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Periparturient Observations on Protein Malnutrition, Serum Proteins and Neonatal Birth Weight in Women of Different Socio–Economic and Age Groups

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ABSTRACT

Study was conducted on pregnant women approaching delivery, admitted in various hospitals of Faisalabad, Pakistan. These women were randomly selected and divided into three socio–economic (SE) groups (low, middle and high) and each group was further subdivided into three age groups (<25, 26-32 and >33 years). Study revealed an higher ($P<0.05$) dietary energy and protein intake in women of high SE status. Protein intake was higher ($P<0.05$) in women of 26-32 years of age. Serum globulins and immunoglobulins were significantly higher ($P<0.05$) while total proteins were relatively higher at post than pre-delivery. After delivery, serum immunoglobulins were higher ($P<0.05$) in women of high SE status. Before delivery, serum proteins and globulins were higher ($P<0.05$) in women of 26-32 years of age. In women of 26-32 years of age, serum albumin was higher ($P<0.05$) before delivery. Serum fibrinogen was higher ($P<0.05$) in women >33 years of age both before and after delivery than other age groups. Serum total protein and albumin determined within 24 hours before delivery showed inverse relationship with birth weight ($r=-0.21$, $P<0.05$; $r=-0.35$, $P<0.001$, respectively). Serum total protein was positively correlated with albumin ($r=0.61$, $P<0.0001$), globulins ($r=0.77$, $P<0.0001$) and immunoglobulins ($r=0.68$, $P<0.0001$) and globulins with immunoglobulins ($r=0.79$, $P<0.0001$) in samples collected within 12 hours after delivery.

Key Words: Pregnancy; Serum proteins; Malnutrition; Socioe–conomic status; Age

INTRODUCTION

Pregnancy is a period of increased protein requirements. The foetus and placenta are accruing protein very rapidly during their period of rapid growth. Protein requirements in non-pregnant adolescent girls and in non-pregnant adult women are 46 and 44 g/day, respectively. In case of pregnant adolescent girls and pregnant adult women, protein requirement increases i.e. 76 g and 74 g/day, respectively. The extra protein is required for the increased maternal needs i.e. uterus and breasts development and expansion of RBC mass (Winick, 1989).

Protein status is usually assessed by measuring levels of total serum proteins, albumin, or plasma non-essential and essential amino acid ratio (Sauberlick *et al.,* 1974). A direct relationship of plasma protein with the quality and quantity of dietary protein with decrease in plasma protein in cases of protein malnutrition has been reported (Flodin, 1953). Therefore, socio-economic (SE) status seems to have a direct impact on plasma proteins. The globulins and A:G ratio were found significantly ($P<0.05$) higher in high and middle SE groups (Tabassum *et al.,* 1998). The information on parameters like serum total proteins, albumin, globulin, immunoglobulin, fibrinogen and dietary intake of proteins and energy with reference to SE and age groups in women before and after delivery is scarce. Furthermore, no reports were available with respect to birth weight of newborn and its association with serum protein value. This paper describes the serum total proteins and fractions in women, within 24 hours before and within 12 hours after delivery, variation in these parameters in women of different SE and age groups; and relationship between birth weight of newborn with serum proteins in mother's serum, and between dietary protein and serum proteins.

MATERIALS AND METHODS

Blood samples (5 mL) were collected from randomly selected women, within 24 hours before and within 12 hours after delivery, admitted in various hospitals of Faisalabad, Pakistan. Out of 5 mL, 1 mL with anticoagulant (EDTA) was used for determination of fibrinogen and 4 mL without anticoagulant was used to obtain serum for biochemical studies. A total of 90 women under observation were divided into three equal SE groups on the following basis: Low SE group (earning up to Rs. 4,000 month^{-1}), middle SE group (earning from Rs. 4,000–10,000 month^{-1}) and high SE group (earning from Rs. 15,000 month^{-1} and above). Each SE group was further divided into three age groups i.e. < 25 years, between 26-32 years and 33 years and above.

The assessment of energy and protein intakes by women under study was made through food frequency questionnaires (Hussain, 1985). Birth weight of newborn was recorded by using weighing scale for babies. Serum total proteins and albumin were determined spectrophotometrically (Oser, 1976; Varley *et al.,* 1980). Globulins were measured by subtracting albumin from total protein. Serum immunoglobulins were determined using a selective turbidity produced by $ZnSO_4$ (McEwan *et al.,* 1970). Plasma fibrinogen was determined by refractometer method (Benjamin, 1978). Data thus obtained

were analyzed by using Analysis of Variance technique and means were compared by DMR test. Pearson correlation coefficients among different parameters were also worked out (Anonymous, 1996).

RESULTS AND DISCUSSION

The protein intake (Table I) was almost similar to that reported by Winick (1989) for pregnant women, which indicates that protein intake during pregnancy was taken to the optimum level. An overall energy intake was significantly higher ($P<0.05$) in women of high SE status (2690.93 kcal day^{-1}) with non-significant difference between age groups (Table I). This indicates that women of high SE status take more energy and also protein (77.56 gm day^{-1}). Protein intake showed significant ($P<0.05$) difference between age groups with higher intake in women of 26-32 years of age (69.80 gm day^{-1}). Overall serum total protein was significantly higher ($P<0.05$) after delivery in women of >33 years of age (Table IIa) and as good as reported for Iranian women (Geissler *et al.,* 1978). However, serum protein found in the current study was much lower than that reported by Gissler *et al.* (1978). The higher ($P<0.05$) values of serum total protein after delivery in women of high SE status (Table II) were also comparable with the findings of Gissler *et al.* (1978). There was no difference in serum protein between women of different SE groups, both pre and post partum (Table IIa). This suggests no effect of dietary protein on serum protein values as probably intake of dietary proteins was adequate to maintain an optimum level in serum. However, significant difference in women of different SE status was reported by Pervaiz (1999) which was related with variable dietary intakes of protein, both in quantity and quality by different groups of women. The findings of serum proteins between women of different ages revealed higher ($P<0.05$) values in women of 26-32 years of age before delivery but no difference after delivery (Table II) which was similar to previous reports and confirms the non-significant difference in women of different ages after delivery (Tabassum *et al.,* 1998; Pervaiz, 1999). The higher serum protein in women of 26-32 years of age might be suggestive of decrease in protein concentration with further increase in age. However, an increase in serum total protein with advancing age has been

Table I. Dietary protein intake and energy intake in women of different socio-economic status and ages

Parameters	Socio-economic groups			
	Low	Middle	High	Overall
Protein Intake				
< 25 years	47.22±13.14c	61.01±1.93Bb	75.97±6.79Ba	61.41±14.80B
26-32 years	55.77±10.19c	62.93±1.94Bb	93.03±2.48Aa	69.80±17.23A
> 33 years	53.00±8.06b	68.63±6.70Aa	65.22±6.23Ca	62.29±9.63B
Overall	52.00±10.91c	64.30±5.26b	77.56±12.70a	69.47±14.53
Energy Intake				
< 25 years	1720.00±74.12Bc	2126.00±24.05Cb	2597.10±61.59Ba	2148.45±375.18
26-32 years	1854.30±58.28Ac	2299.60±50.88Bb	2994.56±30.55Aa	2361.72±473.55
> 33 years	1852.90±50.20A	2499.00±258.47A	2511.50±51.22C	2287.80±346.68
Overall	1809.07±87.43c	2314.48±214.78b	2690.90±215.88a	2266.24±406.65

Values are means±SD; Values in each column with different capital letters are statistically significant at $P<0.05$.

Table II. Serum total proteins, albumin and globulins in women of different socio-economic status and ages at before and after delivery

Parameters	Socio-economic groups					
	Low		Middle		High	
	Pre-delivery	Post-delivery	Pre-delivery	Post-delivery	Pre-delivery	Post-delivery
Total proteins						
< 25 years	4.96±1.61	5.14±1.23	4.44±1.64B	4.88±1.68	4.07±1.03b	6.40±3.27a
26-32 years	4.69±1.75	5.39±2.29	6.28±1.94A	5.00±1.87	4.81±0.53	4.31±2.06
> 33 years	4.18±0.69	4.92±1.34	4.30±1.90B	5.01±1.38	4.44±0.84b	5.89±0.99a
Overall	4.61±1.42	5.15±1.64	5.03±2.00	4.97±1.60	4.43±0.86b	5.58±2.40a
Albumin						
< 25 years	3.41±0.84	2.97±1.01	3.36±0.97	3.62±1.14	3.04±1.04	3.87±1.37A
26-32 years	3.63±1.83	3.44±1.28	3.84±0.86a	2.82±0.81b	3.68±0.78a	2.49±0.90Bb
> 33 years	3.21±0.65	2.97±0.77	3.34±1.77	3.44±0.76	3.30±0.85	3.36±1.10AB
Overall	3.42±1.19	3.13±1.03	3.52±1.25	3.28±0.94	3.33±0.91	3.26±1.25
Globulins						
< 25 years	1.55±1.29	2.17±1.21	1.08±0.90B	1.26±0.93	1.03±1.03	2.53±2.24
26-32 years	1.06±0.48	1.95±1.90	2.45±1.73A	2.18±1.69	1.13±0.68	1.83±1.69
> 33 years	0.87±0.26b	1.95±0.96a	0.96±1.23B	1.57±0.88	1.14±0.72b	2.54±1.15a
Overall	1.16±0.83b	2.02±1.37a	1.51±1.47	1.69±1.25	1.10±0.80b	2.32±1.72a

Values are means±SD; Values in each column with different capital letters are statistically significant at $P<0.05$.

reported (Dimopoullos, 1970; Vijayalakshmi & Sarala, 1987). It may be possible that the higher demand of pregnancy is well met by younger women but these may be higher otherwise in non-pregnant older women. Mean serum albumin before and after delivery (Table II) was close to previous findings in Pakistani women (Tabassum *et al.,* 1998; Pervaiz, 1999), while it was slightly lower than observed in Iranian women (Geissler *et al.,* 1978). The lower values observed during present study may be due to decrease occurring in serum albumin at the time of delivery for being consumed/utilized or transferred to newborn or leaked from vessels. However, globulins during present study were higher (P<0.05, Table IIa) after delivery and also immunoglobulins (P<0.05, Table IIIb) that appear to have a contributory effect in raising the serum total protein levels after delivery may be as a consequence of heamoconcentration with selective leakage of albumin.

There was no difference in serum albumin among women of different ages and of different SE status (Table II, IIa), as already reported previously (Tabassum *et al.,* 1998). However, higher (P<0.05) serum albumin in women of high than low SE status related with consumption of lower dietary protein and energy was reported by Pervaiz (1999). These differences might be due to difference of total number of subjects included in these studies, the difference of eating habits or the time and season of study. The same may also apply to the variation in other protein fractions and total protein concentration in these studies.

Table IIa. Serum total proteins, albumin and globulins at before and after delivery in women of different socio-economic status and ages

Parameters	Pre-Delivery			Post-Delivery		
	Low	Middle	High	Low	Middle	High
Total proteins						
< 25 years	4.96±1.61	4.44±1.64	4.07±1.03	5.14±1.23	4.88±1.68	6.40±3.27
26-32 years	4.69±1.75b	6.28±1.94a	4.81±0.53b	5.39±2.29	5.00±1.87	4.31±2.06
> 33 years	4.18±1.42	4.30±2.00	4.44±0.86	4.92±1.64	5.01±1.60	5.89±2.40
Albumin						
< 25 years	3.41±0.84	3.36±0.97	3.04±1.04	2.97±1.01	3.62±1.14	3.87±1.37
26-32 years	3.63±1.83	3.84±0.86	3.68±0.78	3.44±1.28	2.82±0.81	2.49±0.90
> 33 years	3.21±0.65	3.34±1.77	3.30±0.85	2.97±0.77	3.44±0.76	3.36±1.10
Overall	3.42±1.19	3.52±1.25	3.33±0.91	3.13±1.03	3.28±0.94	3.26±1.25
Globulins						
< 25 years	1.55±1.29	1.08±0.90	1.03±1.03	2.17±1.21	1.26±0.93	2.53±2.24
26-32 years	1.06±0.48b	2.45±1.73a	1.13±0.68b	1.95±1.90	2.18±1.69	1.83±1.69
> 33 years	0.87±0.26	0.96±1.23	1.14±0.72	1.95±0.96	1.57±0.88	2.54±1.15
Overall	1.16±0.83	1.51±1.47	1.10±0.80	2.02±1.37	1.69±1.25	2.32±1.72

Values are means±SD; Values in each column with different capital letters are statistically significant at P<0.05.

Table III. Serum A:G ratio, immunoglobulins and fibrinogen in women of different socio-economic status and ages at before and after delivery

Parameters	Socio-economic groups					
	Low		Middle		High	
	Pre-delivery	Post-delivery	Pre-delivery	Post-delivery	Pre-delivery	Post-delivery
A:G ratio						
< 25 years	5.23±5.76	2.05±1.82	5.32±5.16AB	6.49±7.24	1.75±1.15	20.63±59.69
26-32 years	4.36±2.99	3.95±4.48	2.91±3.16B	2.37±2.43	5.13±7.99	2.17±0.86
> 33 years	4.17±1.97a	1.85±0.83b	15.27±19.11A	3.31±2.75	3.39±2.70	2.27±3.15
Overall	4.58±3.81a	2.62±2.90b	7.92±2.60	3.97±4.74	3.36±4.79	8.57±5.04
Immunoglobulins						
< 25 years	137.61±63.60	176.28±70.68	115.28±73.30AB	156.86±104.44	168.31±119.25	179.06±89.66
26-32 years	132.21±58.37	167.58±71.95	186.01±108.80A	170.23±105.02	144.37±92.16	182.23±100.94
> 33 years	149.95±88.00	196.17±71.19	93.49±61.03B	117.94±55.54	122.38±71.61b	244.08±112.75a
Overall	139.92±69.09b	180.01±69.84a	132.16±90.55	148.05±90.43	145.04±94.99b	202.46±102.60a
Fibrinogen						
< 25 years	270.00±149.44B	330.00±176.70B	222.22±148.14B	366.67±282.84	330.00±226.32	270.00±194.65B
26-32 years	430.00±240.60Ba	210.00±110.05Bb	300.00±226.08AB	350.00±171.59	422.22±185.59	277.78±210.82B
> 33 years	700.00±402.77A	610.00±428.05A	450.00±279.88A	340.00±245.86	330.00±170.29b	550.00±263.52Aa
Overall	466.67±328.35	383.33±315.23	327.59±238.89	351.72±227.75	358.62±193.68	368.97±255.10

Values are means±SD; Values in each column with different capital letters are statistically significant at P<0.05.

Table IIIa. Serum A:G ratio, immunoglobulins and fibrinogen at before and after delivery in women of different socio-economic status and ages

Parameters	Pre-Delivery			Post-delivery		
	Low	Middle	High	Low	Middle	High
A:G ratio						
< 25 years	5.23±5.76	5.32±5.16	1.75±1.15	2.05±1.82	6.49±7.24	20.63±59.69
26-32 years	4.36±2.99	2.91±3.16	5.13±7.99	3.95±4.48	2.37±2.43	2.17±0.86
> 33 years	4.17±1.97b	15.27±19.11a	3.39±2.70b	1.85±0.83	3.31±2.75	2.27±3.15
Overall	4.58±3.81ab	7.92±12.60a	3.36±4.79b	2.62±2.90	3.97±4.74	8.57±5.04
Immunoglobulins						
< 25 years	137.61±63.60	115.28±73.30	168.31±119.25	176.28±70.68	156.86±104.44	179.06±89.66
26-32 years	132.21±58.37	186.01±108.80	144.37±92.16	167.58±71.95	170.23±105.02	182.23±100.94
> 33 years	149.95±88.00	93.49±61.03	122.38±71.61	196.17±71.19a	117.94±55.54b	244.08±112.75a
Overall	139.92±69.09	132.16±90.55	145.04±94.99	180.01±69.84ab	148.05±90.43b	202.46±102.60a
Fibrinogen						
< 25 years	270.00±149.44	222.22±148.14	330.00±226.32	330.00±176.70	366.67±282.84	270.00±194.65
26-32 years	430.00±240.60	300.00±226.08	422.22±185.59	210.00±110.05	350.00±171.59	277.78±210.82
> 33 years	700.00±402.77a	450.00±279.88ab	330.00±170.29b	610.00±428.05	340.00±245.86	550.00±263.52
Overall	466.67±328.35	327.59±238.89	358.62±193.68	383.33±315.23	351.72±227.75	368.97±255.10

Values are means±SD; Values in each column with different capital letters are statistically significant at P<0.05.

Table IIIb. Overall serum A:G ratio, immunoglobulin and fibrinogen at before and after delivery in women of different age groups

Age groups	Before Delivery	After Delivery
A:G ratio		
<25 years	4.05±4.65	9.84±35.05
26-32 years	4.10±5.02	2.85±3.04
>33 years	7.61±12.14a	2.48±2.46b
Overall	5.28±8.18	5.03±20.29
Immunoglobulins		
<25 years	148.16±88.82	170.17±86.04
26-32 years	161.43±88.84	166.14±90.34
>33 years	127.40±75.50b	186.07±96.29a
Overall	145.46±83.32b	174.26±85.65a
Fibrinogen		
<25 years	275.86±176.60B	320.69±216.10B
26-32 years	382.76±220.50AB	279.31±171.92B
>33 years	493.33±328.98A	500.00±333.22A
Overall	385.23±264.59	368.18±266.32

Values are means±SD; Values in each column with different capital letters are statistically significant at P<0.05.

The findings of globulin concentration in women of different ages before delivery (26-33 years, P<0.05) were similar to albumin and serum total protein. This reflects the role of serum albumin, globulin and immunoglobulins in the increase of total proteins at the time of delivery (Table IIa). The difference in overall globulins in women of different ages was significant before delivery with higher values in women of 26-32 years of age but between SE status was non-significant, however, were relatively higher in women of high SE status at after delivery (Table II, IIa). However, significantly (P<0.05) higher serum globulin in women of high SE status after delivery has been reported (Tabassum *et al.,* 1998; Pervaiz, 1999) . This probably suggests increase in globulins due to better nutrition and other social or psychological factors. Overall, higher (P<0.05) serum globulins observed during present study after than before delivery was due to higher immunoglobulins (Table IIa, IIIb). This has also been observed in Iranian women (Geissler *et al.,* 1978). The higher immunoglobulins after delivery suggest its possible role in the defence system.

Mean immunoglobulins were 145 and 174 zst-units before and after delivery, respectively and correspond well with globulin concentration and suggest the probable contribution of immunoglobulins in total rise (P<0.05) of globulin concentration post delivery. A decrease in albumin, while increase in alpha-1-globulin and IgE concentration in subjects with pregnancy toxaemia has been reported (Hung *et al.,* 1980). Relatively lower serum albumins after delivery during present study was also observed. Like globulins, overall serum immunoglobulins also revealed higher values after delivery (P<0.05) in women of >33 years of age (Table IIIb), suggesting its role in the rise of total globulins in these subjects. Similar findings have also been reported in Iranian women (Geissler *et al.,* 1978). The differences among various categories, however, may be attributed to the possible role of nutritional status and other general/physical factors after delivery when the immune system is actually activated.

Fibrinogen showed non-significant difference between before (385.23 µg/100 mL) and after (368.18 µg/100 mL) delivery values (Table IIIb). This probably suggests consumption of fibrinogen in an attempt to prevent blood loss through the injured blood vessels in the uterus at the time of delivery. There was an overall higher concentration (P<0.05) of fibrinogen in subjects > 33 years of age both before and after delivery (Table IIIb). However, no difference was observed in overall concentration between women of different SE status both before and after delivery (Table III). Similarly, fibrinogen also revealed no difference between before and after delivery values, in women of different SE groups, suggesting no effect of nutritional status on this parameter.

The correlation computed between different parameters before delivery revealed inverse relationship between birth weight of neonates (data not given here) and total proteins (r = -0.21, P<0.05) including albumin (r = -0.35, P<0.001).

This indicates decrease in maternal serum total protein and albumin concentration with increase in the birth weight of newborn, may be a sharing effect by the foetus. No effect of energy and protein intakes was observed on serum proteins, both before and after delivery. However, a direct relationship between globulins and immunoglobulins before ($r = 0.66$, $P<0.0001$) and after ($r = 0.79$, $P<0.0001$) delivery suggest the role of immunoglobulins in the increase or decrease in total globulins.

CONCLUSION

Serum total proteins, globulins and immunoglobulins significantly increase ($P<0.05$) while albumin decreases after delivery and women of high SE status take higher dietary protein and energy.

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