Serum Levels of Immunoglobulins in Marasmic Infants

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The syndrome of protein-calorie malnutrition is associated with an increased frequency of infections which often precipitate or aggravate the state of malnutrition. The importance and the far-reaching implications of the interaction between malnutrition and infections, a predominantly synergistic one, have been stressed by Scrimshaw, Taylor, and Gordon (1959) and more recently by the Joint FAO/WHO Expert Committee on Nutrition (1967).

Of the various mechanisms of the host's defences against infection, antibody production assumes an important but not an exclusive role. Antibody response in human malnutrition has been studied in the kwashiorkor type of malnutrition and in adults with severe protein depletion. No such studies have been reported in marasmic malnutrition, the much more prevalent type of human malnutrition (McLaren, 1966).

Infants with kwashiorkor were able to produce antibodies against typhoid, poliomyelitis, and smallpox vaccines (Pretorius and De Villiers, 1962; Brown and Katz, 1965) and had normal levels of isohaemagglutinins (Kahn, Stein, and Zontendyk, 1957). Young adults with severe protein deficiency responded adequately to diphtheria toxoid (Balch, 1950; Havens, Bock, and Siegel, 1954).

To our knowledge, only one study has been published reporting on the levels of immunoglobulins in kwashiorkor (Brown and Katz, 1965). The authors found a significant decrease in the levels of IgG immunoglobulins in the sera of 20 children with kwashiorkor as compared with 5 normal children. The serum levels of IgM and IgA were not statistically different from those of the normal children.

The purpose of this communication is to report the levels of the serum immunoglobulins in infants with marasmic malnutrition.

Subjects and Methods

Studies were made of 16 marasmic infants between the ages of 3 and 30 months. The cause of malnutrition in all 16 was primarily undernutrition aggravated in most instances by gastro-intestinal disturbances or respiratory infections. None had the clinical changes of kwashiorkor and none had a primary disease besides malnutrition. The age, sex, weight, albumin, and globulin levels are shown in Table I. The serum protein, albumin, and globulin were determined by the method of Wolfson *et al.* (1948).

Serum levels of IgM, IgA, and IgG were determined by the radial immunodiffusion method of Mancini, Carbonara, and Heremans (1965), using commercially available antibody agar plates (Immunoplates, Hyland Laboratories, Los Angeles, California). Different dilutions of pooled normal serum previously standardized against immunochemically pure human immunoglobulins were used as standards; these were supplied by Hyland Laboratories. Each serum was tested on at least two different occasions for each of the three immunoglobulins, and the values were averaged.

The serum immunoglobulin levels of 23 healthy infants of the same population and of the same age-group were determined in a similar fashion.

Results

Because of the known variability of the immunoglobulin levels with age, the marasmic and the healthy control infants were divided into 3 groups: 3 to 6 months, 7 to 12 months, and 13 to 30 months. The serum levels of the immunoglobulins in the various age-groups are shown in Tables II, III, and IV and are plotted in Fig. 1-3.

In the 3 to 6 months group, the mean serum levels of IgM, IgA, and IgG in the marasmic infants were much higher than the respective mean levels for healthy infants. This difference was statistically significant.

In the 7 to 12 months group, the levels of IgA and IgG were similar in the marasmic and the healthy infants; the IgM levels were higher in the

TABLE I
Age, Weight, and Serum Proteins of Marasmic Infants

Case No.	Sex	Age (mth.)	Weight (g.)	Serum Protein (g./100 ml.)	Albumin (g./100 ml.)	Globulin (g./100 ml.)
1	M	3	2860	5.78	3.12	2.66
2	M	4½	4350	5.88	3.64	2.24
3	M	4½	3200	7.20	—	—
4	M	5	3800	3.30	1.5	1.8
5	F	5	2745	6.25	4.0	2.25
6	F	5	3930	5.90	—	—
7	M	5½	3880	6.50	—	—
8	F	7	3700	7.46	4.80	2.66
9	M	8	6800	—	—	—
10	F	9	4200	6.89	3.83	3.06
11	M	9	4570	8.06	4.44	3.62
12	M	10	4900	6.62	4.41	2.21
13	F	10	4170	5.03	2.45	2.58
14	M	15	4600	7.68	3.57	4.11
15	F	15	5500	6.00	4.0	2.0
16	M	30	6400	4.80	2.2	2.6

marasmic group and the difference was statistically significant.

In the 13 to 30 months group, there were only 3 marasmic infants, and IgM and IgG levels in these 3 were comparable to those of the healthy controls. IgA, however, was excessively raised in the 3 marasmic infants; 430, 300, and 215 mg./100 ml., respectively, as compared to a mean of 50 mg./100 ml. in the control group, with a range of 28 to 73 mg./100 ml.

Discussion

Marasmic infants seem capable of producing normal or above normal amounts of immunoglobulins when compared to healthy infants of the same age. The increased serum levels of the IgM

FIG. 1.—Serum levels of IgM. ● Healthy infants; ○ marasmic infants.

FIG. 2.—Serum levels of IgA. ● Healthy infants; ○ marasmic infants.

FIG. 3.—Serum levels of IgG. ● Healthy infants; ○ marasmic infants.

TABLE II
*Levels of Serum Immunoglobulins in
Marasmic and Control Infants 3 to 6 Months of Age*

Case No.	Age (mth.)	IgM (mg./100 ml.)	IgA (mg./100 ml.)	IgG (mg./100 ml.)
1	3	170	62	1150
2	4½	182	79	1125
3	4½	110	85	1100
4	5	115	210	950
5	5	128	150	900
6	5	158	92	930
7	5½	82	100	800
Mean		149.3*	111.2*	993.5†
Standard deviation		31.1	51.5	132.4
Standard error of mean		11.74	19.4	50.0
<i>Controls (8 normal infants)</i>				
Mean		61.6*	24.6*	680†
Standard deviation		18.4	19.5	170
Standard error of mean		6.5	6.9	69.8

* Difference statistically significant $p < 0.001$ (using t test for small samples).

† Difference statistically significant $p < 0.01$ (using t test for small samples).

TABLE IV
*Levels of Serum Immunoglobulins in Marasmic
and Control Infants, 13 to 30 Months of Age*

Case No.	Age (mth.)	IgM (mg./100 ml.)	IgA (mg./100 ml.)	IgG (mg./100 ml.)
14	15	64	430	1800
15	15	49	215	970
16	30	140	300	1350
<i>Controls (6 normal infants)</i>				
Mean		77.3	50	1100
Standard deviation		24.1	17.5	285.4
Range		43-105	28-73	750-1450

and IgG in the 3 to 6 months group probably do not represent a haemoconcentration, because blood was drawn in most instances several days after the initial period of hydration, and because of the disproportionate rise in the 3 immunoglobulins in the same subject. More probably, this rise represents the response to the recurrent infections to which they have been subjected. The same can be said about the increased levels of IgM in the 7 to 12 months group. It is interesting to note the marked rise in the serum levels of IgA in the 3 older marasmic infants and in the marasmic infants 3 to 6 months of age. The significance of this rise is difficult to interpret. IgA is the major immuno-

TABLE III
*Levels of Serum Immunoglobulins in
Marasmic and Control Infants 7 to 12 Months of Age*

Case No.	Age (mth.)	IgM (mg./100 ml.)	IgA (mg./100 ml.)	IgG (mg./100 ml.)
8	7	120	44	900
9	8	120	57	940
10	9	85	96	650
11	9	100	24	1300
12	10	110	86	1200
13	10	145	55	870
Mean		113.3*	60.3‡	976.6‡
Standard deviation		20.4	22.7	236
Standard error of mean		8.3	10.8	96.5
<i>Controls (9 normal infants)</i>				
Mean		69.8*	54.1‡	1090.7‡
Standard deviation		33.0	37.7	293.4
Standard error of mean		11.0	11.6	110.9

* Difference statistically significant $p < 0.02$ (using t test for small samples).

‡ Difference statistically not significant $p > 0.05$ (using t test for small samples).

globulin found in the epithelium of the gastro-intestinal tract (Gelzayd, Kraft, and Fitch, 1967). One may speculate that increased IgA in the serum may reflect the recurrent gastro-intestinal disorders from which these children had suffered.

Summary

The serum levels of IgM, IgA, and IgG were determined in 16 infants with marasmic malnutrition. The levels of these 3 immunoglobulins were significantly higher than those of well-nourished infants 3 to 6 months of age. In the older marasmic infants the levels of IgM in those between 7 and 12 months and of IgA in those between 13 and 30 months were significantly higher than the corresponding levels in the well-nourished infants.

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