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Original Article

Serum Protein and Immunoglobulin Levels among Nepalese Living in Southern Nepal

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Abstract

Objective: This study examined the levels of serum protein fractionation, immunoglobulin (Ig) and antistreptolysin O (ASO) of people (91 males and 84 females aged 10–68 years) living in the Terai region of southern Nepal, as there had previously been no information available about them.

Methods: Blood samples were collected early in the morning after overnight fasting. Serum protein fractionation was carried out by cellulose-acetate electrophoresis. IgG, IgA, IgM and ASO were measured by immuno-turbidimetry with clinical kits.

Results: The mean proportion of albumin (Alb) was rather low due to increased globulin (Glb). The Alb level of males was significantly higher than that of females, while the male γ-Glb level was significantly lower than that of females. The mean values of IgG, IgM and ASO for males were lower than those values for females, although the difference was significant only for the IgM value. The mean values of IgM for female age groups of 30–39 years or less were significantly higher than those for the corresponding male age groups. Age correlated positively with IgA, and negatively with ASO in both sexes. γ-Glb and IgG correlated significantly with TP, Alb, α_1-Glb and IgA in both sexes. ASO correlated with β-Glb and IgA in males, and with γ-Glb and IgG in females.

Conclusions: The fact that the level of γ-Glb, a major component of serum globulin, was high suggested exposure to a highly bacterial and viral environment. These results point to the need to prevent infectious diseases as well as improve their nutritional status, especially for children and young adults.

Key words: serum protein, protein fractionation, immunoglobulin, antistreptolysin O, Nepalese

Introduction

We have been conducting nutritional surveys in Nepal for more than a decade and have found their food intake to be generally sufficient (1–3) although there was a latent deficiency of calcium and iron (4, 5).

Another factor useful for estimating Nepalese nutritional status is their serum total protein and albumin concentrations. Their mean values were within the normal range, but a tendency toward higher values of total protein was observed due to increased globulin concentration (4). Immunoglobulin is one of the important serum proteins and has antibody activity. One problem in developing countries is environmental sanitation. Inadequate and poor health facilities cause infectious diseases, a high death rate of children, and result in a lower average life span. Japanese encephalitis and malaria are very common infectious diseases in the Terai region of southern Nepal, posing serious health problems (6, 7).

As there was no information available about the serum immunoglobulin levels of the Nepalese people, this study was conducted to examine the serum immunoglobulin and antistreptolysin O levels of people living in the Terai region of southern Nepal. This was done in the hope of promoting a better understanding of their health status.

Subjects and Methods

The residents of the Chitwan district of the southern agricultural Terai region, are self-supporting but live on a low income.

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Most of them are Hindu. The subjects (91 males and 84 females aged 10 to 68 years old) in this study were a random sampling from among the general populace who came to a medical camp for a routine health check. Blood samples were collected early in the morning after an overnight fast in January 1990 and serum samples were obtained by centrifugation.

Serum protein fractionation was carried out by cellulose-acetate electrophoresis. Immunoglobulin (Ig) G, IgA, IgM and antistreptolysin O (ASO) were measured by immuno-turbidimetry with clinical kits (Nittobo Medical Co. Ltd., Tokyo).

All results were expressed as mean±SD and treated by Student's t-test. Pearson's correlation coefficients were used to examine the relationships among the parameters examined.

Results

Table 1 shows the physical characteristics of the subjects who were almost the same populace as studied previously (5). These values for the 10–14 age group of both sexes were lower than the values for the other age groups. Systolic (SBP) and diastolic blood pressure (DBP) of those over 50 years old tended to be higher than those in the other age groups.

Serum total protein (TP) and the electrophoretic analysis of TP are shown in Table 2. The mean values of the TP level of males and females were 8.6±0.5 and 8.7±0.6 g/dl, respectively, which did not differ significantly between the sexes. The mean proportions of albumin (Alb) and γ-Glb of males were 58.9±3.2 and 19.3±3.0%, respectively, while those of females were 57.2±3.2 and 20.3±3.2%, respectively. The Alb level of the former was significantly higher than that of the latter, on the other hand, the γ-Glb level of the former was significantly lower than that of the latter. Significant differences were observed between the sexes in the 20–29-year age group for Alb, α_1-Glb and β-Glb. γ-Glb for females in the 10–14-year age group was significantly higher than that for males in the same age group (20.9±2.8% vs 18.9±2.7%).

Table 1 Physical characteristics of subjects aged 10 to 68 years

Sex	Subject	Height	Weight	Body mass index	Blood pressure	
					SBP	DBP
(age group)	(n)	(cm)	(kg)	(kg/m^2)	(mmHg)	
Male:						
10–14	17(13)#	139±9	28.6±5.2	14.7±7.2	111± 7	71± 7
15–19	15	158±7	42.8±5.7	17.2±1.2	123±12	81±10
20–29	27	164±7	49.5±5.7	18.9±1.4	130±16	83± 9
30–39	13	163±6	50.0±5.5	18.8±1.1	129±12	86± 6
40–49	9	160±8	47.9±3.7	18.7±1.7	124±13	80± 8
50≤	10	162±6	50.9±6.7	19.5±2.5	141±17	83± 8
Female:						
10–14	16(12)#	135±8	28.3±6.3	15.3±1.7	111± 7	69± 6
15–19	16	152±6	43.7±4.6	19.1±1.8	120± 6	74± 7
20–29	23(22)#	153±5	44.6±5.0	18.9±1.5	127±20	79±10
30–39	12	151±5	39.3±4.6	17.4±1.5	121±13	81±10
40–49	6	146±4	38.9±2.5	18.4±1.4	123±10	78± 8
50≤	11	150±7	41.5±8.3	18.4±3.2	140±15	85± 6

Values are mean±SD. #( )Numbers express blood pressure.

Table 3 Serum immunoglobulin and antistreptolysin-O (ASO) levels of subjects by age group

Sex (age group)	Subject (n)	IgG (mg/dl)	IgA (mg/dl)	IgM (mg/dl)	ASO (U/ml)
Male:					
10–14	17	2,392±445	242± 72	299±149*	343±192
15–19	15	2,571±339	251± 63	307± 97**	238±110
20–29	27	2,591±458	319± 73	299±108*	214± 81
30–39	13	2,488±437	388±100	299±143*	227±100
40–49	9	2,608±687	389±149	340±133	161± 68
50≤	10	2,551±458	415±157	298±154	127± 50
Total	91	2,533±445	321±114	304±124**	229±129
Female:					
10–14	16	2,654±483	242± 94	451±163	324±137
15–19	16	2,609±606	299± 90	430±106	238±123
20–29	23	2,588±602	333±125	400±187	285±175
30–39	12	2,501±420	318± 91	418±128	258±174
40–49	6	2,935±310	333± 77	295±190	256±168
50≤	11	2,692±494	370±176	442±120	172± 77
Total	84	2,630±525	312±120	415±156	263±151

Values are mean±SD. *p<0.05, **p<0.01 (vs. female, same age group).

Table 2 Serum protein fractionation by cellulose-acetate electrophoresis

Sex (age group)	Subject (n)	Total protein (g/dl)	Albumin (%)	α_1-globulin (%)	α_2-globulin (%)	β-globulin (%)	γ-globulin (%)
Male:							
10–14	17	8.2±0.4*	58.7±2.9	4.3±0.6	9.7±1.0	8.5±1.0	18.9±2.7*
15–19	15	8.8±0.4	58.8±3.1	4.3±0.5	9.0±1.1	8.7±0.7	19.2±3.0
20–29	27	8.8±0.5	59.3±2.8*	4.0±0.5*	8.7±1.0	8.4±0.7*	19.6±3.0
30–39	13	8.8±0.4	59.8±2.5	4.1±0.7	8.8±1.0	9.1±0.9	18.1±2.7
40–49	9	8.6±0.7	58.1±3.3	4.1±0.3	8.5±0.8	9.5±1.3	19.9±3.5
50≤	10	8.3±0.5	57.6±5.3	4.6±0.5	8.3±0.8	8.8±0.9	20.6±4.0
Total	91	8.6±0.5	58.9±3.2**	4.2±0.6	8.9±1.0	8.7±1.0	19.3±3.0*
Female:							
10–14	16	8.7±0.6	56.9±3.1	4.3±0.4	9.5±0.9	8.4±0.6	20.9±2.8
15–19	16	8.8±0.6	57.4±3.6	4.1±0.5	9.4±0.9	9.3±0.8	19.8±3.6
20–29	23	8.8±0.6	57.1±3.2	4.4±1.0	9.2±1.4	9.4±1.8	19.7±3.3
30–39	12	8.6±0.6	58.0±3.1	4.5±0.7	8.7±0.9	8.5±1.0	20.3±2.6
40–49	6	8.7±0.4	56.8±2.8	4.4±1.3	8.8±1.0	8.4±1.2	21.8±4.3
50≤	11	8.7±0.5	56.9±3.8	4.4±0.5	9.1±0.9	8.7±0.5	20.9±2.8
Total	84	8.7±0.6	57.2±3.2	4.3±0.7	9.2±1.1	8.9±1.3	20.3±3.2

Values are mean±SD. *p<0.05, **p<0.01 (vs. female, same age group).

Table 4 Correlation between all parameters measured for subjects

Parameter	Age	TP	Alb	α_1-Glb	α_2-Glb	β-Glb	γ-Glb	IgG	IgA	IgM	ASO
Age		–0.03	–0.13	0.11	–0.32**	0.23*	0.14	0.10	0.52***	0.00	–0.44***
TP	–0.08		–0.42***	–0.21*	0.02	–0.01	0.48***	0.64***	0.26*	0.24*	0.08
Alb	–0.04	–0.43***		–0.08	–0.33**	–0.26*	–0.84***	–0.70***	–0.32**	–0.23*	0.05
α1-Glb	0.12	–0.35**	–0.04		0.19	0.24*	–0.24*	–0.21*	–0.05	–0.01	–0.01
α2-Glb	–0.14	–0.16	–0.33**	0.44***		0.10	–0.06	–0.05	–0.16	0.01	0.17
β-Glb	–0.07	–0.03	–0.42***	0.32**	0.42***		–0.12	–0.14	0.29**	0.14	–0.37**
γ-Glb	0.09	0.57***	–0.71***	–0.47***	–0.28**	–0.20		0.84***	0.31**	0.20	0.01
IgG	0.04	0.78***	–0.59***	–0.40***	–0.27*	–0.19	0.85***		0.30**	0.07	0.11
IgA	0.34**	0.35**	–0.41***	–0.06	–0.03	0.21	0.36**	0.29**		0.15	–0.21*
IgM	–0.11	0.09	–0.15	0.02	0.06	0.26*	0.02	0.04	0.12		–0.11
ASO	–0.25*	0.13	–0.15	0.15	–0.16	–0.07	0.26*	0.26*	0.01	–0.01	

Upper right, male (n=91); lower left, female (n=84) *p<0.05, **p<0.01, ***p<0.001.
Abbreviations: TP, total protein; Alb, albumin; Glb, globulin; Ig, immunoglobulin; ASO, antistreptolysin O.

Immunoglobulin and ASO concentrations varied greatly with the individual (Table 3). IgG, the main component of immunoglobulin, did not differ significantly between the sexes although the mean value of IgG for females (2,630±525 mg/dl) was higher than that for males (2,533±445 mg/dl). The only significant difference between the sexes was the IgM value. The mean values of IgM for the female 30–39-year or less age groups were significantly higher than those values for the same age groups in males. The ASO value was very low in older adults and children under 5 years old. The level of ASO in females, especially in the 20–29, 30–39, 40–49-year- and over 50 years old age groups also tended to be higher than in males.

Table 4 shows the correlation coefficients for the serum parameters examined. Significant positive and negative correlations between the parameters examined in both sexes included 8 and 10 cases, respectively. Age correlated positively with IgA, and negatively with ASO in both sexes. TP correlated positively with γ-Glb, IgG and IgA. There were significant positive correlations between γ-Glb and IgG, γ-Glb and IgA, and IgG and IgA were also found in both sexes. A negative correlation between TP and Alb was due to an increase of γ-Glb, which coincided with a negative correlation between Alb and immunoglobulin. Significant correlations between age and α_2-Glb, age and β-Glb, TP and IgM, Alb and IgM, β-Glb and IgA, ASO and β-Glb, and ASO and IgA were observed only in males, while significant positive relationships between β-Glb and IgM, ASO and γ-Glb, and ASO and IgG were found only in females. α_2-Glb also correlated with α_1-Glb, β-Glb, γ-Glb and IgG in females.

Discussion

The mean proportions of Alb and Glb for the subjects were within the normal ranges reported for Japanese (Alb; 55.5–71.3%, α_1-Glb; 2.4–4.6%, α_2-Glb; 6.5–11.9%, β-Glb; 7.5–12.7%, γ-Glb; 7.4–20.2%) (8) although Alb was at the lower limit of the normal range for Japanese and γ-Glb was at the upper limit. One problem is that Alb for the female 20–29-year age group was low. The Alb concentration indicates the nutritional status, therefore, young females need more nutrition for pregnancy and breastfeeding infants, suggesting a need to improve nutritional status. The high amounts of Glb, especially γ-Glb, caused higher amounts of total protein (TP) than what is considered normal for the Japanese (6.8–8.2 g/dl for both sexes) (9) and for Itahari residents, an industrial district in the Terai region reported previously (4, 10). γ-Glb is a major component of globulin and is known to increase with liver disease, and chronic or acute infectious diseases. One contributing factor may be related to the fact that hepatitis in its various forms is a regular occurrence in Kathmandu and other parts of Nepal (7). The γ-Glb value for blood donors with hepatitis C antibodies has been reported by Rossini et al. to be 13.18±2.86 g/dl (n=21, Italians) (11). Calculating from Table 2, the mean values of γ-Glb were about 16.60 g/dl for males and about 17.66 g/dl for females, which were 26-34% higher than those reported by Rossini et al. This may point to a serious problem among young female children whose γ-Glb values were higher than those for the same age group of males. α_1-Glb, α_2-Glb and β-Glb amounts are also related to liver disease, nephritis or inflammation.

The mean value of IgG, the main immunoglobulin, was higher than the normal value of 800–2,000 mg/dl for the Japanese (12). The mean value of IgM for females, except those over 50 years old was higher than that of the normal values of the Japanese (40–350 mg/dl) (12). A normal ASO value (≥166 U/ml for adults) was only observed in males over 40 years old (8). The elevation of the ASO value suggests streptococcal infections, which may decrease as socioeconomic conditions improve. These elevated values of immunoglobulin and ASO may be due to more female exposure to natural bacterial and viral environments than males.

One emerging serious health problem in Nepal is Japanese encephalitis and malaria, especially in hot and humid regions such as Terai. Although there is no clear epidemiological information about the disease, it has been found to occur almost every year since 1978 during the hot and humid seasons in about 23 districts, mainly in the Terai area of the country (6, 7, 13). Serious outbreaks of this disease occurred in 1985 and 1986 and there were 24,989 patients in 1988 (latest available information) (6, 7). Other infectious and parasitic diseases can be caused by polluted drinking water and by exposure to bacterial and viral environmental conditions. The fact that children and females were the most disadvantaged in health and nutrition was also suggested from the results in this study as reported by others (14). To prevent such infectious diseases, environmental sanitation and an improvement in living conditions are necessary, together with information about environmental sanitation as well as an improvement in nutritional status.

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