VII. Corn-soy-wheat macaroni

Dietary protein quality in infants and children[1]

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Acceptable, inexpensive products of high biologic value are badly needed to improve foods in underdeveloped countries. The authors evaluated a corn-soy-wheat macaroni in treating malnourished infants and report their success.

Food which is not consumed has a biologic value of zero and frustrates efforts to improve the diets of impoverished people and to maintain the nutritional quality of the diet for more privileged individuals. One of the great challenges today is the development of inexpensive foods which are nutritionally superior and at the same time acceptable to the intended consumers. The introduction of foods which are both nutritious and inexpensive is painfully slow if they represent forms and tastes which are foreign to the purchaser and consumer. Of the few foods which are almost universally acceptable, cow's milk is far too expensive and perishable for the backward areas of the world and is rejected for sound physiologic reasons by a large proportion of non-white individuals past the weaning age (1). It is probably naive to hope that in the near future a beverage could be developed with the high caloric density of milk plus its high protein content and quality, generous content of most minerals and vitamins, and wide-ranging acceptability, which would, at the same time, be inexpensive, relatively non-perishable, and physiologically tolerable throughout the world.

Wheat is one of the most widely distributed and acceptable cereals, consumed in a variety of forms, but particularly as bread and "pasta" products. The biologic value of wheat protein can be markedly enhanced by adding its first-limiting amino acid, lysine, without altering its organoleptic characteristics and acceptability (2). Its protein content can also be increased, preferably by adding a lysine-rich source of protein (3), although this alters its characteristics significantly, creating problems of food technology and adding to the cost. In some areas of the world, wheat is abundant and is the least expensive cereal available; in many others, rice, corn, sorghum, or millet are more abundant and less expensive. Although bread is more widely consumed than "pasta" products, its consumer is generally more sensitive to any alterations, as are the thousands of bakers involved in its elaboration. It is also considerably more perishable. "Pasta" products are relatively non-perishable, usually made by large industries, consumed with a variety of well flavored supplements, and perhaps most important, easily accepted by all age groups, from the small infant to the edentulous elder citizen.

We have recently evaluated the protein quality of a "pasta" product made from corn, soy, and wheat flours into the form of an "elbow" macaroni (GF-1). This product has a protein content and quality which are significantly higher than those of wheat flour; the cost of its ingredients in this country and in many others should be lower than that of the equivalent wheat product; and, perhaps uniquely important, it is in a form which should be highly acceptable to people of widely differing age, race, and social circumstances in many parts of the world.

Materials and Methods

Comparisons were made of GF-1, Fortifex (see below)

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and corn-soy-milk (CSM) by feeding them to three convalescent malnourished infants, with intervening casein periods. GF-1 and GF-2 (with added DL-methionine), using one of these infants and two others, were also compared. GF-1 or GF-2 was given as the sole source of protein to three infants for 3.0 to 4.3 months; at the end of these periods, a comparison with casein was made. One of the three subjects was an infant newly admitted with kwashiorkor. Four more patients with kwashiorkor also received GF-1 or GF-2 as the sole source of dietary protein during their initial management.

The GF-1 macaroni was made[5] from a blend of: 49.8 per cent corn flour, 27.8 per cent defatted soy flour, 19.4 per cent wheat flour, 0.8 per cent calcium carbonate, 0.1 per cent vitamin mix, and 1.85 per cent mineral mix. An additional batch, with 0.27 per cent DL-methionine added, is identified as "GF-2." Both forms were estimated to yield 350 kcal per 100 gm., and their proximate composition was:

protein	20.7 per cent
carbohydrate	66.2 per cent
fiber	1.0 per cent
ash	4.0 per cent
fat	0.1 per cent
moisture	8.0 per cent

Vitamin content per 100 gm. dry weight was: vitamin A, 1,650 I.U.; vitamin D, 200 I.U.; vitamin E, 1.5 I.U.; ascorbic acid, 40 mg.; thiamin, 0.3 mg.; riboflavin, 0.4 mg.; niacin, 5.0 mg.; pantothenic acid, 2.7 mg.; pyridoxine, 0.17 mg.; vitamin B_{12}, 3.3 mcg.; and folic acid 0.1 mg. Mineral content per 100 gm. was: calcium, 400 mg.; phosphorus, 200 mg.; sodium, 260 mg.; iron, 7.8 mg.; iodine, 47 mcg.; and zinc, 0.9 mg.

The protein efficiency ratio (PER) in weanling Wistar rats at the 10 per cent protein level was reported as 2.7 (casein, 2.9) by the manufacturer and confirmed in our laboratory. With 0.3 per cent DL-methionine, it was 2.8. None of the differences was significant. By amino acid analysis and comparison with egg protein, methionine would seem to be the first-limiting amino acid in this blend. When total sulfur-containing amino acids were taken into account, however, valine and isoleucine ap-

[5]General Foods Corporation processed the macaroni for this study.

Table 1: Comparisons between corn-soy-wheat macaroni (GF-1), a corn-soy-milk mixture (CSM), and a corn-soy-methionine mixture (Fortifex) with intervening control periods on casein, as respective sources of protein for three convalescent, malnourished male infants receiving 2 gm. protein and 125 calories per kilogram per day

protein source	*days on diet*	*nitrogen*					*weight change*	*serum albumin*	
		on days	*intake*	*absorption*	*retention*			*change*	*final*
					actual	*% of intake*			
			mg./kg./day	*% intake*	*mg./kg./day*		*gm./kg./day*	*gm./100 ml.*	
Patient No. 227*									
casein	9	4-9	320	87	132	41	7.3	−0.62	4.06
CSM	9	4-9	320	63	90	28	4.8	−0.24	3.82
casein	9	4-9	320	88	157	49	2.9	−0.27	3.75
Fortifex	9	4-9	320	73	95	30	6.5	−0.10	3.65
casein	9	4-9	320	87	152	48	4.8	0.39	4.04
GF-1	9	4-9	320	79	124	39	5.3	−0.08	3.96
casein	12	7-12	305	86	158	52	1.6	0.02	3.98
Patient No. 234†									
casein	9	4-9	320	88	115	36	6.8	0.07	4.13
CSM	12	4-6	320	73	37	12			
		7-12	320	71	71	22	3.8	—	—
casein	9	4-9	320	89	130	41	3.9	—	4.15
GF-1	9	4-9	320	77	85	27	7.2	−0.13	4.02
casein	9	4-9	320	78	96	30	6.8	−0.29	3.73
Fortifex	9	4-9	320	76	88	28	6.3	0.29	4.02
casein	9	4-9	320	83	139	43	5.7	0.13	4.15
Patient No. 265‡									
casein	9	4-9	320	86	98	31	3.6	0.14	4.23
Fortifex	9	4-6	320	69	42	13			
		7-9	320	70	102	32	6.5	0.54	4.77
casein	9	4-9	320	78	80	25	1.8	−0.09	4.68
GF-1	9	4-8	320	75	78	25	5.8	−0.22	4.46
casein	9	4-9	320	83	139	44	4.0	−0.19	4.27
CSM	9	4-9	320	74	105	33	4.9	−0.56	3.71
casein	9	4-9	320	86	138	43	3.3	−0.12	3.59

*On hospital day No. 116: age, 10.3 months; height, 61.4 cm. (equivalent to 50th percentile at 3.4 months by a U.S. standard); weight, 6.93 kg. (equivalent to 50th percentile at 5.3 months by a U.S. standard [8]).
†On hospital day No. 40: age, 21.6 months; height, 75.6 cm. (equivalent to 50th percentile at 12.6 months by a U.S. standard); weight, 7.68 kg. (equivalent to 50th percentile at 6.3 months by a U.S. standard [8]).
‡On hospital day No. 82: age, 13.5 months; height, 65.8 cm. (equivalent to 50th percentile at 5.6 months by a U.S. standard); weight, 7.55 kg. (equivalent to 50th percentile at 6.2 months by a U.S. standard [8]).

peared equally limiting.

The same corn-soy-milk (CSM) blend previously evaluated in our unit (4) was used in the comparative studies.

The Fortifex was a blend of 50 per cent defatted soy flour, 49 per cent corn meal, and 1 per cent calcium carbonate, with 0.2 per cent DL-methionine added[6].

The casein used was calcium caseinate[7].

Appropriate amounts of cottonseed oil and cane sugar were added to the diets of convalescent malnourished infants to achieve the desired protein and caloric intakes, which were recalculated daily on the basis of body weight. Vitamin and mineral mixes (5) were added when the amounts of the product used were too small to meet the recommended allowances.

The rationale behind the comparative and other studies has been detailed in other publications (2, 5), as have the laboratory methods.

Results

Table 1 summarizes the comparative metabolic studies in the three convalescent infants. Changes in body weight during such short periods must be interpreted with caution and are reported primarily to indicate that the infants were all gaining steadily. The general downward trend of the serum albumin levels is to be expected with most non-milk diets at such critical levels of intake, i.e., 6.4 per cent protein calories. The fall was generally less on the casein diets.

When apparent nitrogen retentions from the three test proteins are compared with the immediately preceding and following casein periods, differences which might be due to a changing physiologic state are minimized. Expressed as a percentage of casein values, the mean retention from CSM was 60.5 per cent, that from Fortifex was 73.0 per cent, and that from CF-1 was 75.5 per cent. Much of the difference is due to differences in apparent digestibility: for CSM, it was 69.7 per cent of intake; for Fortifex, it was 72.8 per cent; for CF-1, it was 77.0 per cent; and for casein, it was 84.9 per cent. When retentions are expressed as a percentage of nitrogen absorbed, they are 38.3 per cent for CSM, 36.6 per cent for Fortifex, 39.0 per cent for CF-1, and 47.0 per cent for casein. These studies suggest that the protein quality of CF-1 is approximately equal to that of Fortifex, both being moderately superior to CSM mostly on the basis of digestibility.

[6]Prepared by the Nestle Company and made available for this study by the Food Conservation Division, UNICEF.

[7]Casec, made available by Mead Johnson Research Center.

Table 2: Comparisons between corn-soy-wheat macaroni (CF-1), the same enriched with methionine (CF-2), and casein as a source of protein in metabolic studies of three convalescent, malnourished male infants

protein source	*intake*			*number of days*	*nitrogen*					*weight change*	*serum albumin*	
	energy	*protein*			*on days*	*intake*	*absorption*	*retention*			*change*	*final*
		amount	*% of calories*					*amount*	*% of intake*			
	kcal/kg./day	*gm./kg./day*				*mg./kg./day*	*% of intake*	*mg./kg./day*		*gm./kg./day*	*gm./100ml.*	
Patient No. 227*												
casein	125	2.0	6.4	9	4- 9	320	87	152	48	4.8	0.39	4.04
CF-1	125	2.0	6.4	9	4- 9	320	79	124	39	5.3	−0.08	3.96
casein	125	2.0	6.4	12	7-12	305	86	158	52	1.6	0.02	3.98
casein	110	1.75	6.36	9	4- 9	279	90	136	49	3.8	0.34	4.98
CF-2	110	1.75	6.36	12	7-12	273	87	122	45	1.3	0.03	5.01
casein	110	1.75	6.36	3	3	269	86	138	51	−2.03	—	—
Patient No. 240†												
casein	110	1.3	6.55	10	5-10	288	87	101	35	2.2	−0.21	4.05
CF-1	110	1.8	6.55	9	4- 9	288	82	76	26	3.0	0.03	4.08
casein	110	1.8	6.55	9	4- 9	288	85	107	37	2.2	0.27	4.35
CF-2	110	1.8	6.55	12	4- 6	288	65	43	15			
					7-12	288	76	98	34	1.95	−0.65	3.70
casein	110	1.8	6.55	9	4- 9	281	85	91	33	0.3	0.08	3.78
Patient No. 258‡												
casein	100	1.65	6.6	9	4- 9	264	93	84	32	3.3	−0.18	4.05
CF-2	100	1.65	6.6	12	4-12	264	79	65	25	3.2	−0.29	3.76
casein	100	1.65	6.6	9	4- 6	264	88	83	31			
					7- 9	264	92	40	15	1.9	0.11	3.87
CF-1	100	1.65	6.6	9	4- 6	264	74	31	12			
					7- 9	264	80	59	22	2.0	0.11	3.98
casein	100	1.65	6.6	9	4- 6	264	81	80	30			
				6	7- 9	264	86	53	20	3.3	—	—

*On hospital day No. 152: age, 11.9 months; height, 74.7 cm. (equivalent to 50th percentile at 4.8 months by a U.S. standard); weight, 8.77 kg. (equivalent to 50th percentile at 10.4 months by a U.S. standard [8]).

†On hospital day No. 83: age, 13.7 months; height, 72.6 cm. (equivalent to 50th percentile at 10.2 months by a U.S. standard); weight, 8.67 kg. (equivalent to 50th percentile at 8.1 months by a U.S. standard [8]).

‡On hospital day No. 52: age, 24 months; height, 76.1 cm. (equivalent to 50th percentile at 12.9 months by a U.S. standard); weight, 9.92 kg. (equivalent to 50th percentile at 11.9 months by a U.S. standard [8]).

In Table 2, a comparsion is made between GF-1 and GF-2, the methionine-enriched version, with casein for the "control" periods. The mean apparent retention of nitrogen from GF-1 was 75.2 per cent of that from casein; for GF-2, it was 79.8 per cent, all of the difference being due to an uncharacteristically higher absorption of nitrogen from GF-2 in one subject, No. 227. When changes in weight and in serum albumin levels are examined, there is no discernible trend in favor of the methionine-enriched product.

During more prolonged feeding, at more favorable protein:calorie ratios (Table 3), very satisfactory growth rates were maintained. The seemingly inferior linear growth of the infant receiving GF-1 is quite characteristic of many newly admitted patients. This is well illustrated in Figure 1, which relates these particular periods of study to the entire period of hospitalization. Balance studies carried out after prolonged feeding of an inadequate protein intake will usually demonstrate markedly increased retentions from milk protein, as in patients with kwashiorkor. In these three infants (Table 4), such an exaggerated increase in nitrogen retention was not apparent, suggesting that they were not protein-deficient at the end of this prolonged feeding study.

Table 5 summarizes the satisfactory results in the initial dietary management of five patients with marasmic kwashiorkor, receiving GF-1 or GF-2 instead of milk protein. In both infants receiving GF-1 and in one of the three receiving GF-2, serum albumin failed to reach the immediate vicinity of 4.0 gm. per 100 ml., which we would expect by thirty days in most infants receiving milk under similar circumstances.

PLASMA AMINO ACIDS. Fasting plasma free amino acids were determined in most of these infants after variable periods on the various diets. These were expressed in the same manner as in previous publications (2, 4). For five infants receiving GF-1, mean total amino acids were: 1.925 μM per milliliter; mean total essential amino acids were 0.559 μM per milliliter; essential amino acids as a fraction of the total were 0.290; and methionine as the molar fraction of essential amino acids was 0.036. For five infants receiving GF-2, mean total amino acids were: 1.995 μM per milliliter; total essential amino acids 0.549 μM per milliliter; essential amino acids as a fraction of total, 0.275; and the molar fraction of methionine, 0.039. For only two infants receiving Fortifex, the respective values were: 1,965, 0.544, 0.277, and 0.044. From our previous publication (4), the values for CSM were 1.931 ± 0.45 (standard deviation), 0.483 ± 0.19, 0.247 ± 0.57, and 0.042 ± 0.013. For comparable milk protein diets (2), the values were: 2.298 ± 0.192, 0.691 ± 0.086, 0.296 ± 0.024, and 0.032 ± 0.006. The combined GF values were significantly lower than the milk protein values and higher than those for CSM ($P<0.05$), except for the molar fraction of methionine, which was not significantly different for any of the three studies.

Discussion

Studies of dietary protein quality for use by infants and children are more difficult to carry out and to interpret than those in experimental animals. Because they are growing at predictably rapid rates, however, studies in infants and children are more meaningful than those in adult volunteers. Studies made during the initial management of severely protein-deficient infants have a spe-

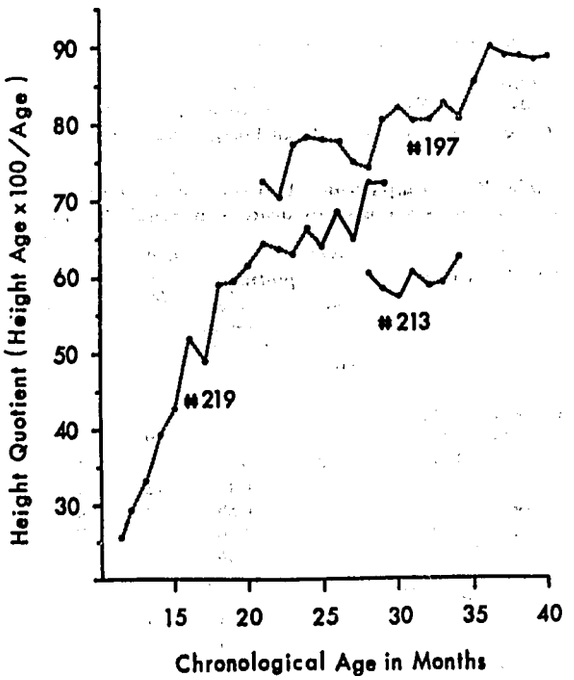

FIG. 1. *Change in height in three malnourished infants receiving corn-soy-wheat macaroni as the sole source of protein during part of their convalescence (solid lines and circles). Patient No. 213 received GF-1; the other two received GF-2.*

Table 3: Growth, as indicated by gain in height- and weight-ages of three convalescent male infants fed GF-1 or GF-2 as the sole source of dietary protein.

patient	*dietary protein source*	*initial age*	*initial height-age**	*initial weight-age**	*protein intake*		*progress in months**			*serum albumin*	
					calculated	*% of calories*	*chronologic*	*height-age*	*weight-age*	*change*	*final*
		← *months* →			*gm./kg./day*		← *months* →			*gm./100 ml.*	
No. 197	GF-2	35.8	30	43.1	2.5	10	4.3	4.3	0.1	0.19	4.07
No. 219	GF-2	24.5	16	24.3	2.5	10	4.3	6.0	2.1	−0.04	3.92
No. 213	GF-1	27.9	17.1	5.8	2.5	8	3.0	1.7	6.1	1.07	3.33

*By Stuart standard (8).

cial significance, dietary protein quality being very critical to such protein-depleted individuals.

By all the criteria used in this study, macaroni made of corn, soy, and wheat flours has been demonstrated to have satisfactory protein quality. Digestibility, measured by the apparent absorption of nitrogen in infants, was at least as high as that of a corn-soy mixture previously found to be very satisfactory, and was apparently superior to that of CSM, a mixture now in wide use throughout the world. Digestibility was at least the equal of all other vegetable products we have studied, with the exception of white wheat flour (2), isolated soy protein, and formulas based on it. It was very near to that of modified cow's milk formulas. Biologic value, measured by retention of absorbed nitrogen, was equal to that of the other corn-soy products and approximately 83 per cent that of casein. Probably because of differences in absorption, net protein utilization (NPU) of the macaroni was superior to that of the other vegetable mixtures studied, but only 75 per cent of that from casein.

Prolonged feeding, with at least 8 per cent of dietary calories coming from this source of protein, resulted in "normal" growth during convalescence from malnutrition. There was no evidence of protein deficiency developing during this time. The satisfactory response in five infants with kwashiorkor indicates that this product can correct a state of protein depletion, an important consideration among infants and children of the poor, who are subject to frequent episodes of protein depletion, resulting from numerous infections and periods of dietary restriction of protein-rich foods, particularly in the underdeveloped world.

The fact that we could not demonstrate any supplementary effect of methionine added to this product confirms the impression, from its amino acid composition, that the total sulfur amino acid content is not first-limiting. Only from the seemingly better serum albumin responses in two of the three infants with kwashiorkor can any beneficial effect of methionine be postulated. This might be a chance occurrence or represent a more critical need for methionine in kwashiorkor, as suggested by previous observations (6).

Our own experience and that of others (7) suggest that a minimum of 6.4 per cent of calories must be provided as high-quality protein for a rapidly growing infant to avoid demonstration of any indication of protein deficiency. If we take our present observations at face value and assume that the protein in the macaroni had 75 per cent of the net protein values of casein, then it would have to provide a minimum of 8.6 per cent of calories as protein in an infant's diet. The prolonged feeding studies suggest that this is an adequate proportion. Since slightly over 20 per cent of calories in the macaroni was derived from protein, an infant or small child could consume only half of his or her daily caloric requirement in the form of this macaroni and amply satisfy the protein requirement.

Because of its good digestibility and the high acceptability demonstrated thus far in Peru, Brazil, and the southern United States, it is not unreasonable to expect that such a "pasta" product could become an important

Table 4: Terminal nitrogen balance after prolonged feeding of corn-soy-wheat macaroni (CF-1 and CF-2) compared with casein as source of protein for three convalescent, malnourished male infants

protein source	*intake*			*number of days*	*nitrogen*					*weight change*	*serum albumin*	
	energy	*protein*			*on days*	*intake*	*absorption*	*retention*			*change*	*final*
		amount	*% of calories*					*amount*	*% of intake*			
	kcal/kg./day	*gm./kg./day*				*mg./kg. day*	*% of intake*	*mg./kg. day*		*gm./kg./day*	*gm./100 ml.*	
Patient No. 197*												
CF-2	100	2.0	8	15	10-12	320	79	37	12	−0.1	−0.17	4.07
					13-15	320	83	80	25			
casein	100	2.0	8	9	1- 3	307	85	12	4			
					4- 6	320	90	48	15			
					7- 9	320	86	27	8	−0.3	−0.7	4.00
Patient No. 219†												
CF-2	100	2.0	8	12	1- 6	318	85	113	36			
					7- 9	319	73	− 7	—			
					10-12	309	82	63	20	0	−0.57	3.92
casein	100	2.0	8	6	1- 6	320	88	82	26	4.3	−0.01	3.91
Patient No. 213‡												
CF-1	125	2.5	8	6	1- 3	400	79	90	23			
					4- 6	400	77	43	11	4.8	0.19	3.33
casein	125	2.5	8	6	1- 6	400	86	103	26	4.0	0.43	3.76

*On hospital day, No. 594: age, 39.6 months; height, 95 cm. (equivalent to 50th percentile at 23.5 months by a U.S. standard); weight, 15.38 kg. (equivalent to 50th percentile at 31.7 months by a U.S. standard [8]).

†On hospital day No. 525; age, 28.5 months; height, 84.2 cm. (equivalent to 50th percentile at 20.4 months by a U.S. standard); weight, 13 kg. (equivalent to 50th percentile at 26.5 months by a U.S. standard [8]).

‡On hospital day No. 86: age, 30.7 months; height, 82 cm. (equivalent to 50th percentile at 18.2 months by a U.S. standard); weight, 9.68 kg. (equivalent to 50th percentile at 10.9 months by a U.S. standard [8]).

weaning food, a main ingredient in school lunch programs, an excellent food for the elderly, or a highly nutritious component of any diet.

Summary

Macaroni based on corn, soy, and wheat flours has been evaluated as the source of dietary protein for convalescent or acutely malnourished infants. The digestibility of its protein was found to be very close to that of modified cow's milk. Net protein utilization was approximately 75 per cent of that of casein, and it was very effective in initiating recovery in severely protein-depleted infants. Its high-protein content and demonstrated high biologic value, combined with the fact that it is very acceptable, make this "pasta" attractive as a weaning food or as an important nutritious ingredient of school lunches, foods for the elderly, or ordinary diets.

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Table 5: Effect on weight and serum albumin of GF-1 and GF-2 in dietary management of five infants with kwashiorkor

hospital days	*protein*		*calories*		*weight change*	*serum albumin*	
	source	*intake*	*intake*	*% protein*		*change*	*final*
		gm./kg./day	*kcal/kg./day*		*gm./kg./day*	*gm./100/ml.*	
Patient No. 213*							
1-6	GF-1	1.7	73	9.2	−14.4	0.69	2.95
7-66	GF-1	2.5	125	8.0	4.7	0.83	3.78
67-91	GF-1	2.5	125	8.0	4.8	−0.45	3.33
Patient No. 266†							
1	‡	‡	‡	‡	−29.2	—	—
2-4	GF-1	1.3	67	8.0	2.8	0.82	3.03
5-9	GF-1	2.0	100	8.0	—	—	—
10	‡	‡	‡	‡	−22.2	—	—
11-37	GF-1	1.8	88	8.0	− 9.2	0.20	3.23
18-31	GF-1	2.5	125	8.0	8.6	0.25	3.48
Patient No. 224#							
1	casein	1.0	50	8.1	− 8.2	0.28	2.39
2-3	GF-2	2.0	75	10.7	− 1.0	0.16	2.55
4-11	GF-2	2.0	100	8.0	5.1	0.32	2.87
12-33	GF-2	2.5	125	8.0	6.5	1.22	4.09
Patient No. 263¶							
1-2	‖	‖	‖	‖	6.7	−0.24	1.82
3-10	GF-2	1.5	62	9.4	1.2	−0.24	1.58
11-17	GF-2	2.5	100	10.0	0.4	0.29	1.87
18-46	GF-2	3.0	100	12.0	0.8	1.86	3.73
47-55	GF-2	2.0	100	8.0	2.5	0.23	3.96
Patient No. 269**							
1	GF-2	1.0	38	10.5	− 7.3	—	—
2-3	GF-2	1.5	50	12.0	3.7	0.12	1.96
4-6	GF-2	2.0	75	10.7	2.8	−0.18	1.78
7-17	GF-2	2.5	100	10.0	− 7.2	0.79	2.57
18-34	GF-2	3.0	125	9.6	4.0	0.57	3.14

*Initial age, 28 months; height, 80.9 cm. (equivalent to 50th percentile at 17 months by a U.S. standard); weight, 7.3 kg. (equivalent to 50th percentile at 5.9 months by a U.S. standard [8]).

†Initial age, 16 months; height, 72 cm. (equivalent to 50th percentile at 10.7 months by a U.S. standard); weight, 8.4 kg. (equivalent to 50th percentile at 8 months by a U.S. standard [8]).

‡Dextrose electrolye solution.

#Initial age, 37 months; height, 84 cm. (equivalent to 50th percentile at 20 months by a U.S. standard); weight, 9.8 kg. (equivalent to 50th percentile at 11 months by a U.S. standard [8]).

¶Initial age, 17 months; height, 76.8 cm. (equivalent to 50th percentile at 13 months by a U.S. standard); weight, 8.1 kg. (equivalent to 50th percentile at 7 months by a U.S. standard [8]).

‖Intravenous fluids.

**Initial age, 21 months; height, 71.6 cm. (equivalent to 50th percentile at 9 months by a U.S. standard); weight, 8.2 kg. (equivalent to 50th percentile at 7 months by a U.S. standard [8]).

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