Nutritional Status
IN FANT NUTRITION
Socioeconomic factors

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Socio - cultural Malnutrition in the Estate Sector of Sri Lanka. 3. Influence of parental, demographic and economic factors on the nutritional status of pre - school children.

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SUMMARY. The relationships between the nutritional status of 420 pre-school children living on 4 tea estates in the Districts of Kandy and Nuwara Eliya and parental, demographic and economic factors have been studied.

Nutritional status of pre-school children was found to depend on the body weight and skin-fold thickness and on the level of basic nutritional knowledge of the mother, on the per capita income of household and whether the family reared livestock or not. The prevalence of under-nutrition increased with family size and birthrank of the child and with decrease in family income. The urgent need for improving sanitation and providing primary health care to the estate population is stressed.

INTRODUCTION

Some of the socio-cultural, demographic, economic and dietary characteristics of 300 families living on 4 tea estates in the Kandy and Nuwara Eliya Districts have been discussed.[25] An assessment of the nutritional status of the 420 pre-school children belonging to these families was made by a dietary survey and by collecting anthropometric, haematological and biochemical data , and the results have been published.[26] An attempt will now be made to assess the influence, if any, of the factors discussed earlier and other parental factors on the nutritional status of the pre-school children.

MATERIALS AND METHODS

The selection of the estates for the study and of the families in the estates, as well as the methods employed in data collection have been discussed.[25,26]

RESULTS

PARENTAL FACTORS

Table 1 shows the mean weight of the mothers and their triceps skin-fold thickness. There is a decline in body weight and skin-fold thickness with increase in age.

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TABLE 1. Means and standard deviations of the weight and triceps skin-fold thickness of mothers categorised according to age.

Age years	Number of mothers	Body Weight Mean kg	S.D.	Skin-fold thickness Mean mm	S.D.
16 - 20	08	41.26	3.34	10.3	3.81
21 - 25	56	33.90	6.81	9.8	6.93
26 - 30	62	28.67	5.32	9.5	4.61
31 - 35	50	32.15	7.49	9.1	7.92
36 - 40	48	33.09	4.80	8.7	8.63
41 - 45	25	30.98	5.64	8.6	10.12
46 - 50	12	27.01	2.94	8.2	11.81

Table 2 shows the prevalence of undernutrition in pre-school children when related to the age, weight, skin-fold thickness and employment of their mothers. The prevalence rates of acute, chronic and concurrent acute and chronic undernutrition is greater in children whose mothers are over 35 yr of age as against those below 35 yr, almost two-thirds of those suffering from protein-energy undernutrition (PEU) being in this category. To group the children according to the body weight of their mothers, the average weight of Sri Lankan women has been taken as 45 kg.[4,6] More than 95% of children with some form of PEU belong to mothers who weigh less than 45 kg. There is also a striking correlation between the mothers' skin-fold thickness and the prevalence of PEU in their children, nearly 85% of those suffering from undernutrition belonging to mothers who had less than 60% of the Jelliffe standard for triceps skin-fold thickness.[19]

Of the total of 300 mothers, 126 were casual labourers, employed by the estate only when work is available, which was less than 20 days per month. The other 174 were on permanent employment working for 22 days or more per month and consequently earning higher wages. Of the children whose mothers worked on a casual basis, 58% were under-nourished whereas only 33% of the children whose mothers were permanent employees of the estate were under-nourished (Table 2). Of the 219 children with PEU about 70% had mothers employed on a casual basis.

The educational status of the parents is indicated in Tables 3 and 4. Only 2% of the mothers and 7% of the fathers had studied up to grade 10 at school, 87.1% of the mothers and 71.3% of the fathers having terminated their schooling at the 5th grade or lower. Tables 3 and 4 show that the educational level of the parents have only a marginal effect on the anthropometric status of their children.

TABLE 2. Influence of maternal factors on protein-energy undernutrition in 420 pre-school children.

		Number of mothers	Protein: Acute n	%	Protein: Chronic n	%	Energy: Concurrent n	%	Undernutrition: Total n	%
Maternal Weight	<45 kg	241	39	100	146	93.5	24	100	209	95.4
	≥45 kg	20	0		10	6.4	0		10	4.5
Total			39	100	156	99.9	24	100	219	99.9
Maternal Triceps Skinfold Thickness *(% of Standard)										
	<60%	177	29	74.3	135	86.5	22	91.7	186	84.9
	61-70%	45	9	23.0	11	7.0	2	8.3	22	10.0
	71-80%	39	1	2.6	10	6.4	0		11	5.0
	81-90%	0	0		0		0		0	
	>90	0	0		0	0		0	0	
Total			39	99.9	156	99.9	24	100	219	99.9
Maternal Age (Years)										
	≤35	176	8	20.5	59	37.8	10	41.7	77	35.2
	≥35	85	31	79.5	97	62.2	14	58.3	142	64.8
Total			39	100	156	100	24	100	219	100
Maternal Employment										
	Permanent	151	10	25.6	53	34.0	3	12.5	66	30.1
	Casual	110	29	74.4	103	66.0	21	87.5	153	69.9
Total		261	39	100	156	100	24	100	219	100

*Source: reference 19

TABLE 3. Relationship between the educational status of the mother and the prevalence of protein-energy undernutrition in 420 pre-school children

Highest grade achieved by the mother	Mothers n	%	Total number of children	Normal n	%	Protein Energy Undernutrition: Acute n	%	Chronic n	%	Concurrent n	%	Total n	%
0	73	24.3	103	39	37.9	12	11.7	45	43.7	07	6.8	64	62.1
1 - 3	103	34.3	144	68	47.2	18	12.5	48	33.3	10	6.9	76	52.7
3 - 5	86	28.7	114	65	57.0	06	5.2	37	32.5	06	5.3	49	43.0
6 - 8	32	10.7	47	23	48.9	02	4.3	21	44.7	01	2.1	24	51.1
9 -10	06	02.0	12	06	50.0	01	8.3	05	41.7	00	0.0	06	50.0
Total	300		420	201	47.9	39	9.3	156	37.1	24	5.7	219	52.1

TABLE 4. Relationship between the educational status of the father and the prevalence of protein-energy undernutrition in 409 pre-school children

Highest Grade Passed by the Father	Fathers n	%	Total Number of Children	Normal n	%	Protein: Acute n	%	Chronic n	%	Energy: Concurrent n	%	Undernutrition: Total n	%
0	24	8.0	39	20	51.3	04	10.3	13	33.3	02	5.1	19	48.7
1 - 3	58	19.3	79	37	46.8	08	10.1	29	38.7	05	6.3	42	53.2
4 - 5	132	44.0	190	90	47.4	12	6.3	76	40.0	12	6.3	100	52.6
6 - 8	56	18.7	64	31	48.3	08	12.5	21	32.8	04	6.3	33	51.6
9 - 10	21	7.0	37	16	43.2	04	10.8	16	43.2	01	2.7	21	56.7
Total	291*		409	194	47.4	36	8.8	155	37.9	24	5.9	215	53.6

* Father had died in 9 Families.

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The prevalence of PEU among children whose mothers studied beyond grade 5 were 51% as against 52% in children of mothers with a lower educational level. However, the parental educational level appears to influence the nutrient intake and the Hb levels of their children. The intake of energy and some nutrients by children 3 to 6 yr increases slightly with the level of education of their parents (Table 5). The Hb level is similarly influenced by the level of education of the mother but not of the father (Table 6).

TABLE 5. Relationship between mean intake of nutrients by children of 3-6 years and educational level of their parents.

Nutrient	Education of the Father			Education of the Mother		
	Grade 0 - 5	Grade 6 - 8	Grade 9 - 10	Grade 0 - 5	Grade 6 - 8	Grade 9 - 10
Energy (kJ)	3221	3192	3683	3078	3187	3830
Protein (g)	18	18	21	18	19	21
Calcium (mg)	170	150	280	195	160	245
Iron (mg)	11	14	14	10	13	16
Retinol (μg)	256	281	303	216	287	337
Thiamin (mg)	0.37	0.44	0.48	0.37	0.41	0.51
Riboflavin (mg)	0.54	0.68	0.76	0.57	0.69	0.73
Ascorbic acid (mg)	07	10	10	08	09	11

TABLE 6. Relationship between mean haemoglobin levels of children of 3-6 years and the educational level of their parents.

Highest grade achieved by the Mother	0 - 5	6 - 8	9 - 10
Mean Hb level, gl^{-1}	87.9	97.7	109.3.
Highest grade achieved by the Father	0 - 5	6 - 8	9 - 10
Mean Hb level, gl^{-1}	101.4	92.3	100.2

The level of basic nutritional knowledge of the mothers was assessed by the answers given to questions asked of them. Only 1% of the mothers could score 24 out of a possible maximum of 36 (i.e. 66.6% of the total score), while 83.3% of them scored 10 or less (i.e. 28% of the total score) The prevalence rate of concurrent acute and chronic undernutrition decreases steeply as the maternal score increases (Table 7). No such trend is seen in prevalence rates of acute or chronic undernutrition.

TABLE 7. Influence of the mother's basic nutritional knowledge on the prevalence of protein-energy undernutrition in pre-school children

Maternal Score (%)	Number of Mothers	Total Number of Children	Normal Children		Protein Energy Undernutrition							
					Acute		Chronic		Concurent		Total	
			n	%	n	%	n	%	n	%	n	%
≤10	63	89	25	34.7	08	9.0	48	18.0	08	9.0	64	55.1
11-15	164	222	108	49.0	21	9.5	78	35.1	15	6.8	114	51.4
16-20	50	68	41	60.3	04	5.9	22	32.4	01	1.4	27	38.7
21-25	23	41	27	65.8	06	14.6	08	19.5	—	—	14	34.0
26-30	—	—	—	—	—	—	—	—	—	—	—	—
31-36	—	—	—	—	—	—	—	—	—	—	—	—
Total	300	420	201	47.8	39	9.3	156	37.1	24	5.7	219	52.1

DEMOGRAPHIC FACTORS

The size of the family or household affects the health of the pre-school child, as shown in Table 8. More than 50% of healthy children in the study were in families of 7 or less. The prevalence rate of chronic undernutrition increases as family size becomes 8 or 9. A similar, though not so marked, trend is seen when the number of living children is considered (Table 9). The prevalence of PEU among pre-school children in families with 5 or more children was only slightly higher than in smaller families (Table 9 and Fig. 1).

TABLE 8. Influence of family size on the prevalence of protein-energy undernutrition in pre-school children.

Family Size	Number of Families	Total Number of Children	Normal		Protein Energy Undernutrition							
					Acute		Chronic		Concurrent		Total	
			n	%	n	%	n	%	n	%	n	%
2	05	—	—	—	—	—	—	—	—	—	—	—
3	70	64	36	56.3	07	10.9	21	32.8	—	—	28	43.8
4	60	91	45	49.5	13	14.3	29	31.9	04	4.4	46	50.5
5	72	121	56	46.3	06	4.9	52	42.9	07	5.8	65	53.7
6	35	52	26	50.0	05	9.6	19	36.5	02	3.8	26	50.0
7	28	45	24	53.3	04	8.9	10	22.2	07	15.6	21	46.7
8	21	31	09	29.0	02	6.4	18	58.1	02	6.4	22	70.9
9	06	11	04	36.4	01	9.1	06	54.5	—	—	07	63.6
10	03	05	01	20.0	01	20.0	01	20.0	02	40.0	04	80.0
Total	300	420	201	47.9	39	9.3	156	7.1	24	5.7	219	52.1

TABLE 9. Relationship between the total number of living children and of living pre-school children in a family with the prevalence of protein energy undernutrition among pre-school children

	Total		Normal		Protein Energy Undernutrition							
					Total		Acute		Chronic		Concurrent	
	n	%	n	%	n	%	n	%	n	%	n	%
Number of Living Children in the Family												
4 or less	357	85.0	172	48.2	185	51.8	32	9.0	134	37.5	19	5.3
5 or more	63	15.0	29	46.0	34	54.0	07	11.1	22	34.9	05	7.9
Total	420		201	47.9	219	52.1	39	9.3	156	37.1	24	5.7
Number of Living Pre-School Children in the Family												
2 or less	320	76.2	160	50.0	160	50.0	29	9.1	117	36.6	14	4.4
3 or more	100	23.8	41	41.0	59	59.0	10	10.0	39	39.0	10	10.0
Total	420		201	47.9	219	52.1	39	9.3	156	37.1	24	5.7

A high birth-rank implies a large number of previous births in the family. The prevalence rate of PEU shows a gradual increase with increase in birth rank, the rate for acute undernutrition showing a more marked increase in those of birth rank of 6 or above (Table 10 and Fig. 1), a result consistent with data shown in Tables 8 and 9.

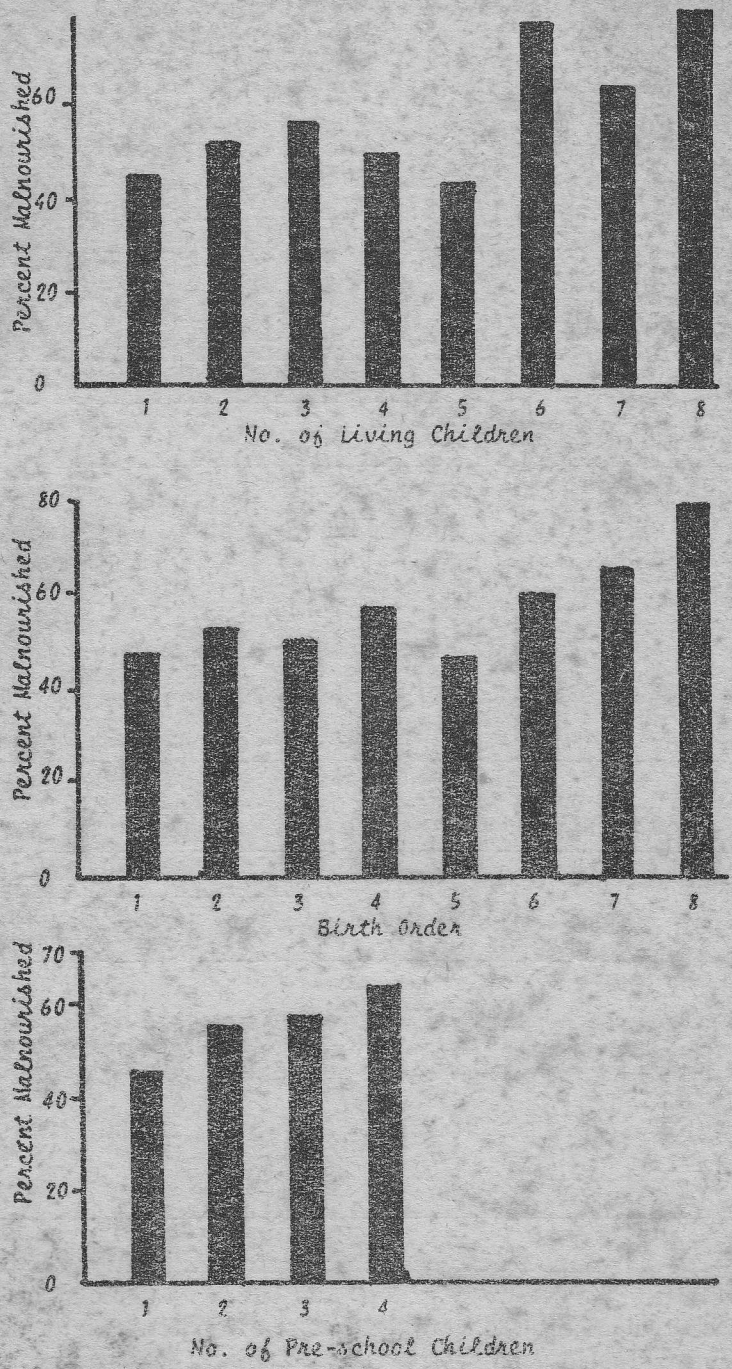

Fig. 1. Influence of the number of living children in the family, the birth order of the child and the number of pre-school children in the family, on the prevalence of protein-energy undernutrition amongst pre-school children.

TABLE 10. Relationship between birth-rank and the prevalence of protein-energy undernutrition in pre-school children.

Birth Rank	Number of pre-school children	% of total population	Normal		Protein Energy Undernutrition							
					Acute		Chronic		Concurrent		Total	
			n	%	n	%	n	%	n	%	n	%
01	145	34.5	73	50.3	09	5.2	60	41.1	03	2.0	72	49.7
02	95	22.6	43	45.3	05	5.3	38	40.0	08	8.4	51	53.7
03	75	17.9	37	49.3	08	10.6	24	32.0	06	8.0	38	50.7
04	49	11.7	22	44.9	06	12.2	15	30.6	06	12.2	27	55.1
05	29	6.9	15	51.7	03	10.3	10	34.5	01	3.4	14	48.3
06	13	3.1	06	46.1	03	23.0	05	38.5	—	—	08	61.5
07	09	2.1	03	33.3	03	33.3	03	33.3	—	—	06	66.7
08	04	1.0	01	25.0	02	50.0	01	25.0	—	—	03	75.0
09	—	—	—	—	—	—	—	—	—	—	—	—
10	—	—	—	—	—	—	—	—	—	—	—	—
11	01	0.2	01	—	—	—	—	—	—	—	—	—
Total	420	100	201	47.8	39	9.3	156	37.1	24	5.7	219	52.1

Table 11 summarises the data on the relationship between prevalence of PEU and the birth interval between siblings. Pre-school children without younger siblings (n= 147) have been excluded. As the birth interval increases from 12 to 24 months there is a fall only in the prevalence of acute undernutrition. A birth - interval of more than 24 months does not appear to influence the prevalence rate of PEU.

TABLE 11. Relationship between the birth interval between siblings and the prevalence of protein-energy undernutrition in pre-school children.

Interval between child and succeeding sibling months	Children		Protein Energy Undernutrition							
			Total		Acute		Chronic		Concufrent	
	n	%	n	%	n	%	n	%	n	%
⩽ 12	15	5.5	07	46.7	02	13.3	04	26.7	01	6.7
13 - 18	31	11.3	14	45.1	02	6.5	11	35.5	01	3.2
19 - 24	52	19.0	28	53.8	01	1.9	21	40.4	06	11.5
25 - 30	50	18.3	25	50.0	05	10.0	15	30.0	05	10.0
31 - 36	47	17.2	26	55.3	04	8.5	16	34.0	06	12.8
37 - 42	19	7.0	14	73.7	02	10.5	11	57.9	01	5.3
>42	59	21.6	27	45.8	10	16.9	13	22.0	04	6.8
Total	273*	99.9	141	51.6	26	9.5	91	33.3	24	8.8

*147 children without younger sibilngs have not been included.

ECONOMIC FACTORS

The influence of the economic status of the family on the nutritional status of pre-school children is illustrated in Tables 12, 13 and 14. None of the children of families in which the per capita monthly income was greater than Rs. 200 showed evidence of PEU (Table 12). In families that earned less than Rs. 200, the prevalence rates for chronic undernutrition and concurrent acute and chronic undernutrition decreased with increasing income. When the families are divided into two groups,

those in which the total family income is Rs. 500 or less and those with higher incomes, it is seen that there are more healthy children in the higher income group than in the lower, at all family sizes except at family size 6 (Tables 13 and 14).

TABLE 12. Relationship between the monthly per capita income (in rupees) and the prevalence of protein-energy undernutrition in pre-school chidren

Per capita Income per month (Rs)	Number of families	Number of children	Prevalence of Protein Energy Undernutrition									
			Normal		Acute		Chronic		Concurreut		Total	
			n	%	n	%	n	%	n	%	n	%
30 - 49	05	07	01	14.3	—	—	06	85.7	—	—	06	85.7
50 - 99	104	174	70	40.2	15	8.6	71	40.8	18	10.3	104	59.8
100 - 149	100	149	80	53.7	15	10.1	50	33.4	04	2.7	69	46.3
150 - 199	68	74	34	45.9	09	12.2	29	39.2	02	2.7	40	54.1
200 - 249	14	12	12	100.0	—	—	—	—	—	—	—	—
⩾250	09	04	04	100.0	—	—	—	—	—	—	—	—
Total	300	420	201	47.8	39	9.3	156	37.1	24	5.7	219	52.1

TABLE 13. Relationship between a household income equal to or less than Rs. 500 per month and the prevalence of protein-energy undernutrition amongst pre-school children in families of different sizes.

Family size	Number of families	Number of pre-school children	Prevalence of Protein Energy Undernutrition									
			Normal		Acute		Chronic		Concurrent		Total	
			n	%	n	%	n	%	n	%	n	%
02	05	—	—	—	—	—	—	—	—	—	—	—
03	70	64	36	56.2	07	10.9	21	32.8	—	—	28	43.9
04	58	87	42	48.3	12	13.8	29	33.3	04	4.5	45	51.7
05	45	77	30	38.9	04	5.2	37	48.1	06	7.8	47	61.0
06	31	46	24	52.1	03	5.6	17	36.9	02	4.3	22	47.8
07	09	17	05	29.4	03	17.6	04	23.5	05	29.4	12	70.5
08	04	05	01	20.0	01	20.0	02	40.0	01	20.0	04	80.0
09	01	01	—		—	—	—	—	—	—	—	—
10	—	—	—	—	—	—	—	—	—	—	—	—
Total	223	297	138	46.4	30	10.0	111	37.3	18	6.1	158	53.2

TABLE 14. Relationship between a family income of more than Rs. 500 per month and the prevalence of protein-energy undernutrition among pre-school children in families of different sizes.

Family size	Number of families	Total number of children	Prevalence of Protein Energy Undernutrition									
			Normal		Acute		Chronic		Concurrent		Total	
			n	%	n	%	n	%	n	%	n	%
02	—	—	—	—	—	—	—	—	—	—	—	—
03	—	—	—	—	—	—	—	—	—	—	—	—
04	02	04	03	75.0	01	25.0	—	—	—	—	01	25.0
05	27	44	26	59.1	02	4.6	15	34.4	01	2.3	18	40.9
06	04	06	02	33.3	03	33.3	02	33.3	—	—	04	66.7
07	19	28	19	67.9	01	3.6	06	21.4	02	7.1	09	32.1
08	17	26	08	30.8	01	3.8	16	61.5	01	3.8	18	69.2
09	05	10	04	40.0	01	10.0	05	50.0	—	—	06	60.0
10	03	05	01	20.0	01	20.0	01	20.0	02	40.0	04	80.0
Total	77	123	63	51.2	09	7.3	45	36.6	06	4.9	60	48.8

There is a small improvement in the intake by children of energy and nutrients such as calcium, iron and vitamin A, with rise in per capita income (Table 15). However, even when the income is more than Rs. 200 per month, the energy and calcium intakes are below the Indian Council of Medical Research recommendations.[13]

TABLE 15. Relationship between per capita income (in rupees) and the mean intake of nutrients by children 3 to 6 years of age.

Nutrient	per capita income				Recommended allowance
	1-100	101-150	151-200	201-300	
Energy, kcal	738	763	810	880	1200-1300
Protein, g	18	17	19	22	18- 22
Calcium, mg	152	203	223	222	400-500
Iron, mg	12	11	14	15	15-20
Retinol, μg	193	212	330	385	300-400
Thiamin, mg	0.36	0.40	0.46	0.50	0.6-0.8
Riboflavin, mg	0.56	0.62	0.75	0.71	0.7-0.8
Ascorbic acid, mg	7	9	10	11	30-50

Table 16 summarises the effect of some economic factors on the prevalence PEU among pre-school children. The prevalence rate rises with decrease in per capita income of family, the percentage of family income spent on food and the expenditure on food per person. The health of the children also depends on the earning capacity of the mothers (Table 2). The haemoglobin concentration in children rises from 91.2 to 103.0 gl^{-1} as the per capita income increases from Rs.100 to Rs.300 per month.

TABLE 16. Relationship between some economic factors with the prevalence of protein-energy undernutrition (PEU) amongst pre-school children.

Economic factor	Total population	PEU	
		n	%
Monthly percapita income (rupees)			
≤100	297	159	75.6
>100	123	60	50.2
% of family income spent on food			
<60	153	97	63.4
60-90	250	116	46.4
>90	17	06	35.3
Expenditure on food per person per week (rupees)			
≤20	37	25	67.5
21 - 30	353	181	51.2
>30	30	09	30.0

The influence on the nutritional status of the children of the rearing of poultry and cattle by the family is demonstrated in Table 17. There is a greater proportion of healthy children in households producing milk and /or eggs than in families that do not engage in such pursuits.

TABLE 17. Influence of the production of milk and eggs by a family on the prevalence of protein-energy undernutriiton among pre-school children.

	Number of house holds-	Number of children	Normal		Protein Energy Undernutrition							
					Total		Acute		Chronic		Concurrent	
			n	%	n	%	n	%	n	%	n	%
Milk												
Producing	67	88	52	59.1	36	40.9	07	7.9	26	29.5	03	3.4
Not producing	233	332	149	44.9	183	55.1	32	9.6	130	39.2	21	6.3
Total	300	420	201	47.8	219	52.1	39	9.3	156	37.1	24	5.7
Eggs												
Producing	62	89	49	55.1	40	44.9	08	8.9	29	32.6	03	3.4
Not Producing	238	331	152	45.9	179	54.1	31	8.8	127	38.3	21	6.3
Total	300	420	201	47.8	219	52.1	39	9.3	156	37.1	24	5.7
Milk and Eggs												
Producing both	39	42	28	66.6	16	38.0	03	7.1	11	26.1	01	2.3
Not Producing any	112	154	61	39.6	91	39.0	18	11.6	70	45.4	12	7.7

DISCUSSION

MATERNAL FACTORS

The influence of maternal factors on the health of the child may be exerted both pre-natally and post-natally.

Pre-natal influences tend to produce a child of low birth -weight. The size at birth determines to a great degree the performance of the child thereafter.[15] As birth-weight decreases the deficit in later size gets larger. Several factors can lead to differences in the size at birth. Those relevant to the present study are the size of the mother, her age, her socio-economic status and her nutritional status.

A small mother gives birth to a small baby. The size of the placenta could influence the delivery of nutrients to the fetus. Placental weight correlates with birth-weight [13,23,36] and placentas of women of higher socio-economic status are heavier than those of the more deprived. [23,36] The socio-economic status of the mother has a direct effect on the weight of the neonate, even among mothers of similar weight. Birth-weight is also influenced by the age of the mother, increasing linearly up to a maternal age of 36 years and declining steadily after the age of 40 years, [23,33,36] the effect being less marked among those of a lower socio-economic status. However, the most important ante-natal factor determining the size at birth is the nutrition of the mother. It is generally agreed that it is the diet consumed during the second half of pregnancy, particularly the energy intake during the third trimester, that

plays a decisive role in determining the size at birth.[16] A woman's body-weight and skin-fold thickness could be taken as an indication of her nutritional status. Those with body-weight over 45 kg and triceps skin-fold thickness nearer the standard (Table 2) would have been able to give their neonates a better start in life. The lower prevalence of PEU among children of this group of mothers is to be expected.

Another factor that could influence birth-weight is the environment in which the mother lives. Under the insanitary conditions that prevail in these estate "lines"[25] it is to be expected that frequent intermittent infections and intrauterine infections would be common, resulting in raised levels of immunoglobulins IgA and IgM in in cord blood. When cord IgM is detected, the corresponding birth-weights are found to be lower than in those without cord IgM.[11,27]

Thus, in a large number of mothers of the estate children studied, factors such as low body-weight and poor energy stores (as body fat) as well as insanitary surroundings and poor economic status would all contribute towards the children being small at birth and poorly equipped for post-natal life.

Maternal factors that affect the health and nutritional status of a child post-natally include the level of general education of mother (and father) and the mother's (or parent's) knowledge of the principles of hygiene and nutrition.

Several studies have shown a correlation between the educational achievement of the parents and the nutritional status of their children. As the level of education of mothers increases there is a corresponding increase in the weight of their pre-school children when expressed as a percentage of standard weight-for-age[2] and no evidence of malnutrition was found among children whose mothers had been educated up to or beyond high school level.[22] There is a satistically significant association between the educational level of both fathers and mothers and the nutritional status of their pre-school children.[9] In the present study, the parental educational level does not appear to be a major contributory factor to the prevalence of protein-energy undernutrition among estate children (Table 5 & 6), probably due to the very low level of achievement by a majority of parents.

However, even at this low level of general education, some basic knowledge of nutrition and hygiene appears to influence the nutritional status of the children (Tables 7 and 18). Not a single case of concurrent acute and chronic undernutrition was found among the 41 children whose mothers scored 21 (58%) or more in the test. The percentage of healthy children increases with the level of nutrition education among the mothers. Therefore, despite a low level of general education among the estate population, an intensive health education programme in the estates is likely to pay handsome dividends.

DEMOGRAPHIC FACTORS

The more young children a mother has to care for, the more her energies and resources are stretched and, presumably, the less adequate her performance. Large families are more prone to have malnourished children [1, 2, 3, 17, 37] In the present study the prevalence of protein-energy undernutrition amongst pre-school children shows a slight increase with family size (Table 8) and with birth-rank (Table 10).

The survival rates of children in Indian villages varies with the interval between a given child and the following sibling, and the younger a given child is at the time of birth of the next sibling, the more likely he is to have a recurrent diarrhoea.[12] In aWHO family study, short preceding as well as suceeding birth intervals were associated with lower physical and mental development of children.[34] Thus, both the displaced and the displacing child seem to be affected by inadequate birth-spacing. The data in Table 11 shows only a slight improvement in nutritional status when the the birth interval increases from 12 to 24 months, but not thereafter.

ECONOMIC FACTORS

The lower the family income, the higher the prevalance of under-nutrition.[9,29] In the present study children of families with a monthly per capita income of more than Rs. 200 were not suffering from PEU. A slight improvement was noticed in the intake of nutrients by the children with increase in per capita income of the family, in agreement with observations by Devadas *et al.*[9] Wray and Aguirre[37] found that, although the total family income made a difference at every income level with regard to the prevalence of PEU, the difference became significant only when the cut-off point was a monthly income equivalent to Rs. 500. Such a division into two groups has been made in this study and Tables 13 and 14 indicate that there are more healthy children in families earning more than Rs. 500 per month at most family sizes.

Families attempt to compensate for larger numbers by spending a higher percentage of their income on food. Prevalence rates of undernutrition are lower in families spending a larger proportion of income on food (Table 16 and reference 29).

The families were divided into two groups, those with and without undernourished children, and maternal factors such as age, body weight, and the mother's score in the test on a basic knowledge of health and nutrition, in the two groups, calculated (Table 18). The average income and the production of milk and egg by the two groups were also tabulated (Table 19). The results were analysed by the khi square test. The differences in body weight, the mean score at the test, the per capita income and in the number of households rearing livestock, between the two groups, were all statistically significant ($p < 0.05$).

TABLE 18. A comparison of the maternal factors in two groups of families, those with undernourished children and those without any such children.

	n	Age yr	Body weight kg	Employment Permanent	Casual	Basic knowledge scores (mean)
Families with undernourished children	224	29	31.1	123	101	12
Families without any undernourished children	37	38	38.7	28	09	19
		n.s.	$p<0.05$	n.s.		$p<0.05$

TABLE 19. A comparison of the average monthly percapita and household income and production of egg & milk in two groups of families, those with and those without undernourisehed children.

		Income		Number producing				
	n	Percapita Rs.	Household Rs.	Milk	Eggs	Milk & Eggs	None	Total
Families with undernourished children	224	76	392	56	52	28	88	224
Families without any undernourished children	37	97	428	11	10	11	5	37
		$p<0.01$	n.s.			$p<0.05$		

Data obtained in this study (Table 5 and 6 in Liyanage and Wikramanayake[26] taken together with the results of surveys conducted in 1975/76 [5] and 1980/81 [31] indicate that changes in "stunting" with time are unrelated to changes in "wasting". This is also supported by studies on Palestinian refugee children carried out in 1974 and 1978 which show that, while stunting increased in the first two years of life and decreased in the third year, wasting and under-weight showed a decrease at all ages.[20] Studies in Colombia[21] suggest that stunting may be more due to sanitary and general socio-economic factors than to individual food availability, which may have a greater effect on wasting. The question then arises: could these two conditions be due to different causes? Analysis by Keller[20] of results of studies in Sri Lanka,[5,30] show that, while the percentages of wasted and stunted pre-school children are highly correlated with the infant mortality rate, only the prevalence of stunting is negatively correlated with the percentages of houses with a relatively safe water supply and with cement floors (Table 17). In Indonesia restriction of food intake of children 1 to 3 years of age due to prolonged breast-feeding was found to be associated with increased wasting but not with increased stunting.[20] The picture is confused by observations such as the one from Northern Nigeria that drinking water from unprotected sources is associated with wasting but not with stunting.[35]

TABLE 20. Coefficients of correlation between stunting, wasting and various socio-economic variables in 15 health administrative districts in Sri Lanka (from Keller[20])

	Infant mortality rate	Percentage of houses with well	cement floor	brick walls	latrine	electricity
Percentage of stunting	0.85	—0.83	—0.67	0.05	0.30	—0.43
Percentage of wasting	0.75	—0.30	—0.29	0.26	0.04	—0.30

for $r = 0.514$, $p = 0.05$

In Tanzania[16] in Jordan,[18] rural Costa Rica[32] and in the Philippines[28] it has been observed that, even with a stable and adequate family income the children of many families are undernourished, suggesting an influence of negative nutritional behaviour of the mother (arising out of ignorance and/or certain cultural paractices) on the nutritional status of the children. In the estate population, too, food avoidances during pregnancy and lactation and faulty weaning practices[24] are likely to contribute towards the prevalence of undernutrition among the children.

The results of the present study reveal that the pre-school population of the estates is undernourished, with a high incidence of protein-energy undernutrition and anaemia among them. In addition to family income, there are several other factors that contribute to undernutrition among the children, viz. insanitary living conditions, poor dietary habits and ignorance, aggravated by demographic factors. There is an urgent need for improving environmental sanitation including provision of potable water, adequate latrine facilities and better housing conditions. The health centres should be adequately staffed and should conduct maternal and child health and family planning clinics. Intensive health education programmes should be instituted, along with regular immunization and de-worming. More space should be provided for home gardening and rearing of livestock and the youth should be instructed in these procedures and supplied with seed, loan facilities and veterinary services. Considering the fact that tea exports account for a considerable proportion of foreign exchange earnings, it is imperative that a greater portion of these earnings be used for the welfare of the labour force.

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