). It was observed that maximum number of mothers serving at different institutions belonged to middle SES and most of them enter in service at this age. Due to more stress during this period, they probably had lower levels of serum total proteins.

The serum albumin concentration in mothers during first 48 hours of parturition ranged from 2.23–5.51. Oberman *et al.* (1956), Passmore and Eastwood (1979) and Benington *et al.* (1970) reported serum albumin to range from 3.5 to 5.6 G/dL in normal individuals. Lower serum albumin at term (1.65 to 3.39 G/dL, Oberman *et al.*, 1956). Hypo-albuminemia has been reported during pregnancy (Benjamin, 1978; Dimopoulos, 1970). The lower level of albumin observed during the present study positively correlates with the serum total protein levels ($r=0.54$). This is due

to the fact that the albumin concentration has a significant contribution towards serum total proteins levels (Benjamin, 1978). The effect of SES was significant ($P<0.01$) in this case as the values significantly declined with decline in SES. The mothers showing low levels of serum albumin had lower intake of energy, protein and vitamin than the RDI. Albumin and pre-albumin concentrations are often used to assess protein-energy mal-nutrition (Ingenbleek *et al.*, 1972).

The serum globulin concentration observed in mothers during the present study tally with the normal range of 1.7–3.53 g/dL reported by Passmore and Eastwood (1979) and 2–3.6 g/dL by Harper (1993). The serum total globulin seldom decreases, though an individual fraction of globulin may decrease due to simultaneous increase in other components (Coles, 1980). Serum globulin showed a positive correlation with serum retinol ($r=0.23$) and β -carotene ($r=0.40$). Significantly lower values for serum globulin were observed in low and middle as compared to the high SES. This can be attributed to the poor nutritional status of these mothers.

The mean albumin globulin (A:G) ratio (1.5 ± 0.4) observed during the present study was somewhat similar to the ratio (>1.5) reported by Cornelius (1970) because albumin tends to predominate over globulin in humans (Benjamin, 1978). It was observed that the A:G ratios did not commensurate with SES of mothers. Higher A:G ratio at middle socioeconomic status have been reported by Tabbasum (1997). High A:G ratio indicates higher proportion of albumin due to increase in albumin or decrease in globulins and reflects immunosuppression; while lower A:G ratio indicates low albumin or higher globulins and in later case immunostimulation (Coles, 1980) as is observed in case of higher age group (above 33 years) at high SES. Significantly lower A:G ratio observed in this group is indicative of some pathological conditions in the subjects under study. A negative correlation of A:G ratio with serum retinol and β -carotene was observed ($r = - 0.1$) and ($r= 0.1$) respectively.

CONCLUSION

Serum retinol and β -carotene have shown a direct correlation with fractions and serum total protein and serum albumin. Low levels of serum total protein at low SES are indicative of poor nutritional status.

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(Received 12 July 1999; Accepted 25 September 1999)