Dr B. V. Amar

COMPARATIVE STUDY OF DEFICIENCY STATES % WISE.

	HAIR			FACE	LIPS	EYES.				TEETH	SKIN		MUSCULO SKELETAL SYSTEM.			
	Lack of Lustre, Thinners & Sparseness.	Dyspigmentation of Proximal Part of the Hair.	Easy pluckability.	Diffuse Depigmentation.	Moon Face	Angulo Stomatitis	Cheilosis.	Bitot's Spots.	Xerosis Conjunctivae	Xerophthalmia.	Caries.	Spongy bleeding.	Pellagrous Dermatitis.	Frontal & Parietal bossing.	Epiphyseal Enlargement.	Beading of ribs.	Knock knees or bow legs.
Devarashola.	41	47.58	5.93	31.05	19.9	22.2	6.3	15.2	5.5	5.6	19.6	0.85	16.52	1.9	0.57	0.27	41.02
Rockwood.	59.9	42.3	5.6	4.3	23.69	9.96	4.43	59.65	2.46	2.93	25.8	0.89	13.65	11.5	4.1	1.42	53.4
Devon.	58.0	47.1	13.6	25.8	14.0	8.2	6.49	11.4	6.07	.35	24.8	0.0	5.0	6.83	2.1	1.43	21.58.

BASED ON SURVEY DONE BY:-

Dr. JOSEPH ALAPATT Dr. J.K.RAYMOND PEREZ. Dr. B.V.AMAR.

CLINICAL ASSESSMENT SURVEY- 1978-79

(Deverashola, Rockwood, Devcon and All-India).

	HAIR							FACE			
	Total No. of Children.	Lack of Lustre Thinners and Sparseness.		Dyspigmentation of Proximal part of hair.		Easy Pluckability		Diffuse Depigmentation.		Moon Face.	
		No. of Sign of Children.	Percentage	No. of sign of Children.	Percentage.	No. of sign of Children.	Percentage.	No. of Sign of Children.	Percentage.	No. of sign of Children	Percentage.
		1	2	3	4	5	6	7	8	9	10
1- 1½ Years:											
Deverashola.	53	21	39.6	27	3.9	2	3.8	11	20.8	8.	15.1
Rockwood.	46	14	30.4	9	19.6	2	4.3	10	21.7	8.	17.4
Devon.	27	14	51.9	15	55.6	4	14.8	3	11.1	6	22.2
Mean for the group.	126	49	38.9	51	40.5	8	6.3	34	19	22	17.5
All-India.	-	-	6.3	-	5.8	-	3	-	-	-	1.4
1½ -2 Years.											
Deverashola.	36	18	50.00	20	55-6	2	5.6	11	30.6	9	25
Rockwood.	40	17	42.5	17	42.5	2	5	14	35	6	15
Devon.	16	5	31.3	8	50	1	6.3	4	25	5	31.3
Mean for the group.	92	40	43.5	45	48.9	5	5.4	29	31.5	20	21.7
All India-	-	-	4.4	-	7	-	2.9	-	-	-	2.4
2 - 2½ Years:-											
Deverashola.	43	26	60.5	24	55.8	4	9.3	13	30.2	13	30.2
Rockwood.	49	20	40.8	26	53.1	6	12.2	21	42.9	12	24.5
Devon.	37.	17	45.9	16.2	43.2	16.2	16.2	16	43.2	8	21.6
Mean for the group.	129	63	48.8	66	51.2	16	12.4	50	38.8	33	25.6
All-India.	-	-	3.6	-	6.6	-	1.6	-	-	-	3.4
2½ - 3 Years:-											
Deverashola.	38	13	34.2	14	36.8	2	5.3	11	28.9	6	15.8
Rockwood.	43	19	44.2	15	34.9	1	2.3	12	27.9	11	25.6
Devon.	16	5	33.3	4	25	2	12.5	4	25	3	18.8
Mean for the group.	97	37	38.1	33	34	5	5.2	27	27.8	20	20.6
All-India.	-	-	6.1	-	6.6	-	1.2	-	-	-	4.9

CLINICAL ASSESSMENT SURVEY- 1978-79.
(Deverashola, Rockwood, Devon and All-India.).

H A I R .

	Total No. of Children.	Lack of lustre, thinness and Sparseness.		Dyspigmention of proximal parl of hair		Easy pluckability.	
		Signs of Children.	Percentage.	Signs of Children.	Percentage.	Signs of Children.	Percentage
		1	2	3	4	5	6
3 - 4 Years:-							
Deverashola.	96	42	43.75	44	45.83	7	7.29
Rockwood.	106	39	36.79	47	44.33	4	3.77
Devon.	80	29	36.25	41	51.25	9	11.25
Mean for the Group.	282	110	39.00	132	46.80	20	7.09
All-India:	-	-	2.9	-	3.8	4	1.00
4 - 5 Years:-							
Deverashola.	85	27	31.76	38	44.70	4	4.70
Rockwood.	102	36	35.29	47	46.07	5	4.90
Devon.	53	25	47.16	22	41.50	5	9.43
Mean for the Group.	240	88	36.66	107	44.58	14	5.83
All-India:	-	-	1.5	-	1.6	-	0.5

	Total No. of Children.	Diffuse Hypigmentation		Moon Face		Xerosis		Xeropthalmia		Bitot's spot.	
		Sign of Children.	Percentage.	Sign of Children	Percentage.	Sign of Children	Percentage.	Sign of Children.	Percentage.	Sign of Children	Percentage.
		1	2	3	4	5	6	7	8	9	10
3-4 Years:-											
Deverashola	96	31	32.29	23	23.95	9	9.37	7	7.29	51	53.12
Rockwood.	106	42	39.62	27	25.47	14	13.20	4	3.77	61	57.54
Devon.	80	27	33.75	9	11.25	5	6.25	-	-	37	46.25
Mean for the Group.	282	100	35.46	59	20.92	28	9.92	11	3.90	149	52.83
All-India.	-	-	-	-	3.5-	-	5.5	-	-	-	3.3
4 - 5 Years:-											
Deverashola.	85	32	37.64	11	13.41	3	3.52	7	8.23	42	49.41
Rockwood.	102	46	45.09	16	16.68	15	14.70	2	1.96	74	72.54
Devon.	53	17	32.07	8	15.09	1	1.88	-	-	25	47.16
Mean for the Group.	240	95	39.58	35	12.41	19	7.91	9	3.75	141	58.75
All-India.	-	-	-	-	1.8	-	5.8	-	-	-	4.8

CLINICAL ASSESSMENT SURVEY- 1978-79

(Devarashola, Rockwood, Devon and All-India.).

6666	Total No. of Children.	TEETH Caries Sign of Children	TEETH Caries Percentage.	GUMS Spongy bleeding gums Sign of Children.	GUMS Spongy bleeding gums Percentage.	SKIN Pellagrous-dermatosis Sign of Children.	SKIN Pellagrous-dermatosis Percentage.	BONE Frontal and Parietal Bossing. Sign of Children.	BONE Frontal and Parietal Bossing. Percentage.	BONE Epiphyseal enlargement. Sign of Children.	BONE Epiphyseal enlargement. Percentage.
		1	2	3	4	5	6	7	8	9	10
1 - 1½ Years:-											
Devarashola.	53	2	3.8	-	-	8	15.1	2	3.8	-	-
Rockwood.	46	1	2.2	-	-	6	13.00	5	10.09	2	4.3
Devon.	27	-	-	-	-	2	7.24	3	11.1	-	-
Mean for the group.	126	3	2.4	-	-	16	12.7	10	7.9	2	1.6
All-India.	-	-	-	-	-	-	0.2	-	2.23	-	1.3
1½ - 2 Years.											
Devarashola.	36	-	-	-	-	5	13.9	1	2.8	-	-
Rockwood	40	4	10	-	-	2	5	2	5	2	5,0
Devon.	16	4	25	-	-	4	25.0	4	25.0	-	-
Mean for the group.	92	8	8.7	-	-	11	12	7	7.6	2	2.2
All-India.	-	-	0.4	-	0.1	-	0.4	-	2.23	-	1.3
2 - 2½Years:-											
Devarashola.	43	5	11.6	-	-	6	14	2	4.7	1	2.3
Rockwood.	49	9	18.4	1	2	6	12.2	6	12.2	1	2.0
Devon.	37	8	21.6	-	-	1	2.7	2	5.4	3	8.1
Mean for the Group.	129	22	17.0	1	0.8	13	10.1	10	7.8	5	3.9
All-India.	-	-	2.0	-	0.8	-	0.4	-	2.23	-	1.3
2½ - 3 Years:-											
Devarashola.	39	9	23.7	1	2.6	3	7.9	-	-	1	2.6
Rockwood	43	4	9.3	-	-	3	7.0	7	16.3	3	7.0
Devon.	16	4	25.0	-	-	-	-	1	6.25	-	-
Mean for the group.	97	17	17.5	1	1.0	6	6.2	8	8.2	4	4.1
All-India.	-	-	4.1	-	1.2	-	0.4	-	2.23	-	1.3

CLINICAL ASSESSMENT SURVEY- 1978-79.

(Deverashola, Rockwood, Devon & All-India).

	Total No. of Children.	EYES						LIPS.			
		Xerosis Conjunctivae.		Xerophthalmia (including Keratomalacia).		Bitot's Spot		Angular Stomatitis		Cheilosis.	
		Sign of Children	Percentage	Sign of Children	Percentage.	Sign of Children	Percentage.	Sign Of Children	Percentage.	Sign of Children	Percentage.
		1	2	3	4	5	6	7	8	9	10
1 - 1½ Years:-											
Deverashola	53	3	5.7	1	1.9	16	30.19	2	3.8	-	-
Rockwood.	46	2	4.3	1	2.2	14	30.4	-	-	1	2.2
Devon.	27	3	11.1	-	-	2	7.4	1	3.7	1	3.7
All-India:	126	-	1.3	-	0.1	-	6	-	1.6	-	.4
Mean for the Group.	126	8,	6.3	2	1.6	32	25.4	3	2.4	2	1.6
1½ - 2 Years:-											
Deverashola.	36	1	2.8	-	-	16	44.4	3	8.3	1	2.8
Rockwood.	40	2	5.00	1	2	22	55.00	3	7.5	2	5.00
Devon.	16	2	12.5	-	-	4	28.00	-	-	-	-
Mean for the group.	92	5	5.4	1	1.1	42	45.7	6	6.5	3	3.3
All-India:	-	-	2.2	-	-	-	1.5	-	3.8	-	0.6
2-2½Years:-											
Deverashola.	43	3	7	2	4.7	19	44.2	2	4.7	4	9.4
Rockwood.	49	6	12.2	1	4.1	37	75.5	3	6.1	3.	6.1
Devon.	37	3	8.1	-	-	7	18.9	6	16.2	-	-
Mean for the group.	129	12	9.3	4	3.1	63	48.8	11	8.5	7	5.4
All-India:	-	-	3.5	-	-	-	1.9	-	3.4	-	1.2
2½- 3 Years:-											
Deverashola.	38	4	10.5	3	7.9	15	39.5	8	21.1	1	2.6
Rockwood.	43	6	15.00	2	4.7	21	48.8	4	9.3	-	-
Devon.	80	-	-	-	-	10	62.5	-	-	2	12.5
Mean for the Group.	199	10	10.3	5	5.2	46	47.4	12	12.4	3	3.1
All-India.	-	-	4.2	-	-	-	3.1	-	6.1	-	1.5

CLINICAL ASSESSMENT SURVEY- 1978-79

(Deverashola, Rockwood, Devon and All-India.).

	Total No. of Children.	MUSCULAR AND SKELETAL SYSTEMS.			
		Bleading of Ribs.		Knock-knees or Bow legs.	
		Sign of Children	Percentage	Sign of Children	Percentage.
1- 1½ Years:-					
Deverashola.	53	-	-	13	24.5
Rockwood.	46	-	-	11	23.9
Devon.	27	-	-	1	3.7
Mean for the group.	126	-	-	25	19.8
All-India:	-	-	0.4	-	9.07
1½ - 2 Years:-					
Deverashola.	36	-	-	9	25.00
Rockwood.	40	2	5	16	40.00
Devon.	16	-	-	7	43.8
Mean for the group.	92	2	2.2	32	34.8
All-India:	-	-	0.4	-	0.07
2 - 2½ Years:-					
Deverashola.	43	-	-	14	32.6
Rockwood.	49	-	-	28	57.1
Devon.	37	-	-	8	21.6
Mean for the group.	129	-	-	50	38.8
All-India:	-	-	0.4	-	0.07
2½ - 3 Years:-					
Deverashola	36	-	-	17	44.7
Rockwood.	43	-	-	14	32.6
Devon.	16	-	-	7	43.8
Mean for the group.	97	-	-	38	39.2
All-India.	-	-	0.4	-	0.07

ANTHROPOMETRICAL ASSESSMENT: 1978-79.

(Devarashola Group of Estates.).

HEIGHT AGAINST AGE GROUP.

	0 - 3 Months.	3 - 6 Months.	6 - 9 Months.	9/12 - 1 Year.	1 - 1½ Yrs. Male	1 - 1½ Yrs. Female	1½ - 2 Yrs. Male	1½ - 2 Yrs. Female	2 - 2½ Yrs. Male	2 - 2½ Yrs. Female	2½ - 3 Yrs Male	2½ - 3 Yrs Female	3 - 4 Yrs Male	3 - 4 Yrs Female	4 - 5 Yrs. Male	4 - 5 Yrs. Female.
Devarashola.	2.5	5.9	6.6	7	7.7	7.4	8.3	8.4	9.8	9.1	10.9	10.7	11.5	10.8	13.1	12.6
Rockwood.	3.1	5.3	6.5	6.9	8.3	7.4	9.0	8.4	9.8	8.8	11.3	9.9	12.1	11.4	12.9	12.6
Devon.	4.0	8.6	9.3	9.3	7.6	7.8	9.1	7.7	9.1	9.5	10.5	10.2	11.2	11.4	13.2	13.4
All-India.	-	-	-	-	7.8	7.3	8.5	8.0	9.4	9.0	9.8	9.7	11.1	10.7	13.2	12.6

WEIGHT AGAINST AGE GROUP:

Devarashola.	51.0	60.9	63.5	66.7	70.8	70.3	74.0	75.0	79.3	79.2	86.0	82.8	89.0	86.7	95.2	92.3
Rockwood.	51.5	55.7	63.7	63.9	68.6	66.6	72.9	72.3	78.2	76.9	83.6	81.3	84.3	85.6	92.1	91.9
Devon.	57.0	57.2	64.5	68.3	73.7	71.8	78.0	77.2	75.4	78.0	85.5	85.1	87.4	87.3	93.2	95.1
All-India.	-	-	-	-	70.8	69.3	74.2	73.3	78.2	77.1	81.8	85.8	86.2	84.9	93.9	92.6

AGE BY HEAD CIRCUMFERENCE

Devarashola.	37.1	41.2	42.5	43.2	45.6	43.8	45.9	46.0	46.5	46.3	48.0	47.2	47.9	47.3	48.9	48.3
Rockwood.	35.5	39.6	41.8	43.1	44.4	41.6	44.4	44.2	46.4	45.8	46.6	45.7	47.1	46.4	47.5	47.4
Devon.	41.0	39.7	42.8	43.8	45.2	43.8	47.1	44.3	46.6	45.8	47.0	46.3	48.4	47.0	48.9	47.4
All India.	-	-	-	-	43.9	43.0	45.1	44.0	45.5	44.6	46.3	45.4	47.2	46.1	47.9	47.1.

AGE BY MID-ARM CIRCUMFERENCE.

Devarashola.					12.7	13.2	12.6	12.7	13.1	13.0	13.6	13.5	13.8	13.5	14.1	14.3
Rockwood.					13.5	13.1	13.6	13.3	13.5	13.4	14.1	13.4	14.0	14.5	14.3	14.2
Devon.					12.9	11.2	11.4	11.6	12.6	12.5	13.0	12.8	12.8	12.9	13.1	13.5
All-India					12.5	12.1	12.7	12.5	13.0	12.8	13.0	13.0	13.4	13.4	14.0	13.9

AGE BY CHEST CIRCUMFERENCE

Devarashola.					44.6	44.0	45.0	43.7	47.8	45.9	48.8	47.9	49.6	43.1	51.0	50.7
Rockwood.					44.6	42.4	45.9	45.9	48.0	46.4	48.5	48.0	49.5	48.5	49.7	49.4
Devon.					44.9	44.1	47.3	43.6	47.4	46.4	48.5	47.4	50.0	48.3	49.9	49.4
All India.					43.1	42.1	44.5	43.4	45.4	44.4	46.6	45.5	48.1	46.9	49.6	48.6

Dr. B.V. Amar NUT 7-7

221
222
223

Nutritional assessment of under fives belonging to three estates in Gudulur Taluk.

Survey done by: Dr. Joseph Alapatt.
Dr. B.V. Amar.
Dr. Raymond X. Perez.

SUMMARY: Large majority of children are suffering from malnutrition Anthropometrical measurement shows close parallel to the all India mean and falls below the normal growth curves. Clinical assessment supports these facts; most of those, examined showed deficiency signs. Practice of bad food habits and unhealthy housing and sanitation has contributed to the high degree of malnutrition among the under Fives. Illetracy also plays an important role.

INTRODUCTION: Good nutrition is of prime importance in attaining normal growth and development and maintenance of health throughout life. During our stay in the estates we noticed that most of the mothers go for work leaving behind their children in the Creches and paying little attention to their diet. 1979 being the International Year of the Child we decided to look into the nutritional status of these children. We participated in similar surveys during our "Social Paediatrics" posting which gave us the impetus to attempt this survey.

OBJECTIVES: Objectives are as follows:-

1) Anthropometrical and Clinical Assessment of nutricional status.
2) having found the deficiency/malnutrition; to assess the impact of existing, curative and educational standards of the health care in the estates.

MATERIALS AND METHODS:

PERSONNEL: 1) Medical adviser (CLWS, UPASI)
2) One health worker (--" --)
3) Balasevikas and the compounder of the respective estates.

A proforma containing anthropometrical measurements and various signs of nutritional deficiency states was prepared for each child.

We instructed and supervised the balasevikas, health worker, and the compounder in the use of measuring tape, weight, balance and height scale in taking anthropometrical measurements while we carried out the clinical assessment of children.

Advance notice was given to all the workers to bring their children to the respective creeches/schools for assessment. Defaulters were covered by line to line approach, The hospital in-patients were also examined thereby obtaining 100% coverage of the children in these estates.

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ANALYSIS: Key to the Graphs : ANTHROPOMETTICAL MEASUREMENTS:

1. Weight/age study in male.
2. Weight/age study in female.
3. Ht/age study males.
4. Ht/age study females.
5. Chest circumference/age male.
6. Chest circumference/age female.
7. Head circumference male.
8. Head circumference female.
9. Midarm circumference male.
10. Midarm circumference female.

Graph 1 & 2:-

All the three estates and the Indian mean appear to be much below the normal cond to health standards. 7

2 - 2½ year age group, both boys and girls have not registered any weight gains all of growth curve also occurs in Rockwood estate at 4th year.

In Devarshola 3 years 4years age group show only bare, minimal weight gain.

Graph 3 & 4:-

Growth curves of all 3 estates drop at the age of 4 years Growth curve which are well below the standards begin to fall- one thinks it is time to worry.

1½ - 2½ years age group in Devon (both boys and girls) show a stepp fall in the growth curve, thereby suggesting that weaning period and their customs contribute to a great many % of PCM in this estate. The vegetarian food habits of this community also contributes.

Graphs 5,6,7,8 & 11.

At birth, the head circumference is much greater than the chest circumference but depending upon the mental growth, the two curves meet each other sooner or later and the Chest circumference overtakes the head circumference at the age of 2 years in Indian children and 9 month or so among American children. This has been linked up with malnutrition prevailing in our country. Among the estates, in Devarshola, the crossing takes place at the age of 2½ years. In Rockwood, the head circumference always remains lower, in Devon, they cross at 1 year.

Based upon this we find that in Rockwood, - from birth, the child is at a disadvantage(therefore interbreeding among the Maplhas is very common and polygamy is the rule) and continues to be deprive them from growing up normal citizens of India.

DEVARSHOLA: As for as the data collected, this is perhaps the only estate amongst these three estates which shows signs of promise and this is due to

(i) The group Manager is incharge of this estate.
(ii) The group medical officer (GMO) and his AMO are residing there, having a group hospital with OT facilities.

Head and chest circumference cross each other at a later age than the mean, Indian child does (2 years), as this is an indication of the prevailing nutrititional status of children, this goes to show the situation at Devarshola estate.

Graphs 9 & 10:

Midarm circumference in devon is well below that of All India mean, whereas Rockwood and Devarshola are above it. 1-1½ years boys in Devan, there is fall in circumference.

DISCUSSION

BAR DIAGRAM: % of dificiency status in each estate.

On observing the tables the bar diagram, protien calorie deficiency is prevalent in all 3 estates, Rockwood and Devarshola have high incidences (47.56% and 42.3% resp) of protine dificiency as compared to Devon where protin calorie deficiency is more, explaining the fact that there are more vegetarians in Devon estate.

Vit 'A' : dificiency is prevalent in all, amounting to more than 40%. But in Rockwood, it is nearly 60%. This high incidence of Vit 'A' deficiency may be explained due to their cooking habits (Prolonged boiling of vegitables). The carotene intak of Devon appears to be much more than the other tow estates - may be due to their food habits (vegetarians).-

Vit 'B' : deficiency appear to be more in Devarshola.

Vit 'C' : deficiency does not seen to exist as citrus fruits are easily available amidst the hills.

As far as Vit 'D': deficiency is concerned it is double that of Devon in Rockwood, and Devershola estates. The % of attendence in creches and schools in Devon estate is comparitively low and the child is carried on the back of the mother explaining the following.

PCM because they do not get enough supplement from creche or schools. Vit 'D' deficiency is less than elsewhere ie., u v light exposure is more than the other two estates reflecting the low attendence in school and creches in Devon estate, where they are given Mid Day Meal which for some form they only Balance diet.

The climate and the natural set up do not allow enough sunlight resulting in the deficiency of Vit 'D' in all three estates.

RECOMMENDATIONS:

1. Education is a must People there lack literacy. They should be able to read, write, and understand. Unless there is basic education, the health education will be abortive.

2. Family Planning shouldbe introduced and encouraged there. For a few, it is against their religious customs. The cause of this failure can also be explained by the fact that after the age of 10, he/she in the family becomes one of the earning members in the house. Naturally, an earning member is an asset to the family and they would like to have as many as possible. (They should be encouraged to have less but healthier and better educated children there by, increasing earning capacity.)

3. Early marriage should be discouraged.

4. During our line to line visit we observed that, the lines are crowded and the houses are not adequate enough to accomodate the king size families. Sanitation is very poor and the surrounding are not kept clean. The house lack adequate ventilation.

Health education should be based on the following:-

1. Family Planning.
2. Sanitation.
3. Food habits.
4. Consanguity.

During our assessment we came across, few cases of gross mental retardation congenital heart diseases, CDH, and TEV - may be due to consanguity.

5. Rockwood needs a full time MO as it is far from the group hospital and the Medical Officers are not staying in an approachable distance.

An annual objective review by the Medical Officers to assess the response to the health education should be carried out.

A closer participation of the estate beaurocracy is indicated.

ACKNOWLEDGEMENTS:

We thank first and foremost, our Community Medicine Department for having given us this excellant opportunity of studying the workings of the Tea estates and its workers. We thank them also for their guidance and full Co-operation in having made the project a success.

We thank Dr. Mrs. Rahamathullah, Dr. S. Pothi and the CLWS workers, for their guidance and organisation.

Our heartful thanks to the group Medical Officer, and the Medical Officer for their help, encouragement and guidance.

We are <u>grateful</u> to the Manager, Balasevikas, and Compounders of the respective estates, for helping us to obtain insight into the problem.

BIOLOGRAPHY

Text Book of preventive and social medicine - Park.
National Plan of action for international year of the child 1979.
Text Book of Paediatrics- Nelson.
Text Book of Pediatrics - Achar.
Outline of Paediatrics - Slobody.

1. Report not corrected before submission
2. The report is sketchy
3. Discussion on results - is incomplete
4. Graphs - class intervals are not properly marked.
5. Tables should be given. Graphs only when necessary
6. Raw data?

Poor.
CPD
3/5/80

RN
2/5

INUT 7.8

Dr. B. V. Aman

PROGRAM COMPONENT

Right at the outset of our internship, we were informed about the need of basic health doctors' appreciation and involvement in the following,

1. Preventive: 1
   a) Eviornmental sanitation.
   b) Immunisation of under 5s.
2. Health education of the masses.
3. Family Planning.
4. Curtive work.

ENVIRONMENTAL SANITATION:- In the estates of Nilgiris, we noticed poor housing, inadequate ventilation and lighting, improper disposal of waste and excreta.

No portable water is available for the consumption of the workers.

We advised the estate Manager and link workers, how to circumvent the same.

IMMUNISATION:- During our social paediatore posting, before, we embarked to the estates, we immunised 1056 children belonging to our neighbouring villages, (Buddagunte palya, Garaga palya and providence school) with DPT & OPV.

We did a study of the immunerisation coverage among the CLWS estates, with Dr. Rahmathullah, the figures of which she presented during the child health conference, at Coonoor.

HEALTH EDUCATION:- During our Social paediatrics posting, we educated the parents of the neighbouring villages with the help of charts, the need for i) proper disposal of waste and excreta.
ii) the need for immunisation
iii) Balanced diet.
iv) anti helminthic precautions.
v) Portable water.

In the estate,s we educated the link workers by giving them simple data about nutrition, sanitation, Immunisatin and common diseases, who inturn are supposed to educate the workers.

During our clinical assessment of children, we informed the parents, of the children's inadequacies, their cause and correction.

FAMILY PLANNING:- Curative work:- We handled the out patient clinic in Coonoor, during the morning hours.

During the UEASI week, we were the medical officers who were posted at different sport venues.

The congenital heart disease, TEV, CDH, these cases we reffered to the Coimbatore District Hospital for the necessary treatment. We brought to the notice of the Medical Officer, cases which needed treatment in the estates.

Our interest in social paediatries was enhanced during SJMC Hospital posting whereas we have already mentioned, we assessed nutritional status of children among the neighbouring villages, we were asked to do a study on the following amongst the estate workers.

1. Double checking the ICMR pilot project.
2. Respiratory disorders amongst the insecticide sprayers.
3. Link workers scheme.

We finished the double checking of the ICMR pilot project.

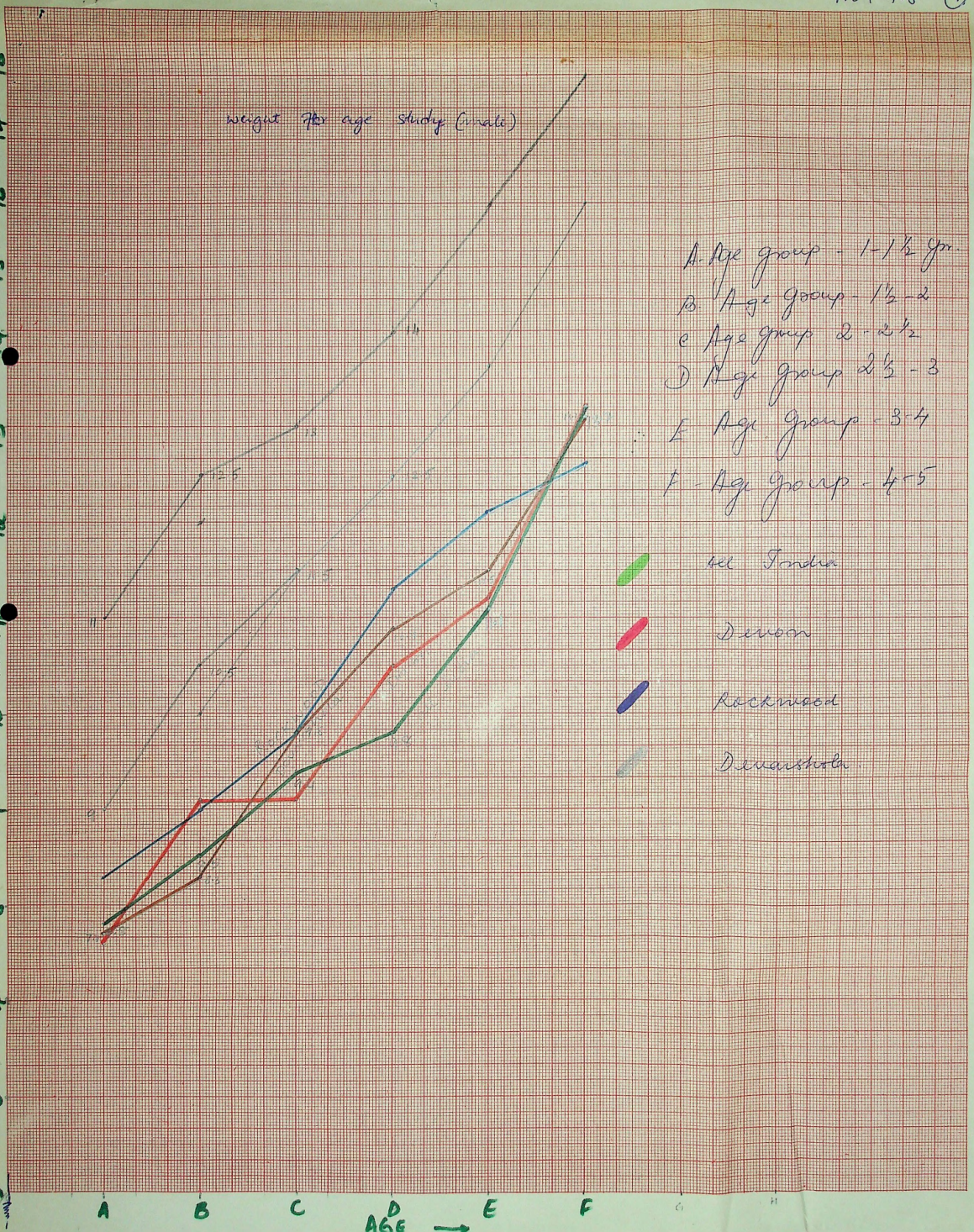
We could not carry out a study on the insecticide, sprayers as all the male workers are employed in spraying as a part of the task work. We attended the link workers meeting at different estates and educated them.

We prepared the folders and its contents for the 'Child Health Conference' which was held at UPASI on September 2, 1979.

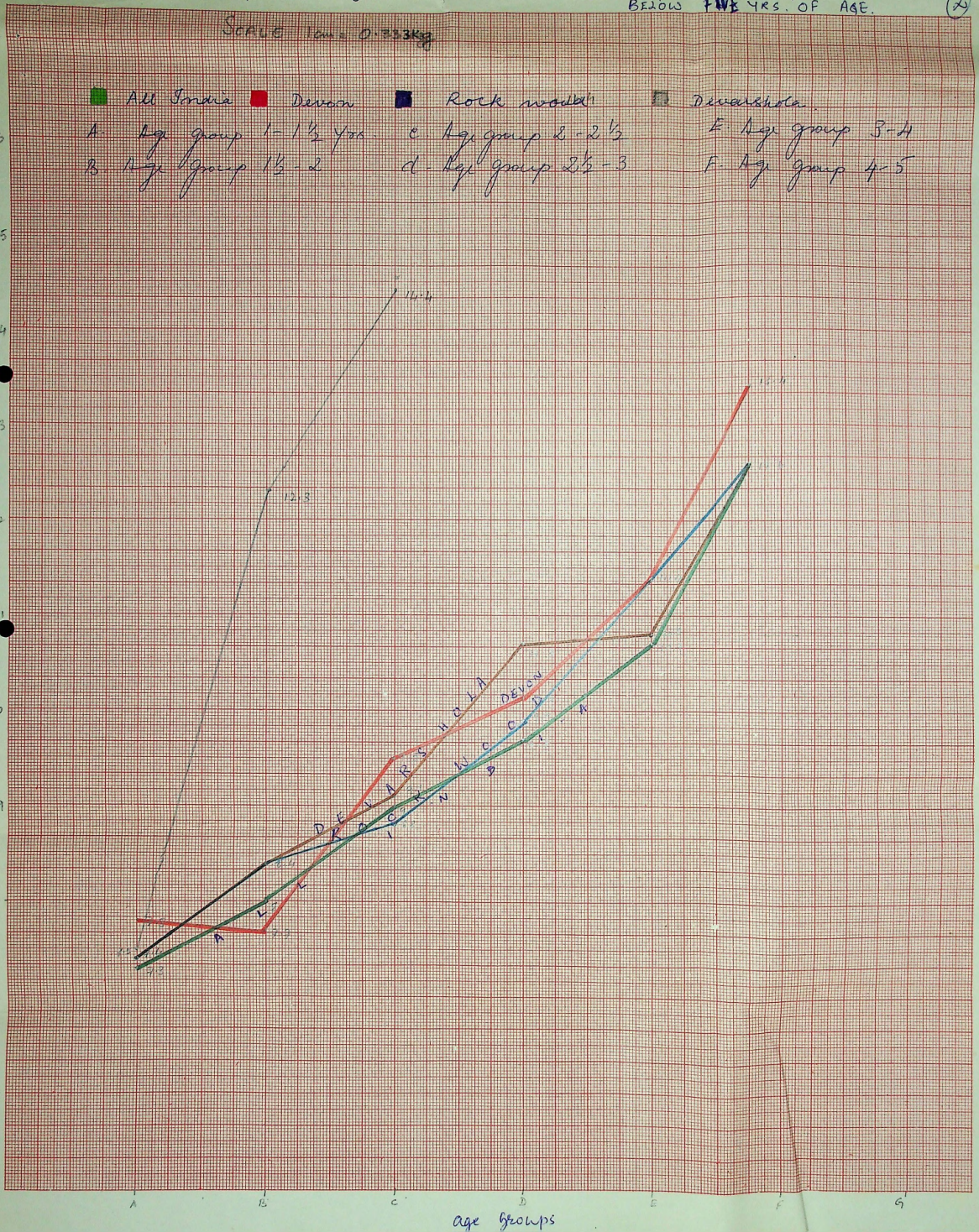
As instructed and guided by Dr. Dara, S. Amar, we started examining children for the incidence of scabrics and pediculosn in Glendall estate. But, before we could complete the survey we were requested by Dr. Mrs. Rahamathullah, to assess the Nutritional status of children belonging to the Devarshola group of estates.

We assessed all the children (100%)

FAMILY PLANNING:- During my Family Planning postings, I did 4 tubectomies. ~~It~~ I did not get an opportunity for vasectomy. During my Coonoor postings, I did 7 Tubectomies making it a total of 11 Tubectomies.

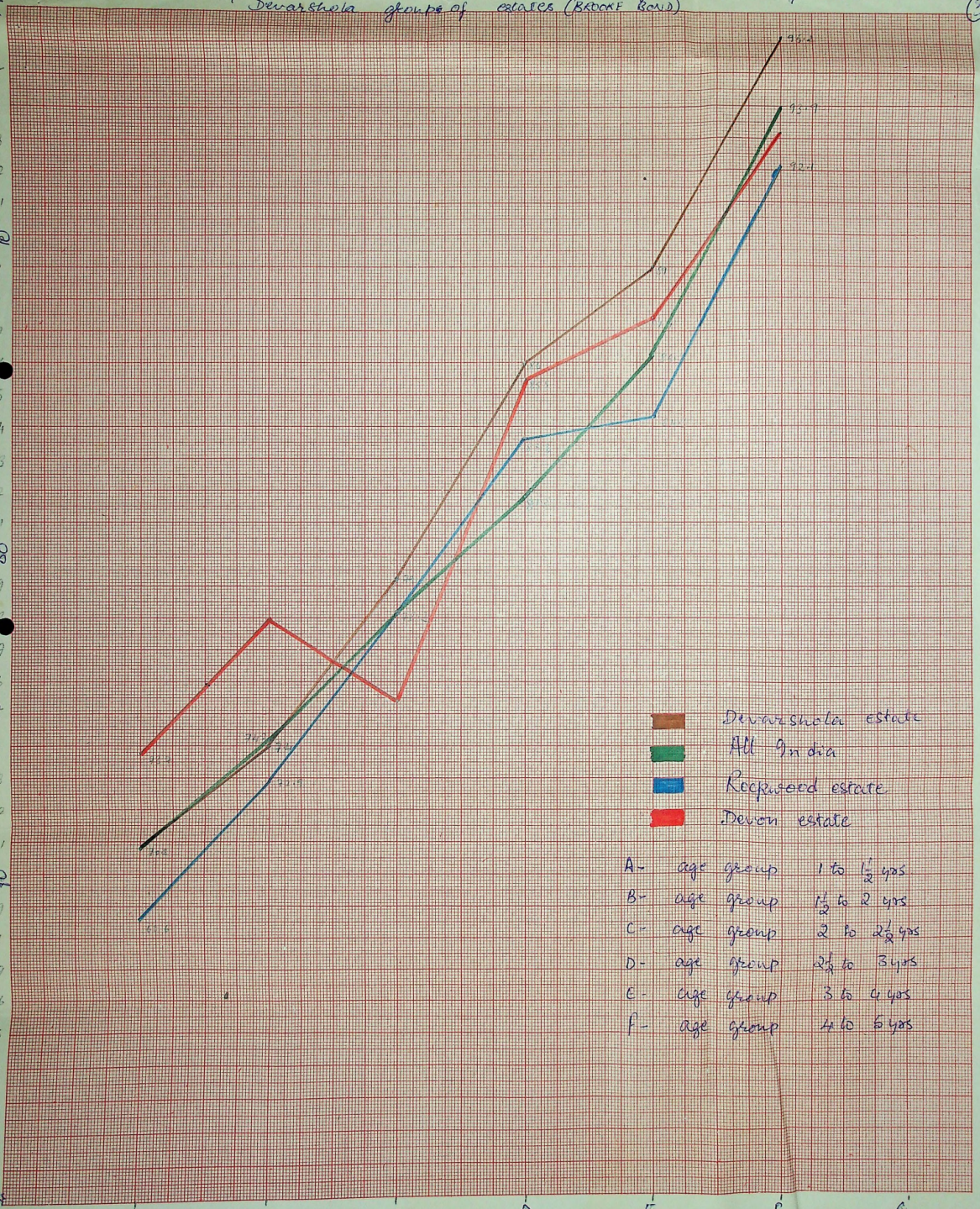

weight for age study (female)
A. Age group - 1-1½ yr.
B. Age group - 1½-2
C Age group 2-2½
D Age group 2½-3
E Age group - 3-4
F - Age group - 4-5
Tel Indian
Deccan
Rockwood
Dewanshola
WEIGHT in kgs
AGE
A
B
C
D
E
F
18
17
16
15
14
13
12
11
10
9
8
7
6
5

A comparison of wt/age for Devarshola group of estates (females) BELOW FIVE YRS. OF AGE. (2)

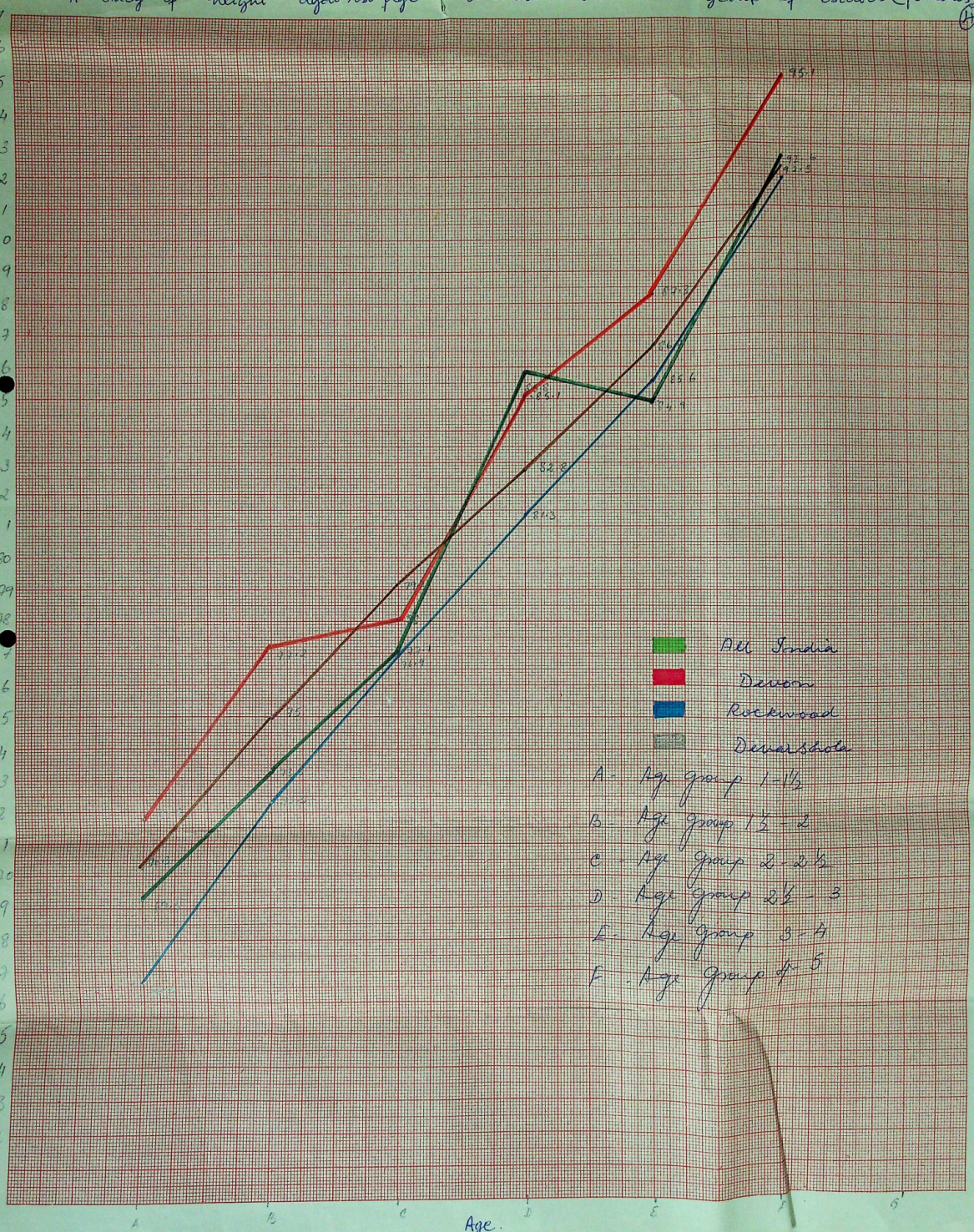


a study of Ht. in cms in relation to age groups of children in ♂ (3)

Devarshola groups of estates (BROOKE BOND)



A study of height against Age amidst Devarshola group of estates (Females) (H)



a study of age / chest occ / age of Devarshola group of estates

UNDER FIVES: MALES

A Age group 1 - 1½ yrs

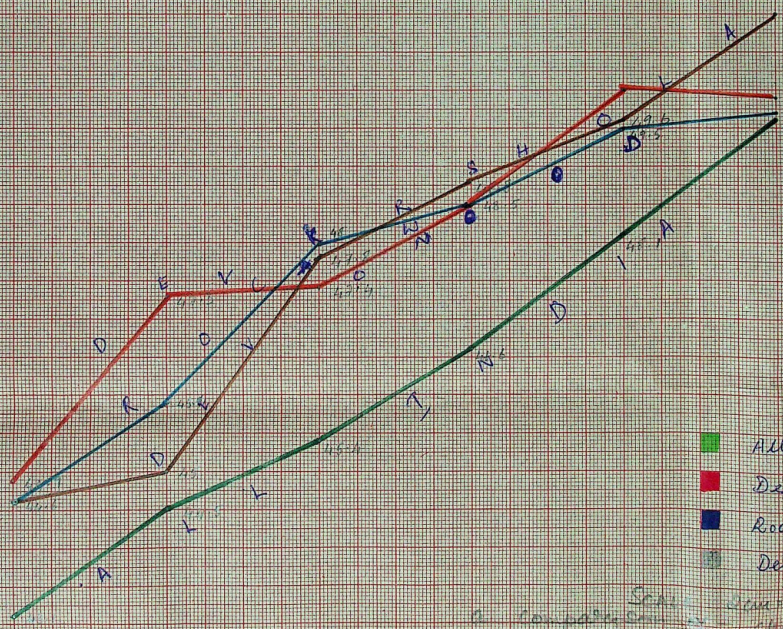
B Age group 1½ - 2

C Age group 2 - 2½

D Age group 2½ - 3

E Age group 3 - 4

F Age group 4 - 5



Chest circumference 2 BD = 1 cm

Age

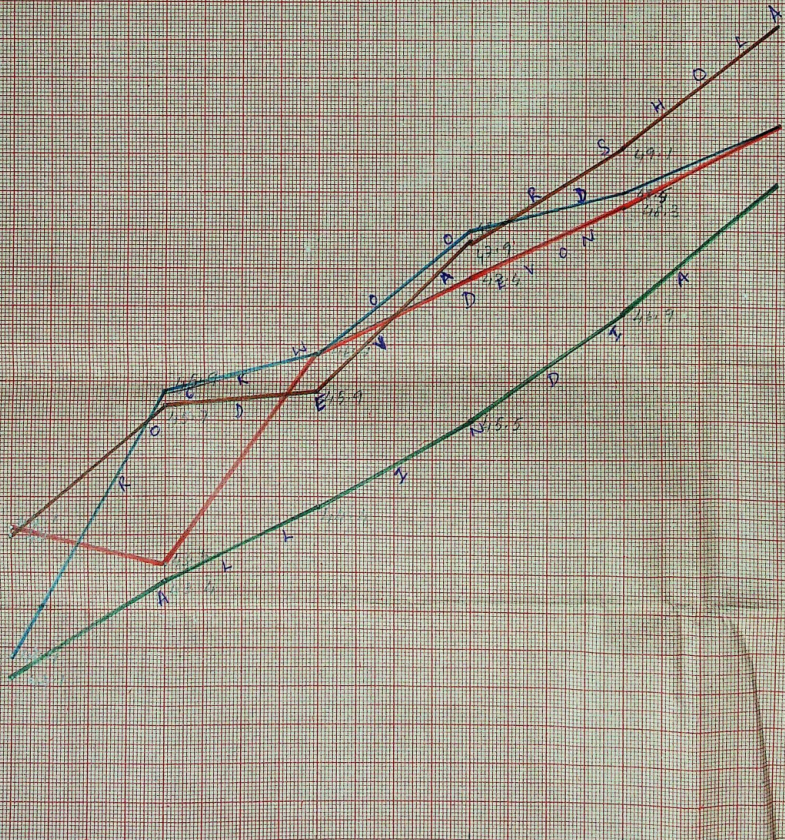
A B C D E F G

age groups.

Chest circumference in relationship with the age groups of children (under five females) among the three estates

- All India
- Dewoon
- Rockwood
- Dewarshola

A - Age group 1 - 1½ yrs. B - Age group 1½ - 2 yrs. C - Age group 2 - 2½ D - Age group 2½ - 3 E - Age group 3 - 4 F - Age group 4 - 5



Head circumference in relation to age [Devarshola group of estates] UNDER FIVE MALES C' (7)

A - Age group 1 - 1½ yr.

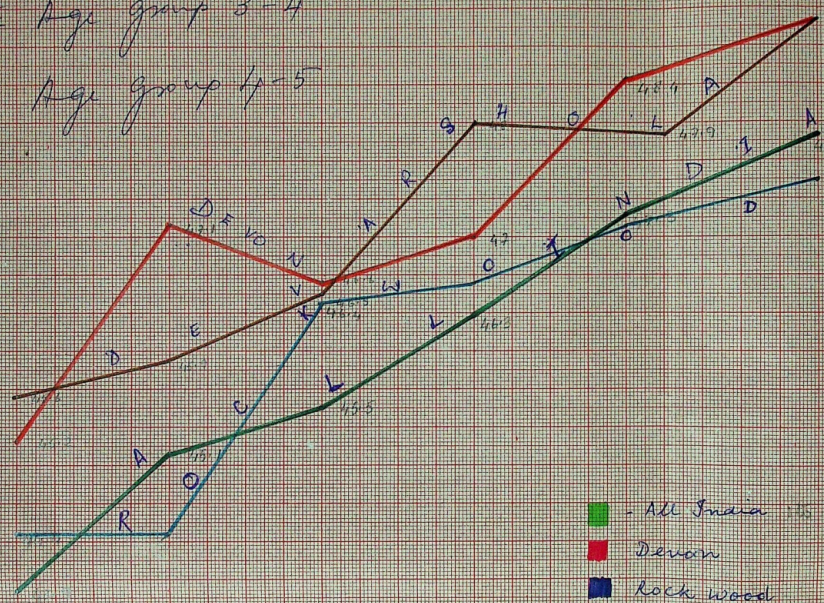
B - Age group 1½ - 2

C - Age group 2 - 2½

D - Age group 2½ - 3

E - Age group 3 - 4

F - Age group 4 - 5



Scale

Head circumference in relation to Age

A B C D E F

Age groups.

HEAD CIRCUMFERENCE / AGE

♀ (8)

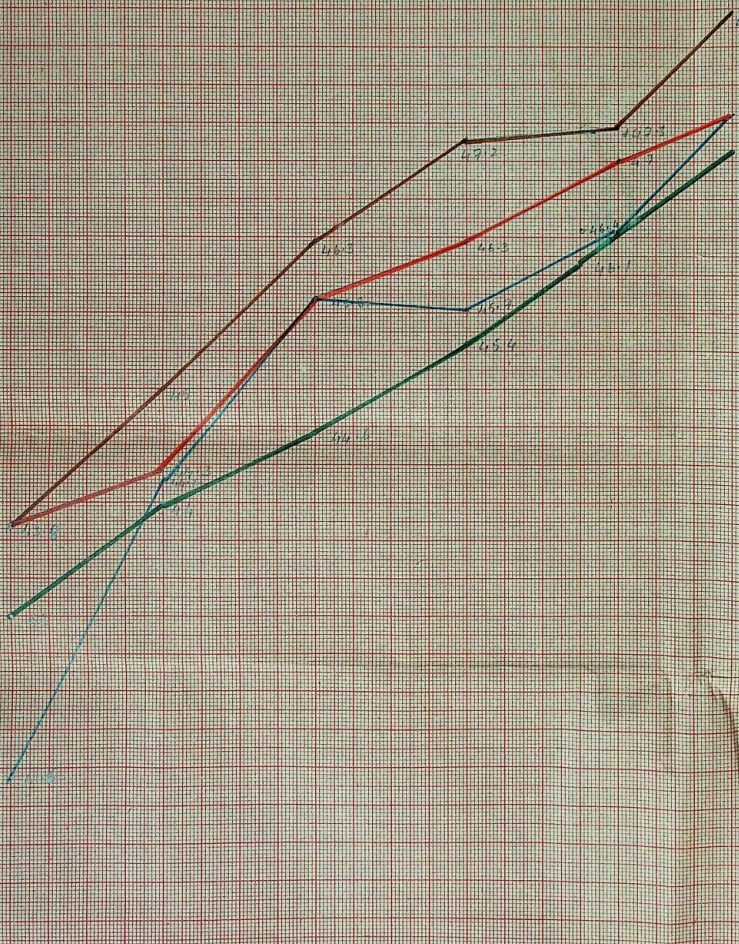
Del Tondo

Denver

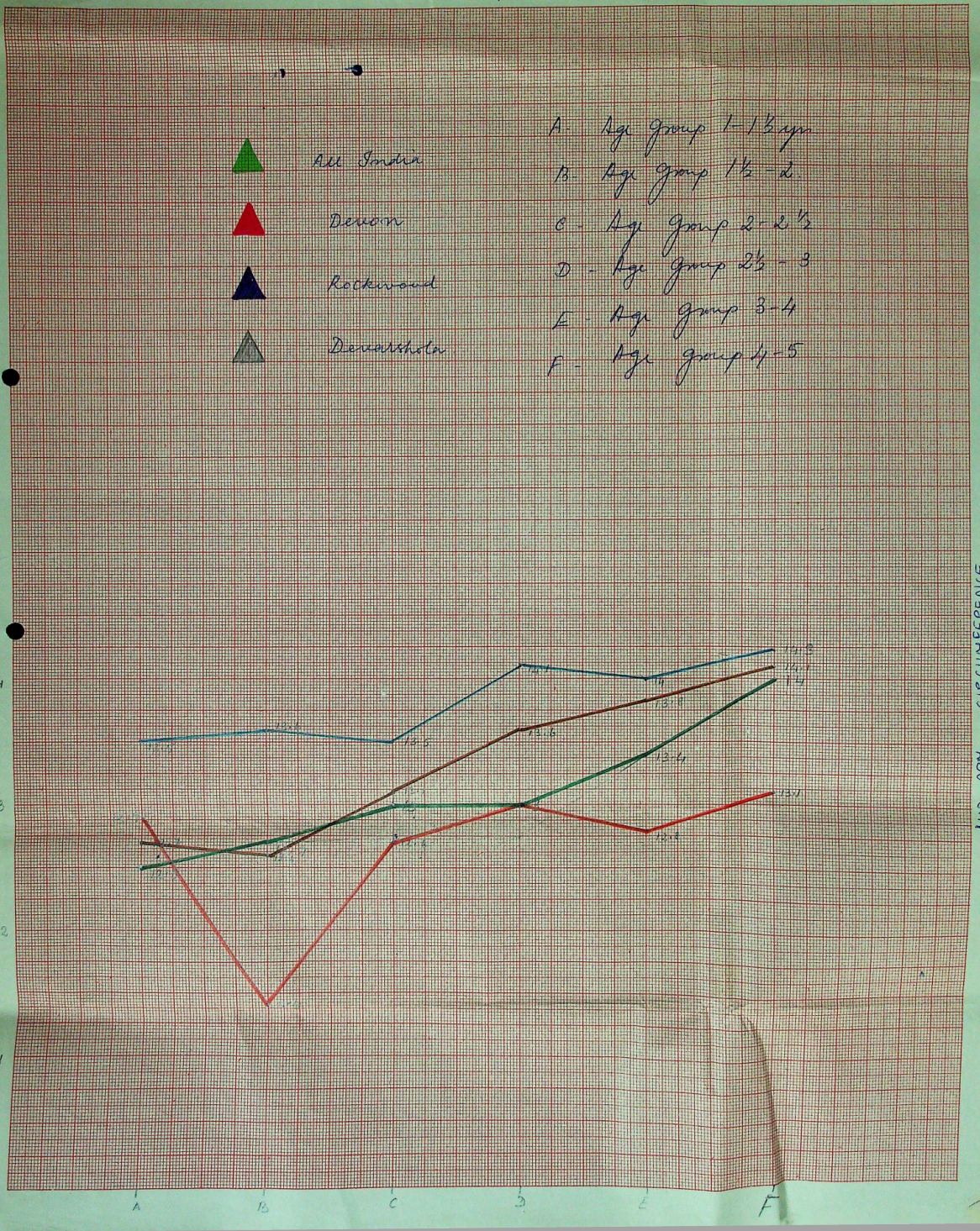
Rockwood

Devanshetu

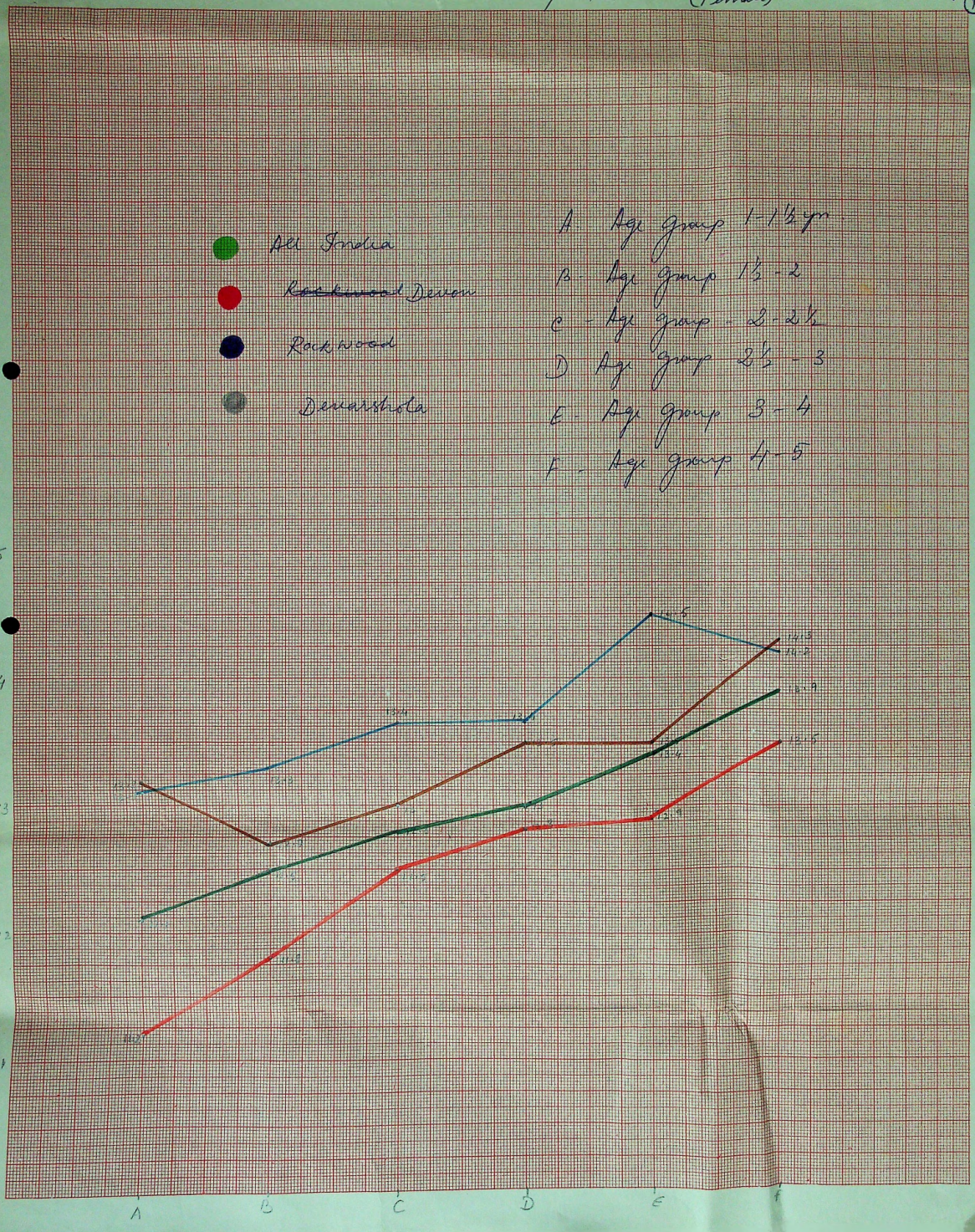
A: Age Group 1 - 1½ yrs
B: Age Group 1½ - 2
C - Age Group 2 - 2½
D - Age Group 2½ - 3
E - Age Group - 3 - 4
E Age Group 4 - 5



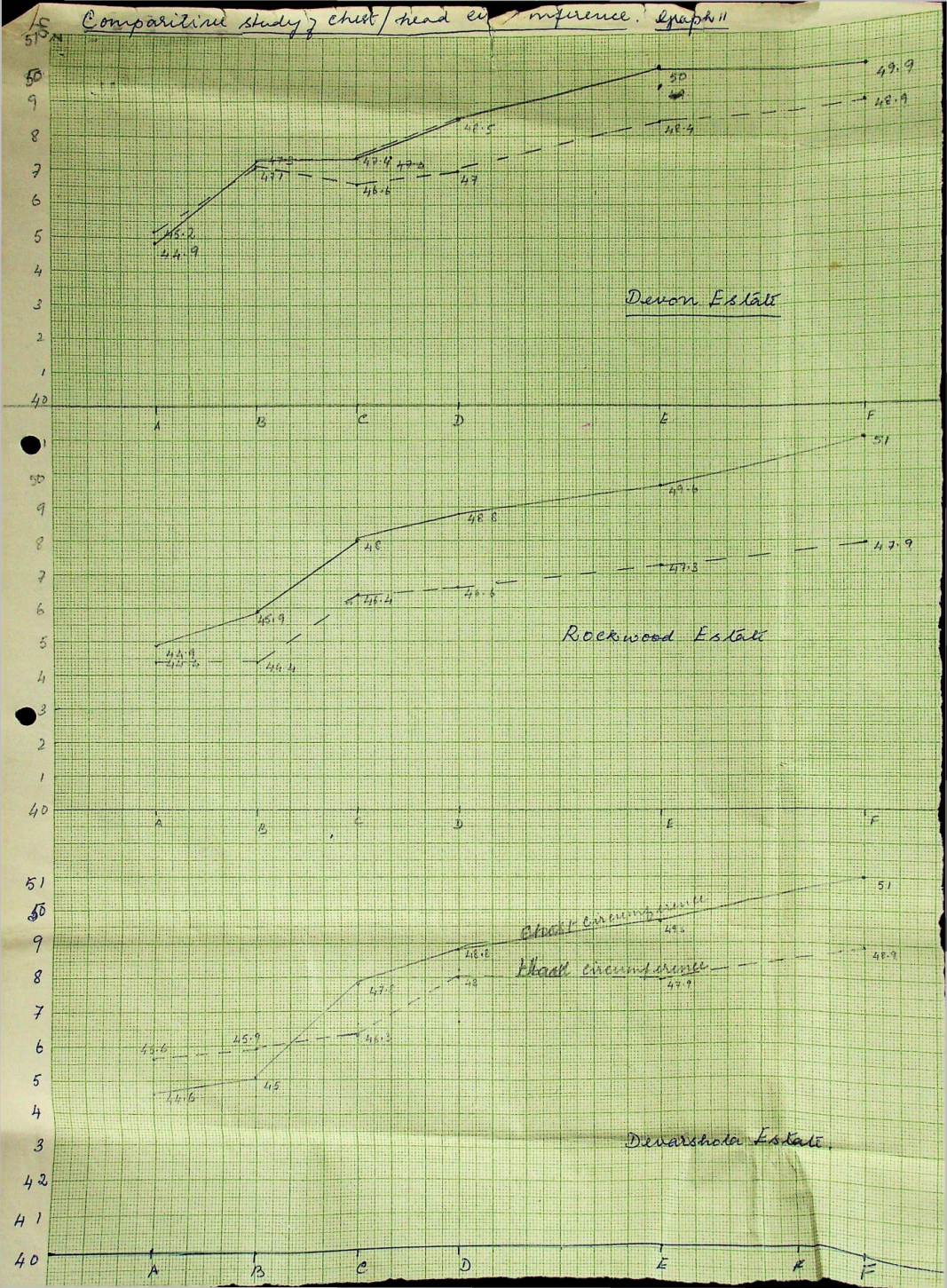
Mid arm circumference in relation to age. (Male) ♂ (9)

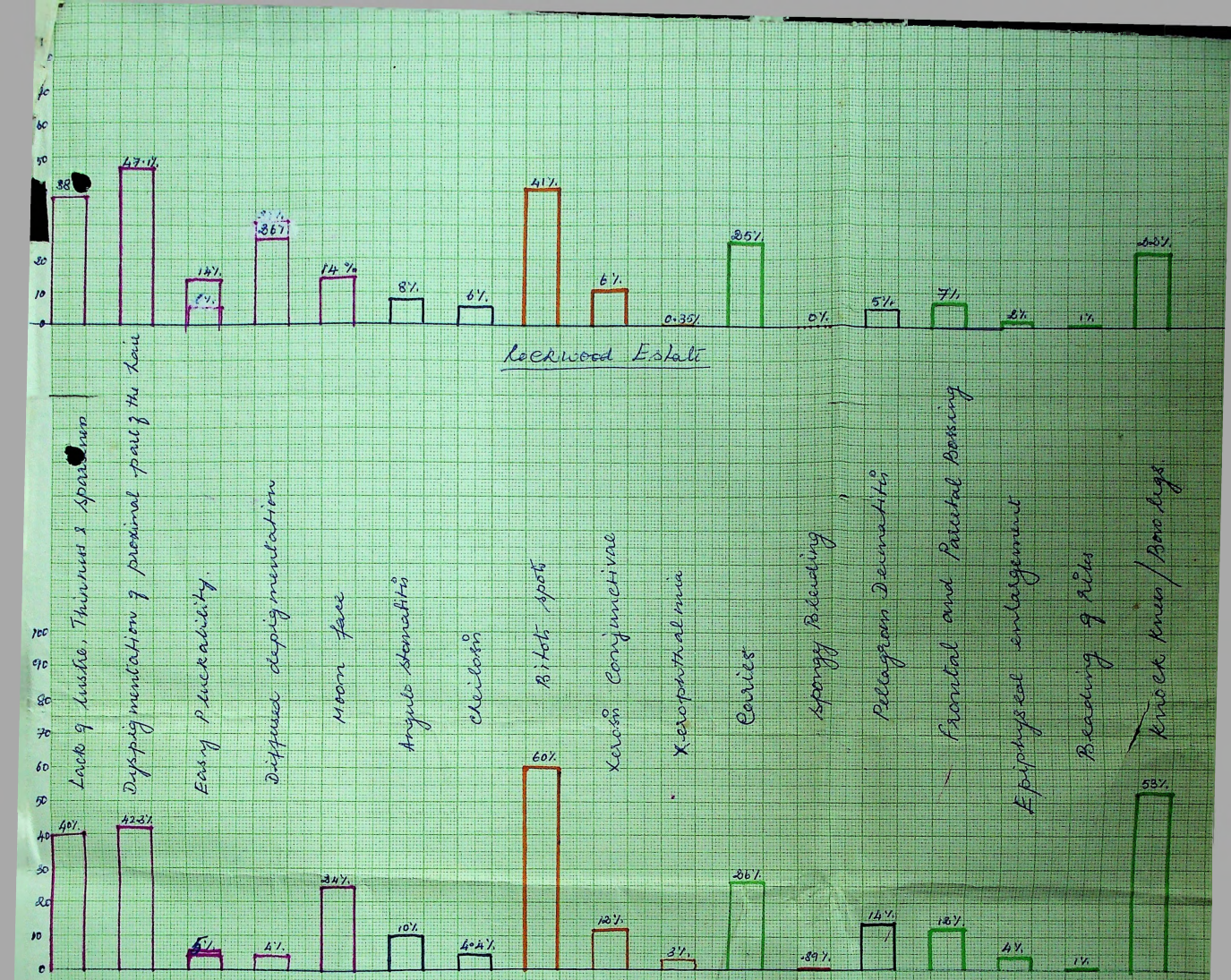


MID ARM CIRCUMFERENCE / AGE. (Female) - ♀ (17)

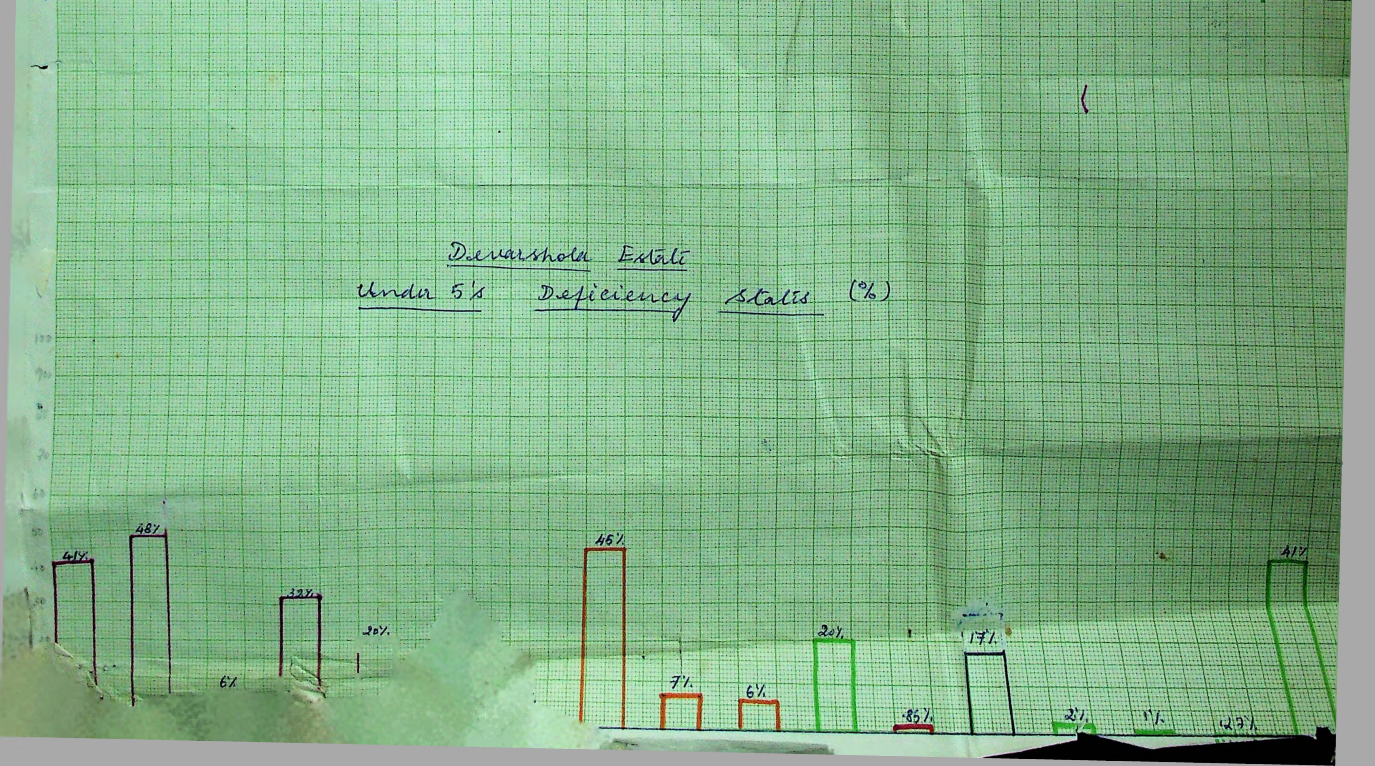


Comparitive study of chest/head circumference. Graph II





Lockwood Estate



Under 5's Deficiency Stalis (%)

NUT 7.5

NUTRITIONAL ASSESSMENT.

Clinical Analysis of Highwavys Group of Estates.

Age group. 0-3 months.	Name of the estates.						
	Cloudland.	Highwavys.	Upper Manalaar.	Manalaar.	Vennier I.	Vennier II.	Vennier III.
Total number of children.	4	5	3	8	8	1	7
Hair.							
1 a	1	1	..	..	..	..	..
1 b	1	..	..	..	..	..	..
1 c	..	..	..	..	..	..	..
1 d	..	..	..	..	..	..	..
Face.							
2 a	..	..	..	..	..	..	..
2 b	..	..	..	..	..	..	..
Eyes.							
3 a	..	..	..	..	..	..	..
3 d	..	..	..	..	..	..	..
Lips.							
4 a	..	..	..	..	..	..	..
4 b	..	..	..	..	..	..	..
Teeth.							
6 a	..	..	..	..	..	..	..
6 b	..	..	..	..	..	..	..
Skin.							
8 a	..	..	..	..	..	..	..
8 b	..	..	..	..	..	..	..
Nail.							
9 a	..	..	..	..	..	..	..
Muscular & skeletal systems.							
11 a	..	..	..	..	..	..	..
11 d	..	..	..	..	..	..	..
11 g	..	..	..	..	..	..	..
11 h	..	..	..	..	..	..	..
11 f	..	..	..	..	..	..	..
Otitis.							
O	..	..	..	..	..	..	1
Pyoderma.							
P	..	..	..	..	..	..	..
LRTI	..	..	..	..	1	..	..
Scabies.	..	..	..	..	..	..	..
Pb	..	..	..	..	..	..	..
Mo	..	..	..	..	..	..	..

NUTRITIONAL ASSESSMENT.

Clinical Analysis of Highwavys Group of Estates.

Age group. 3-6 months.	Name of the estates.						
	Cloudland.	Highwavys.	Upper Manalaar.	Manalaar.	Vennier I.	Vennier II.	VennierIII
Total number of children.	9	9	7	14	9	4	5
Hair.							
1 a	3	4	2	6	2	2	1
1 b	..	..	..	..	..	..	..
1 c	..	..	..	..	..	..	..
1 d	..	..	..	..	..	..	..
Face.							
2 a	..	..	..	..	..	..	..
2 b	..	..	..	..	..	..	..
Eyes.							
3 a	..	..	..	..	..	..	..
3 d	..	..	..	..	..	..	..
Lips.							
4 a	..	..	..	..	..	..	..
4 b	..	..	..	..	..	..	..
Teeth.							
6 a	..	..	..	..	..	..	..
6 b	..	..	..	..	..	..	..
Skin.							
8 a	..	..	..	..	..	..	..
8 b	..	..	..	..	..	..	..
Neil.							
9 a	..	..	..	..	..	..	..
Muscular & skeletal systems.							
11 a	..	..	..	1	..	..	..
11 d	1	..	..	..	..	..	..
11 g	..	..	..	..	..	..	..
11 h	..	..	..	..	..	..	..
11 f	..	..	..	..	..	..	..
Otitis.							
O	..	..	..	..	..	..	..
Pyoderma.							
P	..	..	1	..	..	..	..
LRTI	..	..	..	..	..	..	..
Scabies.							
S	..	..	..	..	..	..	..
Pb	..	..	..	..	..	..	..
Mc	..	..	..	..	..	..	..

NUTRITIONAL ASSESSMENT.

Clinical Analysis of Highwavys Group of Estates.

Age group. 6-9 months.	Name of the estates.						
	Cloudland.	Highwavys.	Upper Manalaar.	Manalaar.	Vennier I.	Vennier II.	Vennier III
Total number of children.	5	12	7	12	3	7	10
Hair.							
1 a	3	6	1	8	2	3	4
1 b	..	..	..	1	..	..	..
1 c	..	..	..	..	..	..	..
1 d	..	..	..	..	..	1	..
Face.							
2 a	..	..	..	..	..	..	..
2 b	..	..	..	..	..	..	..
Eyes.							
3 a	..	..	..	..	..	..	..
3 d	..	..	..	..	..	..	..
Lips.							
4 a	..	..	..	..	..	..	..
4 b	..	..	..	..	..	..	..
Teeth.							
6 a	..	..	..	..	..	..	..
6 b	..	..	..	..	..	..	...
Skin.							
8 a	..	..	..	1	..	..	..
8 b	..	..	..	..	..	..	..
Nail.							
9 a	..	..	..	..	..	..	..
Musculer & skeletal systems.							
11 a	..	..	..	..	..	..	..
11 d	..	..	..	1	..	..	..
11 g	..	..	..	..	..	..	..
11 h	..	..	..	..	..	..	..
11 f	..	..	..	..	..	..	..
Otitis.							
O	..	..	1	..	..	..	..
Pyoderma.							
P	..	..	..	1	..	..	..
LRTI.	1	1	1	..	..	..	..
Scabies.							
S	..	..	...	..	..	..	..
Pb	..	..	...	..	..	..	..
Mc	..	..	...	..	..	..	..

NUTRITIONAL ASSESSMENT.

Clinical Analysis of Highwavys Group of Estates.

Age group. 9-12 months.	Name of the estates.						
	Cloudland.	Highwavys.	Upper Manalaar.	Manalaar.	Venniar I.	Venniar II.	Venniar III.
Total number of children.	5	13	6	24	5	3	8
Hair.							
1 a	3	6	3	15	3	6	1
1 b	..	..	..	..	..	..	..
1 c	..	..	..	..	..	..	..
1 d	..	..	..	2	..	..	..
Face.							
2 a	..	..	..	..	..	..	..
2 b	..	-.	..	..	..	..	..
Eyes.							
3 a	..	..	..	..	..	..	..
3 d	..	..	..	..	..	..	..
Lips.							
4 a	..	..	..	..	..	..	..
4 b	..	..	..	...	..	..	..
Teeth.							
6 a	..	..	..	..	..	..	..
6 b	..	..	..	..	..	..	..
Skin.							
8 a	..	..	..	..	..	..	..
8 b	..	...	..	...	..	..	..
Neil.							
9 a	..	..	..	..	..	..	..
Muscular & skeletal systems.							
11 a	..	1	..	1	..	1	..
11 d	..	..	..	..	..	..	..
11 g	..	..	..	..	..	..	..
11 h	..	..	..	..	..	..	..
11 f	..	..	..	..	..	..	..
Otitis.							
O	..	..	2	..	..	..	..
Pyoderma.							
P	..	1	..	..	..	1	..
LRTI.	..	..	..	..	..	1	..
Scabies.							
S	..	..	..	..	..	..	..
Pb	1	..	..	..	..	..	..
Mc	1	..	..	..	..	..	..

NUTRITIONAL ASSESSMENT.

Clinical Analysis of Highwayvs Group of Estates.

Age group. 1-1½ years.	Name of the estates.																	
	Cloudland.		Highwayvs.		Upper Menalaar.		Menalaar.		Vennier I.		Vennier II.		Vennier III.					
	M	F	M	F	M	F	M	F	M	F	M	F	M	F				
Total number of children.	7	9	9	13	13	9	12	17	3	7	13	6	10	6				
Hair.																		
1 a	4	8	6	5	9	6	2	7	2	6	8	3	6	6				
1 b	-	1	-	-	-	-	-	-	-	-	-	-	-	-				
1 c	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
1 d	-	-	-	-	1	-	-	-	-	-	1	-	-	1				
Face.																		
2 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
2 b	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Eyes.																		
3 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
3 d	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Lips.																		
4 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
4 b	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Teeth.																		
6 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
6 b	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Skin.																		
8 a	-	-	-	-	-	-	1	-	-	-	-	-	-	-				
8 b	-	-	-	-	-	-	1	-	-	-	-	-	-	-				
Nail.																		
9 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Muscular & skeletal systems.																		
11 a	-	-	-	-	-	-	-	1	-	-	-	-	-	-				
11 d	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
11 g	-	-	1	-	-	-	-	-	-	-	-	-	-	-				
11 h	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
11 f	-	-	1	-	-	-	-	-	-	-	-	-	-	-				
Otitis.																		
O	-	-	-	-	-	1	-	-	-	1	-	-	-	-				
Proderma.																		
P	1	-	-	1	-	-	-	-	-	-	-	-	-	-				
LRTI.	-	-	-	1	1	-	-	-	-	-	-	-	1	1				
Scabies.																		
S	-	1	-	-	-	-	-	-	-	-	-	-	-	-				
Fb	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Mc	-	-	-	-	-	-	-	-	-	-	-	-	-	-				

NUTRITIONAL ASSESSMENT.

Clinical Analysis of Highwavys Group of Estates.

Age group. 1½-2 years.	Name of the estates.																			
	Cloudland.		Highwavys.		Upper Menalaar.		Menalaar.		Vennier I.		Vennier II.		Vennier III.							
	M	F	M	F	M	F	M	F	M	F	M	F	M	F						
Total number of children.	9	8	4	10	8	6	15	14	11	13	12	11	4	10						
Hair.																				
1 a	5	3	3	8	3	3	6	12	6	5	8	7	3	7						
1 b	1	-	-	-	-	-	-	1	-	-	-	-	-	-						
1 c	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
1 d	1	-	-	1	-	-	-	-	1	-	-	-	-	3						
Face.																				
2 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
2 b	-	-	-	1	-	-	-	-	-	-	-	-	-	-						
Eyes.																				
3 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
3 d	-	-	-	-	-	-	-	-	-	1	-	-	-	-						
Lips.																				
4 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
4 b	-	-	-	-	-	-	-	-	1	-	1	-	-	-						
Teeth.																				
6 a	-	-	-	1	-	-	-	-	-	-	-	1	-	-						
6 b	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
Skin.																				
8 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
8 b	-	-	-	1	-	-	-	-	-	-	1	1	-	-						
Nail.																				
9 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
Muscular & skeletal systems.																				
11 a	-	-	-	-	-	-	-	1	-	-	3	2	1	-						
11 d	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
11 g	-	-	-	-	1	-	-	-	-	-	-	-	1	-						
11 h	-	-	-	-	-	-	-	-	-	-	-	-	1	-						
11 f	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
Otitis.																				
O	1	-	-	1	1	-	1	1	2	1	-	-	-	-						
Pyoderma.																				
P	2	1	-	-	-	-	-	-	-	-	-	-	-	-						
LRTI.	1	-	-	1f	-	-	-	-	-	-	-	1	-	-						
Scabies.																				
S	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
Pb	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
Mc	-	-	-	-	-	-	-	-	-	-	-	-	-	-						

NUTRITIONAL ASSESSMENT.

Clinical Analysis of Highwavys Group of Estates.

Age group. 2 - 2½ years.	Name of the estates.													
	Cloudland.		Highwavys.		Upper Menalaar.		Menalaar.		Venniar I.		Venniar II.		Venniar III.	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Total number of children.	3	6	12	13	9	8	6	7	2	5	9	3	6	10
Hair.														
1 a	1	3	6	10	2	4	3	3	-	1	5	2	2	7
1 b	-	1	-	-	-	1	-	-	-	-	-	-	-	-
1 c	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1 d	-	-	-	-	-	1	1	-	-	-	-	-	-	1
Face.														
2 a	1	-	-	1	-	-	-	-	-	-	-	-	-	-
2 b	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eyes.														
3 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3 d	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lips.														
4 a	-	-	-	-	-	-	-	-	-	-	-	-	-	1
4 b	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Teeth.														
6 a	-	-	-	-	1	-	-	-	-	-	2	-	-	-
6 b	-	1	-	-	-	-	-	-	1	-	-	-	-	-
Skin.														
8 a	-	-	1	-	-	-	-	-	-	-	-	-	-	-
8 b	-	-	2	-	-	-	1	1	-	-	-	-	-	-
Nail.														
9 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Muscular & skeletal systems.														
11 a	-	1	1	-	-	-	-	-	-	-	-	1	-	1
11 d	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11 g	-	-	2	-	-	-	-	-	-	-	-	-	-	-
11 h	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11 f	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Otitis.														
O	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Pyoderma.														
P	-	-	-	2	1	-	-	-	-	-	1	-	-	-
LRTI.	-	-	-	-	-	-	-	-	-	-	-	1	-	1
Scabies.														
S	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Pb	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mc	-	-	-	-	-	-	-	-	-	-	-	-	-	-

NUTRITIONAL ASSESSMENT.

Clinical Analysis of Highways Group of Estates.

Age group. 2½ - 3 years.	Name of the estates.													
	Cloudland.		Highways.		Upper Manalaar.		Manalaar.		Vennier I.		Vennier II.		Vennier III.	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Total number of children.	2	5	9	10	12	11	8	12	3	3	4	3	10	5
Hair.														
1 a	1	2	2	7	2	3	3	4	1	2	1	1	3	-
1 b	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1 c	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1 d	-	1	-	1	-	-	-	-	-	-	-	-	-	-
Face.														
2 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 b	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eyes.														
3 a	-	-	-	-	-	-	-	-	-	-	-	-	1	-
3 d	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lips.														
4 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4 b	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Teeth.														
6 a	-	1	-	1	-	-	1	-	1	-	-	-	1	-
6 b	-	-	-	-	-	-	-	1	-	1	-	-	-	-
Skin.														
8 a	-	-	-	-	-	-	-	1	-	-	-	-	-	-
8 b	-	-	1	1	1	-	1	1	-	1	-	1	-	-
Nail.														
9 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Muscular & skeletal systems.														
11 a	-	-	-	-	-	-	-	1	-	-	-	-	-	-
11 d	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11 g	-	-	-	-	-	-	-	-	-	-	1	-	-	-
11 h	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11 f	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Otitis.														
O	-	-	1	-	1	1	-	-	-	-	-	-	1	-
Pyoderma.														
P	-	-	-	1	-	-	-	-	-	-	-	-	-	-
LRTI.	-	-	-	-	-	-	1	-	-	-	-	-	-	1
Scabies.														
S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pb	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mc	-	-	-	-	-	-	-	-	-	-	-	-	-	-

NUTRITIONAL ASSESSMENT.

Clinical Analysis of Highwavys Group of Estates.

Age group. 3 - 4 years.	Name of the estates.																	
	Cloudland.		Highwavys.		Upper Manalaar.		Manalaar.		Vennlar I.		Vennlar II.		Vennlar III.					
	M	F	M	F	M	F	M	F	M	F	M	F	M	F				
Total number of children.	15	16	21	16	13	23	37	23	17	7	17	9	15	11				
Hair.																		
1 a	2	9	4	5	2	7	7	14	6	2	6	5	2	4				
1 b	-	-	1	-	-	-	-	-	-	-	-	-	-	1				
1 c	-	-	-	-	-	1	-	-	-	-	-	-	-	-				
1 d	1	-	-	-	-	-	-	-	-	-	-	1	-	-				
Face.																		
2 a	2	-	-	-	-	-	-	-	-	-	-	-	-	-				
2 b	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Eyes.																		
3 a	-	-	1	-	-	-	2	1	-	-	-	-	-	2				
3 d	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Lips.																		
4 a	-	-	-	1	-	-	-	-	-	-	-	-	-	-				
4 b	-	-	-	-	-	-	1	-	-	-	-	-	-	-				
Teeth.																		
6 a	2	3	2	-	1	-	3	-	4	1	2	1	-	-				
6 b	-	-	-	-	-	-	-	-	-	-	1	-	-	-				
Skin.																		
8 a	1	2	1	-	-	1	-	2	-	-	-	-	1	-				
8 b	-	-	2	1	-	-	5	1	4	-	3	3	2	2				
Nail.																		
9 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Muscular & skeletal systems.																		
11 a	1	-	-	-	-	-	-	1	-	-	-	-	-	-				
11 d	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
11 g	2	1	1	-	-	1	-	-	-	-	1	-	1	-				
11 h	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Otitis.	1	-																
O	2	1	2	-	1	1	-	-	1	-	1	-	5	1				
Pyoderma.																		
P	-	-	1	-	-1	1	1	-	2	-	1	-	-	1				
LRTI.	-	-	-	-	-	-	3	-	-	-	1	-	-	-				
Scabies.																		
S	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
Fb	1	-	-	-	-	-	-	-	-	-	-	-	-	-				
Mc	-	-	-	-	-	-	-	-	-	-	-	-	-	-				

NUTRITIONAL ASSESSMENT.

Clinical Analysis of Highwavys Group of Estates.

Age group. 4 - 5 years.	Name of the estates.													
	Cloudland.		Highwavys.		Upper Manalaar.		Manalaar.		Vennlar I.		Vennlar II.		Vennlar III.	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Total number of children.	6	13	23	20	15	13	37	48	7	8	13	22	8	16
Hair.														
1 a	-	4	-	6	2	2	11	22	-	2	4	11	2	-
1 b	-	1	-	-	-	-	1	2	-	-	-	-	-	-
1 c	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1 d	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Face.														
2 a	-	-	-	-	-	-	-	-	-	-	1	-	-	-
2 b	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eyes.														
3 a	-	-	1	-	-	-	2	2	-	-	-	-	-	1
3 d	-	-	-	-	-	-	-	1	-	-	1	-	-	-
Lips.														
4 a	-	-	-	-	-	-	-	1	-	-	1	-	-	-
4 b	-	-	-	-	-	-	3	2	-	-	-	-	-	-
Teeth.														
6 a	-	2	5	4	1	-	1	5	-	3	1	2	2	2
6 b	-	1	-	-	1	-	-	-	-	1	-	1	-	-
Skin.														
8 a	-	1	-	-	-	-	-	2	-	2	1	-	-	-
8 b	-	-	3	4	-	-	8	4	-	1	2	3	-	3
Nail.														
9 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Muscular & skeletal systems.														
11 a	-	-	-	-	-	-	3	1	-	-	-	-	-	-
11 d	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11 g	-	-	2	1	-	-	-	-	-	-	1	-	-	-
11 h	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11 f	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Otitis.														
O	-	1	-	-	-	-	-	-	-	-	-	-	1	1
Pyoderma.														
P	-	-	-	-	1	-	-	-	-	-	-	-	1	-
LRTI.	1	-	-	1	1	2	-	-	-	-	1	-	-	2
Scabies.														
S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pb	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Mc	-	-	-	-	-	-	-	-	-	-	-	-	-	-

KEY:-

Hair.

1 a - Lack of lustre Thinness and sparseness.
1 b - Dyspigmentation of proximal part of hair.
1 c - Flag sign.
1 d - Easy pluckability.

Face.

2 a - Diffuse depigmentation.
2 b - Naso-labial dyssebacea.

Eyes.

3 a - Xerosis conjunctivae.
3 d - Angular palpebritis.

Lips.

4 a - Angular stomatitis.
4 b - Angular scars.

Teeth.

6 a - Caries.
6 b - Mottled enamel.

Skin.

8 a - Xerosis.
8 b - Follicular hyperkeratosis, types 1 and 2.

Nail.

9 a - Kollonychia.

Muscular and Skeletal systems.

11 a - Frontal and parietal bossing.
11 d - Knock-knees or bowlegs.
11 g - Pigeon chest.
11 h -
11 f - Harisson's sulcus.

O - Otitis.
P - Pyoderma.
LRTI - Lower Respiratory tract infection.
S - Scabies.
Pb -
Mc - Molluscum Contagiosum.

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ss.
27-2-1980.

HEIGHT FOR AGE - HIGH WAVYS GROUP - 1979.

Name of Estate/ Division.	0 - 3 months.			3 - 6 months.			6 - 9 months.			9 - 12 months			1 year to 1½ years.						1½ years to 2 years.					
													Male			Female			Male			Female		
	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean	N	Total	Mean.
Cloudland	4	207	51.75	9	525	58.3	5	314	62.8	5	342.5	68.5	7	501.5	71.64	9	638	70.9	9	695	77.2	8	628	78.5
Highwavys	5	272.5	54.5	9	532	59.1	12	786	65.5	13	892.5	68.7	9	639	71	13	921	70.84	4	298	74.5	0	751	75.1
Manalaar	8	423	52.88	14	841	60.07	12	770	65.16	24	1638	68.25	12	864	72	17	1188	69.88	15	1129	75.27	14	1016	72.57
Upper Manalaar	3	158	52.66	7	408	58.3	7	431	62.71	6	403	67.16	13	927	71.3	9	616	68.44	8	615	76.87	6	431	71.83
Venniar I (a)	3	153	51	5	291	58.2	3	187	62.33	3	195	65	2	129	64.5	5	350	70	4	295	73.75	8	580	72.5
Veniar I (b)	5	243	48.6	4	230	57.5	-	-	-	2	129	64.5	1	70	70	2	138	69	7	535	76.42	5	358	71.6
Veniar II	1	53	53	4	222	55.5	7	451	64.43	8	522	65.25	13	875	67.31	6	425	70.83	12	861	71.75	11	805	73.18
Veniar III	7	358	51.14	5	295	59	10	631	63.1	8	532	66.5	10	692	69.2	6	398	66.33	4	292	73	10	714	71.4
Group Total:-	36	1867.5	51.88	57	3344	58.67	56	3570	63.75	69	4654	67.44	67	4697.5	70.1	67	4674	69.76	63	4720	74.9	72	5283	73.38
Deli Study	-	-	57.4	-	-	63.0	-	-	66.5	-	-	69.0	-	-	-	-	-	-	-	-	-	-	-	-
All-India.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	70.8	-	-	69.3	-	-	74.2	-	-	73.3

Name of Estate/ Division.	2 years to 2½ years.						2½ years to 3 years.						3 years to 4 years.						4 years to 5 years.					
	Male			Female			Male			Femal			Male			Female			Male			Female		
	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean	N	Total	Mean.
Cloudland.	3	235	78.3	6	457	76.2	2	162	81	5	406	81.2	15	1325	88.3	16	1403	87.7	6	548	91.3	13	1227	94.4
Highwavys.	12	970	80.83	13	1038	81.38	9	741	82.33	10	828	82.8	21	1879	89.47	16	1370	85.62	23	2188	95.12	20	1887	94.35
Manalaar.	6	466	77.67	7	552	78.86	8	681	85.13	12	982	81.83	36	3309	89.43	23	2002.5	87.06	37	3476	98.94	48	4923	102.56
Upper Manalaar.	9	706	78.4	8	613	76.62	12	980	81.66	11	883	80.27	13	1135	87.30	23	2017	87.69	15	1400	93.33	13	1213	93.30
Veniar I (a)	1	80	80.0	4	301	75.3	2	169	84.5	1	77	77.0	9	792	88.0	6	520	86.66	4	378	94.5	3	289	96.33
Veniar I(b)	1	83	83.0	1	74	74.0	1	90	90.0	2	171	85.5	8	684	85.5	1	92	92.0	3	272	90.66	5	473	94.6
Veniar II	9	701	77.89	3	230	76.67	4	318	79.5	3	241	80.33	17	1497	88.06	9	780	86.67	13	1233	94.85	12	2046	93.0
Veniar III.	6	463	77.17	10	756	75.6	10	830	83	5	400	80	15	1306	87.07	11	972	88.36	8	728	91	16	1493	93.3
Group Total:-	47	3704	78.8	52	4041	77.7	48	3971	82.73	49	3988	81.39	135	11,927	88.35	105	9156.5	87.2	109	10,223	93.79	140	13,551	96.79
Delhi Study.	-	-	78.2	-	-	77.9	-	-	81.8	-	-	85.8	-	-	-	-	-	-	-	-	-	-	-	-
All-India.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	86.2	-	-	84.9	-	-	93.9	-	-	92.6

WEIGHT FOR AGE - HIGHWAVYS GROUP - 1979.

Name of Estate/Div.	0 - 3 months.			3 - 6 months.			6 - 9 months.			9 - 12 months.			1 Year to 1½ years.						1½ years to 2 years.					
													Male			Female			Male			Female		
	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean
Cloud Land	4	17.5	4.38	9	51.7	5.74	5	32.5	6.54	5	37.0	7.4	7	55.7	7.96	9	69.2	7.7	9	84.6	9.4	8	74.7	9.33
High Wavys	5	18.8	3.76	9	48.3	5.37	12	80.1	6.68	13	89.3	6.87	9	76.0	8.44	13	102.5	7.88	4	34.3	8.57	10	84.5	8.45
Manalaar	8	33.4	4.18	14	79.9	5.71	12	78.1	5.58	24	185.9	7.75	12	97.9	8.16	17	131.5	7.74	15	138.4	9.23	14	114.2	8.16
Upper Manalaar	3	8.83	2.94	7	33.9	4.84	7	43.5	6.21	6	42.3	7.05	13	103.6	7.96	9	66.6	7.4	8	72.8	9.06	6	50.1	8.35
Veniar I (a)	3	11.1	3.7	5	26.8	5.36	3	19.4	6.46	3	19.4	6.46	2	14.6	7.3	5	35.5	7.5	4	33.2	8.3	8	66.2	8.27
Veniar I (b)	5	17.5	3.5	4	19.6	4.9	-	-	-	2	13.4	6.7	1	7.3	7.3	2	15.0	7.5	7	62.8	8.97	5	39.2	7.84
Veniar II	1	4.3	4.3	4	17.6	4.4	7	46.9	6.7	8	54.3	6.79	13	100.0	7.69	6	45.4	7.57	12	97.7	8.14	11	88.8	8.1
Veniar III	7	28.0	4.0	5	25.2	5.04	10	62.1	6.21	8	59.6	7.45	10	78.7	7.87	6	42.1	7.02	4	32.1	8.03	10	78.6	7.86
Group Total:-	36	139.43	3.87	57	311.0	5.46	56	362.6	6.48	69	501.2	7.26	67	533.9	7.97	67	507.8	7.58	63	555.9	8.82	72	596.3	8.28
Delhi Study	-	-	4.8	-	-	6.2	-	-	6.9	-	-	7.6	-	-	-	-	-	-	-	-	-	-	-	-
All-India	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.8	-	-	7.3	-	-	8.5	-	-	8.0

Name of Estate/Div.	2 Years to 2½ Years.						2½ years to 3 Years.						3 Years to 4 years.						4 years to 5 years.					
	Male			Female			Male			Female			Male			Female			Male			Female		
	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean	N	Total	Mean.	N	Total	Mean
Cloud Land	3	27.7	9.2	6	53.3	8.9	2	18.8	9.4	5	50.5	10.1	15	167.3	11.2	16	177.7	11.1	6	76.1	12.68	13	198.8	12.2
High Wavys	12	121.1	10.09	13	121.1	9.31	9	88.8	9.86	10	97.6	9.76	21	255.7	12.17	16	178.6	11.16	23	304.0	13.21	20	257.6	12.88
Manalaar	6	54.9	9.15	7	67.2	9.6	8	88.6	11.07	12	124.2	10.35	37	443.3	11.98	23	272.8	11.86	37	505.7	13.66	48	638.71	13.30
Upper Manalaar	9	88.3	9.8	8	72.0	9.0	12	124.9	10.40	11	111.4	10.12	13	155.1	11.93	23	269.9	11.73	15	195.0	13.0	13	171.0	13.15
Veniar I (a)	1	10.4	10.4	4	36.6	9.15	2	20.7	10.5	1	10.0	10.0	9	105.5	11.72	6	68.6	11.43	4	53.0	13.25	3	45.1	15.0
Veniar I (b)	1	10.7	10.7	1	8.1	8.1	1	12.1	12.1	2	22.4	11.2	8	84.6	10.57	1	12.5	12.5	3	36.3	12.1	5	65.9	13.8
Veniar II	9	85.2	9.47	3	28.4	9.47	4	38.0	9.5	3	30.1	10.03	17	200.0	11.76	9	100.1	11.12	13	106.8	12.98	22	282.8	12.85
Veniar III	6	58.8	9.8	10	89.3	8.93	10	106.15	10.62	5	47.7	9.54	15	167.4	11.16	11	127.1	11.55	8	97.5	12.19	16	209.6	13.1
Group Total:-	47	457.11	9.73	52	476.9	9.15	48	498.1	10.38	49	493.9	10.08	135	1578.9	11.7	105	1207.3	11.5	109	1436.4	13.18	140	1839.5	13.07
Delhi Stury.		-	78.2	-	-	77.9	-	-	81.8	-	-	85.8	-	-	-	-	-	-	-	-	-	-	-	-
All-India.		-	-	-	-	-	-	-	-	-	-	-	-	-	86.2	-	-	84.9	-	-	93.9	-	-	92.6

CHEST CIRCUMFERENCE FOR AGE - HIGH WAVYS GROUP - 1979.

Name of Estate/ Division.	0 - 3 months.			3 - 6 months.			6 - 9 months.			9 - 12 months.			1 year to 1½ years. Male			1 year to 1½ years. Female			1½ years to 2 years. Male			1½ years to 2 years. Female		
	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.
Cloud Land.	4	143.5	35.88	9	352	39.1	5	203	40.6	5	217	43.4	7	309.5	44.2	9	387.5	43.1	9	426	47.3	8	372	46.2
High Wavys.	5	180.5	36.1	9	349	38.78	12	505.5	42.13	13	558.5	42.96	9	397.25	44.13	13	574	44.15	4	191.5	47.87	10	454	45.4
Manalaar.	8	282	35.25	14	545	38.93	12	488.5	40.7	24	1049.5	43.73	12	519.5	43.29	17	732.5	43.08	15	663.5	44.25	14	574	44.15
Upper Manalaar.	3	110.5	36.83	7	272	38.85	7	287	41	6	249	41.5	13	569.5	43.8	9	382	42.4	8	365.5	45.68	6	260.5	43.41
Veniar (I) (a).	3	101.5	33.83	5	195	39	3	122	40.66	3	125	41.66	2	84.5	42.25	5	211	42.2	4	176.5	44.12	8	349	43.63
Veniar (I) (b).	5	171	34.2	4	155	38.75	-	-	-	2	83.5	41.75	1	44	44	2	87.5	43.75	7	328	46.85	5	221	44.2
Veniar II.	1	35	35	4	152.5	38.13	7	301.5	43.1	8	339	42.4	13	575.	44.2	6	267.5	44.58	12	549.5	45.79	11	493	44.82
Veniar III.	7	247	35.29	5	199	39.8	10	413	41.3	8	346	43.25	10	449.5	44.95	6	262	43.67	4	182.5	45.63	10	443.5	44.35
Group Total:-	36	1271	35.30	57	2219.5	38.93	56	2320.5	41.43	69	2937.5	42.57	67	2948.75	44.01	67	2904	43.34	63	2883	45.76	72	3167	43.98
All-India.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43.1	-	-	42.1	-	-	44.5	-	-	43.4

Name of Estate/ Division.	2 years to 2½ years. Male			2 years to 2½ years. Female			2½ years to 3 years. Male			2½ years to 3 years. Female			3 years to 4 years. Male			3 years to 4 years. Female			4 years to 5 years. Male			4 years to 5 years. Female		
	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.
Cloud Land.	3	140	46.70	6	270.50	45.10	2	95	47.50	5	239	47.80	15	731	48.70	16	760.50	47.50	6	301.50	50.25	13	626.75	48.20
High Wavys.	12	575	47.91	13	594.50	45.73	9	446.50	49.61	10	453	45.30	21	1045.5	49.69	16	769.5	48.09	23	1165.5	50.67	20	973.5	48.67
Manalaar.	6	284	47.33	7	319.5	45.64	8	389	48.63	12	561.5	46.79	36	1758.5	48.84	23	1117.5	48.58	36	1824.4	50.67	47	2310	49.14
Upper Manalaar.	9	415	46.11	8	358.75	44.84	12	557	46.41	11	500.5	45.5	13	622.5	47.88	23	1098	47.73	15	738	49.2	13	635.5	48.88
Veniar I (a).	1	45	45	4	175.5	43.87	2	93.5	46.75	1	46	46	9	425	47.22	6	281.1	46.91	4	196	49	3	151.5	50.5
Veniar I (b).	1	50	50	1	46	46	1	50.5	50.5	2	97.5	48.75	8	390	48.75	1	50	50	3	146.5	48.83	5	257.5	51.5
Veniar II.	9	430	47.78	3	143	47.67	4	192	48	3	142.5	47.5	17	834.5	49.9	9	439.5	48.83	13	657.5	50.58	22	1032.55	46.93
Veniar III.	6	283	47.17	10	462	46.2	10	485	48.5	5	239	47.8	15	727.25	48.48	11	542.15	49.34	8	410.5	51.31	16	798.5	49.9
Group Total:-	47	2222	47.27	52	2369.75	45.57	48	2308.5	48.09	49	2279	46.51	134	6532.25	48.74	105	5058.65	48.18	108	5439.9	50.36	139	6685.8	48.82
All-India.	-	-	45.4	-	-	44.4	-	-	46.6	-	-	45.5	-	-	48.1	-	-	46.9	-	-	49.6	-	-	48.6

N = No. of children.

sspd.
19-2-1980.

MID-ARM CIRCUMFERENCE FOR AGE - HIGHWAVYS GROUP - 1979.

Name of Estate/ Division.	0 - 3 Months.			3 - 6 months.			6 - 9 months.			9 - 12 months.			1 Year to 1½ Years.						1½ years to 2 years.					
													Male.			Female.			Male.			Female.		
	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.
Cloud Land.	4	42.25	10.56	9	109.5	12.17	5	61.5	12.3	5	60.5	12.1	7	89	12.7	9	111.5	12.4	9	115.5	12.8	8	104	13
High Wavys.	5	50	10	9	102	11.3	12	145.5	12.13	13	156.25	12	9	114.25	12.69	13	164.75	12.67	4	51.25	12.81	10	127	12.7
Manalaar.	8	83.5	10.44	14	161.5	11.54	12	145.5	12.12	24	300.25	12.51	12	149.5	12.46	17	212.5	12.5	15	194	12.93	14	165.5	12.73
Upper Manalaaar.	3	34	11.33	7	76.5	10.92	7	82	11.71	6	72.5	12.08	13	162.5	12.5	9	111	12.33	8	103	12.87	6	74	12.33
Veniar I (a).	3	28	9.33	5	57	11.4	3	36	12	3	34.5	11.5	2	25.5	12.75	5	61	12.2	4	50.5	12.62	8	100.5	12.56
Veniar I (b).	5	48.7	9.74	4	47.5	11.87	-	-	-	2	24	12	1	12	12	2	23	11.5	7	87	12.42	5	60.5	12.1
Veniar II.	1	10.5	10.5	4	42.5	10.63	7	88.25	12.61	8	95	11.88	13	159	12.24	6	72.25	12.04	12	145.5	12.13	11	133	12.09
Veniar III.	7	72.5	10.36	5	56.5	11.3	10	118	11.8	8	100.9	12.61	10	128.5	12.85	6	72	12	4	48	12	10	122.9	12.29
Group Total:-	36	369.45	10.26	57	653	11.45	56	676.5	12.08	69	843.9	12.23	67	840.25	12.54	67	828	12.35	63	794.75	12.61	72	837.4	12.32
All-India.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.5	-	-	12.1	-	-	12.7	-	-	12.5

Name of Estate/ Division.	2 years to 2½ years.						2½ years to 3 years.						3 years to 4 years.						4 years to 5 years.					
	Male.			Female.			Male.			Female.			Male.			Female.			Male.			Female.		
	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.
Cloud Land.	3	35.5	11.8	6	76	12.7	2	25	12.5	5	65.25	13.05	15	196.25	13.1	16	214.95	13.4	6	81	13.5	13	177	13.6
High Wavys.	12	152	12.66	13	164	12.61	9	124	13.77	10	127	12.7	21	282.5	13.45	16	216.75	13.54	23	323.75	14.07	20	277.5	13.87
Manalaar.	6	77.5	12.92	7	92	13.14	8	106	13.25	12	157.75	13.15	36	482.75	13.4	23	315.7	13.72	36	502.3	13.95	47	652	13.87
Upper Manalaar.	9	118	13.11	8	105	13.12	12	155	12.91	11	144	13.09	13	180.5	13.88	23	302.5	13.15	15	207.5	13.83	13	187	14.38
Veniar I (a).	1	13.5	13.5	4	50.5	12.62	2	25	12.5	1	13	13	9	119	13.22	6	78	12	4	56	14	3	46	15.33
Veniar I (b).	1	13.5	13.5	1	12	12	1	13	13	2	26.25	13.12	8	103	12.88	1	13	13	3	40.5	13.5	5	71	14.2
Veniar II.	9	115.5	12.83	3	38.5	12.83	4	53.5	13.38	3	39.5	13.17	17	230.75	13.57	9	120	13.33	13	178.25	13.33	22	307	13.95
Veniar III.	6	78.5	13.08	10	124.25	12.43	10	135.5	13.6	5	67	13.4	15	201	13.4	11	148.25	13.48	8	107.25	13.41	16	225	14.06
Group Total:-	47	604	12.85	52	662.75	12.74	48	637	13.27	49	639.75	13.05	134	1795.75	13.40	105	1409.15	13.42	108	1491.55	13.81	130	1942.5	13.97
All-India.	-	-	13	-	-	12.8	-	-	13	-	-	13	-	-	13.4	-	-	13.4	-	-	14	-	-	13.9

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MID-ARM CIRCUMFERENCE FOR AGE - HIGHWAVYS GROUP - 1979.

Name of Estate/ Division.	0 - 3 Months.			3 - 6 months.			6 - 9 months.			9 - 12 months.			1 Year to 1½ Years.						1½ years to 2 years.					
													Male.			Female.			Male.			Female.		
	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.
Cloud Land.	4	42.25	10.56	9	109.5	12.17	5	61.5	12.3	5	60.5	12.1	7	89	12.7	9	111.5	12.4	9	115.5	12.8	8	104	13
High Wavys.	5	50	10	9	102	11.3	12	145.5	12.13	13	156.25	12	9	114.25	12.69	13	164.75	12.67	4	51.25	12.81	10	127	12.7
Manalaar.	8	83.5	10.44	14	161.5	11.54	12	145.5	12.12	24	300.25	12.51	12	149.5	12.46	17	212.5	12.5	15	194	12.93	14	165.5	12.73
Upper Manalaaar.	3	34	11.33	7	76.5	10.92	7	82	11.71	6	72.5	12.08	13	162.5	12.5	9	111	12.33	8	103	12.87	6	74	12.33
Veniar I (a).	3	28	9.33	5	57	11.4	3	36	12	3	34.5	11.5	2	25.5	12.75	5	61	12.2	4	30.5	12.62	8	100.5	12.56
Veniar I (b).	5	48.7	9.74	4	47.5	11.87	-	-	-	2	24	12	1	12	12	2	23	11.5	7	87	12.42	5	60.5	12.1
Veniar II.	1	10.5	10.5	4	42.5	10.63	7	88.25	12.61	8	95	11.88	13	159	12.24	6	72.25	12.04	12	145.5	12.13	11	133	12.09
Veniar III.	7	72.5	10.36	5	56.5	11.3	10	118	11.8	8	100.9	12.61	10	128.5	12.85	6	72	12	4	48	12	10	122.9	12.29
Group Total:-	36	369.45	10.26	57	653	11.45	56	676.5	12.08	69	843.9	12.23	67	840.25	12.54	67	828	12.35	63	794.75	12.61	72	837.4	12.32
All-India.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.5	-	-	12.1	-	-	12.7	-	-	12.5

Name of Estate/ Division.	2 years to 2½ years.						2½ years to 3 years.						3 years to 4 years.						4 years to 5 years.					
	Male.			Female.			Male.			Female.			Male.			Female.			Male.			Female.		
	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.
Cloud Land.	3	35.5	11.8	6	76	12.7	2	25	12.5	5	65.25	13.05	15	196.25	13.1	16	214.95	13.4	6	31	13.5	13	177	13.6
High Wavys.	12	152	12.66	13	164	12.61	9	124	13.77	10	127	12.7	21	282.5	13.45	16	216.75	13.54	23	323.75	14.07	20	277.5	13.87
Manalaar.	6	77.5	12.92	7	92	13.14	8	106	13.25	12	157.75	13.15	36	482.75	13.4	23	315.7	13.72	36	502.3	13.95	47	652	13.87
Upper Manalaar.	9	118	13.11	8	105	13.12	12	155	12.91	11	144	13.09	13	180.5	13.88	23	302.5	13.15	15	207.5	13.83	13	187	14.38
Veniar I (a).	1	13.5	13.5	4	50.5	12.62	2	25	12.5	1	13	13	9	119	13.22	6	78	12	4	56	14	3	46	15.33
Veniar I (b).	1	13.5	13.5	1	12	12	1	13	13	2	26.25	13.12	8	103	12.88	1	13	13	3	40.5	13.5	5	71	14.2
Veniar II.	9	115.5	12.83	3	38.5	12.83	4	53.5	13.38	3	39.5	13.17	17	230.75	13.57	9	120	13.33	13	0 13.25	13.33	22	307	13.95
Veniar III.	6	78.5	13.08	10	124.25	12.43	10	135.5	13.6	5	67	13.4	15	201	13.4	11	148.25	13.48	8	107.25	13.41	16	225	14.06
Group Total:-	47	604	12.85	52	662.75	12.74	48	637	13.27	49	639.75	13.05	134	1795. 75	13.40	105	1409.15	13.42	108	1491. 55	13.81	130	1942.5	13.97
All-India.	-	-	13	-	-	12.8	-	-	13	-	-	13	-		13.4	-	-	13.4	-		14	-	-	13.9

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HEAD CIRCUMFERENCE FOR AGE - HIGHWAVYS GROUP - 1979.

Name of Estate/ Division.	0 - 3 months.			3 - 6 months.			6 - 9 months.			9 - 12 months.			1 year to 1½ years.						1½ years to 2 years.					
													Male.			Female.			Male.			Female.		
	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.
Cloud Land	4	148.5	37.13	9	362	40.2	5	208	41.6	5	216	43.2	7	312.5	44.64	9	389.5	43.28	9	415.5	46.2	8	367	45.88
High Wavys	5	183.5	36.7	9	353.5	39.28	12	508	42.3	13	561.25	43.17	9	403.5	44.83	13	573	44.07	4	182	45.5	10	441	44.1
Manalaar	8	295	36.88	14	556.5	39.75	12	501.3	41.78	24	1051.8	43.82	12	536	44.67	17	754	44.35	15	682.5	45.5	14	578	44.46
Upper Manalaar	3	114.5	38,16	7	276	39.42	7	291.5	41.64	6	253.5	42.25	13	577	44.38	9	386	42.88	8	362.5	45.31	6	262	43.66
Veniar I (a)	3	104	34.66	5	200	40	3	123.5	41.16	3	128	42.66	2	86.5	43.25	5	215	43	4	175.5	43.62	8	355	44.37
Veniar I (b)	5	175	35	4	157	39.25	-	-	-	2	84.5	42.25	1	44	44	2	87.5	43.75	7	321	45.85	5	215.5	43.1
Veniar II	1	37	37	4	152	38	7	292	42.71	8	343.5	42.9	13	569.5	43.81	6	262	43.67	12	531	44.25	11	485.5	44.14
Veniar III	7	257.5	36.79	5	200.5	40.1	10	414.5	41.45	8	345.5	43.19	10	442.5	44.25	6	269.5	43.25	4	180.5	45.13	10	441	44.1
Group Total:-	36	1315	36.53	57	2257.5	39.61	56	2338.8	41.76	69	2984.1	43.25	67	2971.5	44.35	69	2936.4	43.83	63	2850.5	45.25	72	3145	43.68
Delhi Study.	-	-	38.2	-	-	40.7	-	-	42.2	-	-	43.2	-	-	-	-	-	-	-	-	-	-	-	-
All-India.	-	--	-	-	-	-	-	-	-	-	-	-	-	-	43.9	-	-	43	-	-	45.1	-	-	44

	2 years to 2½ years.						2½ years to 3 years.						3 years to 4 years.						4 years to 5 years.					
	Male			Female.			Male			Female			Male			Female			Male			Female.		
	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.
Cloud land.	3	139.25	46.42	6	266.5	44.4	2	94.5	47.25	5	229.5	45.9	15	715.5	47.2	16	744.25	46.3	6	289.5	48.25	13	610.5	47
High Wavys.	12	558	46.54	13	594	45.69	9	422	46.88	10	446	44.6	21	1022.75	48.70	16	745	46.56	23	1112	48.34	20	949.5	47.47
Manalaar.	6	276	46	7	370	45.28	8	334.5	41.81	12	553.5	46.13	36	1697.5	47.15	23	1102	47.91	36	1745.5	48.48	47	2219.7	47.22
Upper Manallar.	9	414.5	46.05	8	357.5	44.68	12	550.5	45.87	11	504.5	45.86	13	611.5	47.03	23	1071.5	46.58	15	706.25	47.08	13	613.5	47.19
Veniar I (a).	1	46	46	4	177	44.3	2	90.5	45.25	1	47	47	9	419.5	46.61	6	277.5	46.25	4	191.13	47.87	3	143	47.66
Veniar I (b).	1	46	46	1	46	46	1	47	47	2	93	46.5	8	377.5	47.18	1	48.5	48.5	3	140	46.66	5	136.5	47.3
Veniar II.	9	414.25	46.03	3	139	46.33	4	185.5	46.38	3	134.5	44.83	17	797	46.88	9	412	45.78	13	623.25	46.94	22	1039.5	47.25
Veniar III.	6	274	45.67	10	450.5	45.05	10	468	46.8	5	230	46	15	702.5	46.8	11	514.5	46.77	8	385	48.13	16	757.5	47.47
Group Total:-	47	2168	46.12	52	2347.5	45.14	48	2192.5	45.67	49	2238	45.67	134	6343.75	47.34	105	4915.25	46.81	108	5293	49	139	6571.7	47.27
~~Delhi Study~~ All-India.	-	-	45.5	-	-	44.6	-	-	46.3	-	-	45.4	-	-	47.2	-	-	46.1	-	-	47.9	-	-	47.1

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NUTRITIONAL ASSESSMENT.

Clinical Analysis of Highwavys Group of Estates.

Age group. 0-3 months.	Name of the estates.						
	Cloudland.	Highwavys.	Upper Manalaar.	Manalaar.	Venniar I.	Venniar II.	Venniar III.
Total number of children.	4	5	3	8	8	1	7
Hair.							
1 a	1	1	..	..	..	..	..
1 b	1	..	..	..	..	..	..
1 c	..	..	..	..	..	..	..
1 d	..	..	..	..	..	..	..
Face.							
2 a	..	..	..	..	..	..	..
2 b	..	..	..	..	..	..	..
Eyes.							
3 a	..	..	..	..	..	..	..
3 d	..	..	..	..	..	..	..
Lips.							
4 a	..	..	..	..	..	..	..
4 b	..	..	..	..	..	..	..
Teeth.							
6 a	..	..	..	..	..	..	..
6 b	..	..	..	..	..	..	..
Skin.							
8 a	..	..	..	..	..	..	..
8 b	..	..	..	..	..	..	..
Nail.							
9 a	..	..	..	..	..	..	..
Muscular & skeletal systems.							
11 a	..	..	..	..	..	..	..
11 d	..	..	..	..	..	..	..
11 g	..	..	..	..	..	..	..
11 h	..	..	..	..	..	..	..
11 f	..	..	..	..	..	..	..
Otitis.							
O	..	..	..	..	..	..	1
Pyoderma.							
P	..	..	..	..	..	..	..
LRTI	..	..	..	..	1	..	..
Scabies.	..	..	..	..	..	..	..
Pb	..	..	..	..	..	..	..
Mc	..	..	..	..	..	..	..

NUTRITIONAL ASSESSMENT.

Clinical Analysis of Highwavys Group of Estates.

Age group. 3-6 months.	Name of the estates.						
	Cloudland.	Highwavys.	Upper Manalaar.	Manalaar.	Vennier I.	Vennier II.	VennierIII
Total number of children.	9	9	7	14	9	4	5
Hair.							
1 a	3	4	2	6	2	2	1
1 b	..	..	..	..	..	..	..
1 c	..	..	..	..	..	..	..
1 d	..	..	..	..	..	..	..
Face.							
2 a	..	..	..	..	..	..	..
2 b	..	..	..	..	..	..	..
Eyes.							
3 a	..	..	..	..	..	..	..
3 d	..	..	..	..	..	..	..
Lips.							
4 a	..	..	..	..	..	..	..
4 b	..	..	..	..	..	..	..
Teeth.							
6 a	..	..	..	..	..	..	..
6 b	..	..	..	..	..	..	..
Skin.							
8 a	..	..	..	..	..	..	..
8 b	..	..	..	..	..	..	..
Nail.							
9 a	..	..	..	..	..	..	..
Muscular & skeletal systeme.							
11 a	..	..	..	1	..	..	..
11 d	1	..	..	..	..	..	..
11 g	..	..	..	..	..	..	..
11 h	..	..	..	..	..	..	..
11 f	..	..	..	..	..	..	..
Otitis.							
O	..	..	..	..	..	..	..
Pyoderma.							
P	..	..	1	..	..	..	..
LRTI	..	..	..	..	..	..	..
Scabies.							
S	..	..	..	..	..	..	..
Pb	..	..	..	..	..	..	..
Mc	..	..	..	..	..	..	..

NUTRITIONAL ASSESSMENT.

Clinical Analysis of Highwavys Group of Estates.

Age group. 6-9 months.	Name of the estates.						
	Cloudland.	Highwavys.	Upper Manalaar.	Manalaar.	Venniar I.	Venniar II.	Venniar III
Total number of children.	5	12	7	12	3	7	10
Hair.							
1 a	3	6	1	8	2	3	4
1 b	..	..	..	1	..	..	..
1 c	..	..	..	..	..	..	..
1 d	..	..	..	..	..	1	..
Face.							
2 a	..	..	..	..	..	..	..
2 b	..	..	..	..	..	..	..
Eyes.							
3 a	..	..	..	..	..	..	..
3 d	..	..	..	..	..	..	..
Lips.							
4 a	..	..	..	..	..	..	..
4 b	..	..	..	..	..	..	..
Teeth.							
6 a	..	..	..	..	..	..	..
6 b	..	..	..	..	..	..	...
Skin.							
8 a	..	..	..	1	..	..	..
8 b	..	..	..	..	..	..	..
Nail.							
9 a	..	..	..	..	..	..	..
Muscular & skeletal systeme.							
11 a	..	..	..	..	..	..	..
11 d	..	..	..	1	..	..	..
11 g	..	..	..	..	..	..	..
11 h	..	..	..	..	..	..	..
11 f	..	..	..	..	..	..	..
Otitis.							
O	..	..	1	..	..	..	..
Pyoderma.							
P	..	..	..	1	..	..	..
LRTI.	1	1	1	..	..	..	..
Scabies.							
S	..	..	...	..	..	..	..
Pb	..	..	...	..	..	..	..
Mc	..	..	...	..	..	..	..

NUTRITIONAL ASSESSMENT.

Clinical Analysis of Highwavys Group of Estates.

Age group. 9-12 months.	Name of the estates.						
	Cloudland.	Highwavys.	Upper Manalaar.	Manalaar.	Venniar I.	Venniar II.	Venniar III.
Total number of children.	5	13	6	24	5	8	8
Hair.							
1 a	3	6	3	15	3	6	1
1 b	..	..	..	..	..	..	..
1 c	..	..	..	..	..	..	..
1 d	..	..	..	2	..	..	..
Face.							
2 a	..	..	..	..	..	..	..
2 b	..	-.	..	..	..	..	..
Eyes.							
3 a	..	..	..	..	..	..	..
3 d	...	..	..	..	..	..	..
Lips.							
4 a	..	..	..	..	..	..	..
4 b	..	..	..	...	..	..	..
Teeth.							
6 a	..	..	..	..	..	..	..
6 b	..	..	..	..	..	..	..
Skin.							
8 a	..	..	..	..	..	..	..
8 b	..	...	..	...	..	..	..
Nail.							
9 a	..	..	..	..	..	..	..
Muscular & skeletal systeme.							
11 a	..	1	..	1	..	1	..
11 d	..	..	..	..	..	..	..
11 g	..	..	..	..	..	..	..
11 h	..	..	..	..	..	..	..
11 f	..	..	..	..	..	..	..
Otitis.							
O	..	..	2	..	..	..	..
Pyoderma.							
P	..	1	..	..	..	1	..
LRTI.	..	..	..	..	..	1	..
Scabies.							
S	..	..	..	..	..	..	..
Pb	1	..	..	..	..	..	..
Mc	1	..	..	..	..	..	..

NUTRITIONAL ASSESSMENT.

Clinical Analysis of Highwavys Group of Estates.

Age group. 1-1½ years.	Name of the estates.													
	Cloudland.		Highwavys.		Upper Manalaar.		Manalaar.		Vennier I.		Vennier II.		Vennier III.	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Total number of children.	7	9	9	13	13	9	12	17	3	7	13	6	10	6
Hair.														
1 a	4	8	6	5	9	6	2	7	2	6	8	3	6	6
1 b	-	1	-	-	-	-	-	-	-	-	-	-	-	-
1 c	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1 d	-	-	-	-	1	-	-	-	-	-	1	-	-	1
Face.														
2 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 b	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eyes.														
3 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3 d	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lips.														
4 a	-	-	-	-	-	-	-	-	--	-	-	-	-	-
4 b	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Teeth.														
6 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6 b	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Skin.														
8 a	-	-	-	-	-	-	1	-	-	-	-	-	-	-
8 b	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Nail.														
9 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Muscular & skeletal systems.														
11 a	-	-	-	-	-	-	-	1	-	-	-	-	-	-
11 d	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11 g	-	-	1	-	-	-	-	-	-	-	-	-	-	-
11 h	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11 f	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Otitis.														
O	-	-	-	-	-	1	-	-	-	1	-	-	-	-
Pyoderma.														
P	1	-	-	1	-	-	-	-	-	-	-	-	-	-
LRTI.	-	-	-	1	1	-	-	-	-	-	-	-	1	1
Scabies.														
S	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Pb	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mc	-	-	-	-	-	-	-	-	-	-	-	-	-	-

NUTRITIONAL ASSESSMENT.

Clinical Analysis of Highwavys Group of Estates.

Age group. 1½-2 years.	Name of the estates.															
	Cloudland.		Highwavys.		Upper Manalaar.		Manalaar.		Vennier I.		Vennier II.		Vennier III.			
	M	F	M	F	M	F	M	F	M	F	M	F	M	F		
Total number of children.	9	8	4	10	8	6	15	14	11	13	12	11	4	10		
Hair.																
1 a	5	3	3	8	3	3	6	12	6	5	8	7	3	7		
1 b	1	-	-	-	-	-	-	1	-	-	-	-	-	-		
1 c	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
1 d	1	-	-	1	-	-	-	-	1	-	-	-	-	3		
Face.																
2 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
2 b	-	-	-	1	-	-	-	-	-	-	-	-	-	-		
Eyes.																
3 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
3 d	-	-	-	-	-	-	-	-	-	1	-	-	-	-		
Lips.																
4 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
4 b	-	-	-	-	-	-	-	-	1	-	1	-	-	-		
Teeth.																
6 a	-	-	-	1	-	-	-	-	-	-	-	1	-	-		
6 b	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Skin.																
8 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8 b	-	-	-	1	-	-	-	-	-	-	1	1	-	-		
Neil.																
9 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Muscular & skeletal systems.																
11 a	-	-	-	-	-	-	-	1	-	-	3	2	1	-		
11 d	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
11 g	-	-	-	-	1	-	-	-	-	-	-	-	1	-		
11 h	-	-	-	-	-	-	-	-	-	-	-	-	1	-		
11 f	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Otitis.																
O	1	-	-	1	1	-	1	1	2	1	-	-	-	-		
Pyoderma.																
P	2	1	-	-	-	-	-	-	-	-	-	-	-	-		
LRTI.	1	-	-	1f	-	-	-	-	-	-	-	1	-	-		
Scabies.																
S	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Pb	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Mc	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

NUTRITIONAL ASSESSMENT.

Clinical Analysis of Highwavys Group of Estates.

Age group. 2 - 2½ years.	Name of the estates.													
	Cloudland.		Highwavys.		Upper Manalaar.		Manalaar.		Venniar I.		Venniar II.		Venniar III.	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Total number of children.	3	6	12	13	9	8	6	7	2	5	9	3	6	10
Hair.														
1 a	1	3	6	10	2	4	3	3	-	1	5	2	2	7
1 b	-	1	-	-	-	1	-	-	-	-	-	-	-	-
1 c	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1 d	-	-	-	-	-	1	1	-	-	-	-	-	-	1
Face.														
2 a	1	-	-	1	-	-	-	-	-	-	-	-	-	-
2 b	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eyes.														
3 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3 d	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lips.														
4 a	-	-	-	-	-	-	-	-	-	-	-	-	-	1
4 b	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Teeth.														
6 a	-	-	-	-	1	-	-	-	-	-	2	-	-	-
6 b	-	1	-	-	-	-	-	-	1	-	-	-	-	-
Skin.														
8 a	-	-	1	-	-	-	-	-	-	-	-	-	-	-
8 b	-	-	2	-	-	-	1	1	-	-	-	-	-	-
Nail.														
9 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Muscular & skeletal systems.														
11 a	-	1	1	-	-	-	-	-	-	-	-	1	-	1
11 d	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11 g	-	-	2	-	-	-	-	-	-	-	-	-	-	-
11 h	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11 f	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Otitis.														
O	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Pyoderma.														
P	-	-	-	2	1	-	-	-	-	-	1	-	-	-
LRTI.	-	-	-	-	-	-	-	-	-	-	-	1	-	1
Scabies.														
S	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Pb	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mc	-	-	-	-	-	-	-	-	-	-	-	-	-	-

NUTRITIONAL ASSESSMENT.

Clinical Analysis of Highwayys Group of Estates.

Age group. 2½ - 3 years.	Name of the estates.													
	Cloudland.		Highwayys.		Upper Manalaar.		Manalaar.		Vennier I.		Vennier II.		Vennier III.	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Total number of children.	2	5	9	10	12	11	8	12	3	3	4	3	10	5
Hair.														
1 a	1	2	2	7	2	3	3	4	1	2	1	1	3	-
1 b	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1 c	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1 d	-	1	-	1	-	-	-	-	-	-	-	-	-	-
Face.														
2 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2 b	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eyes.														
3 a	-	-	-	-	-	-	-	-	-	-	-	-	1	-
3 d	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lips.														
4 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4 b	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Teeth.														
6 a	-	1	-	1	-	-	1	-	1	-	-	-	1	-
6 b	-	-	-	-	-	-	-	1	-	1	-	-	-	-
Skin.														
8 a	-	-	-	-	-	-	-	1	-	-	-	-	-	-
8 b	-	-	1	1	1	-	1	1	-	1	-	1	-	-
Nail.														
9 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Muscular & skeletal systems.														
11 a	-	-	-	-	-	-	-	1	-	-	-	-	-	-
11 d	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11 g	-	-	-	-	-	-	-	-	-	-	1	-	-	-
11 h	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11 f	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Otitis.														
O	-	-	1	-	1	1	-	-	-	-	-	-	1	-
Pyoderma.														
P	-	-	-	1	-	-	-	-	-	-	-	-	-	-
LRTI.	-	-	-	-	-	-	1	-	-	-	-	-	-	1
Scabies.														
S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pb	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mc	-	-	-	-	-	-	-	-	-	-	-	-	-	-

NUTRITIONAL ASSESSMENT.

Clinical Analysis of Highwavys Group of Estates.

Age group. 3 - 4 years.	Name of the estates.													
	Cloudland.		Highwavys.		Upper Manalaar.		Manalaar.		Venniar I.		Venniar II.		Venniar III.	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Total number of children.	15	16	21	16	13	23	37	23	17	7	17	9	15	11
Hair.														
1 a	2	9	4	5	2	7	7	14	6	2	6	5	2	4
1 b	-	-	1	-	-	-	-	-	-	-	-	-	-	1
1 c	-	-	-	-	-	1	-	-	-	-	-	-	-	-
1 d	1	-	-	-	-	-	-	-	-	-	-	1	-	-
Face.														
2 a	2	-	-	-	-	-	-	-	-	-	-	-	-	-
2 b	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eyes.														
3 a	-	-	1	-	-	-	2	1	-	-	-	-	-	2
3 d	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lips.														
4 a	-	-	-	1	-	-	-	-	-	-	-	-	-	-
4 b	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Teeth.														
6 a	2	3	2	-	1	-	3	-	4	1	2	1	-	-
6 b	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Skin.														
8 a	1	2	1	-	-	1	-	2	-	-	-	-	1	-
8 b	-	-	2	1	-	-	5	1	4	-	3	3	2	2
Nail.														
9 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Muscular & skeletal systems.														
11 a	1	-	-	-	-	-	-	1	-	-	-	-	-	-
11 d	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11 g	2	-	1	-	-	1	-	-	-	-	1	-	1	-
11 h	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Otitis. 11 i	1	-	-	-	-	-	-	-	-	-	-	-	-	-
O	2	1	2	-	1	1	-	-	1	-	1	-	5	1
Pyoderma.														
P	-	-	1	-	-1	1	1	-	2	-	1	-	-	1
LRTI.	-	-	-	-	-	-	3	-	-	-	1	-	-	-
Scabies.														
S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pb	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Mc	-	-	-	-	-	-	-	-	-	-	-	-	-	-

NUTRITIONAL ASSESSMENT.

Clinical Analysis of Highwavys Group of Estates.

Age group. 4 - 5 years.	Name of the estates.													
	Cloudland.		Highwavys.		Upper Manalaar.		Manalaar.		Vennier I.		Vennier II.		Vennier III.	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Total number of children.	6	13	23	20	15	13	37	48	7	8	13	22	8	16
Hair.														
1 a	-	4	-	6	2	2	11	22	-	2	4	11	2	-
1 b	-	1	-	-	-	-	1	2	-	-	-	-	-	-
1 c	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1 d	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Face.														
2 a	-	-	-	-	-	-	-	-	-	-	1	-	-	-
2 b	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eyes.														
3 a	-	-	1	-	-	-	2	2	-	-	-	-	-	1
3 d	-	-	-	-	-	-	-	1	-	-	1	-	-	-
Lips.														
4 a	-	-	-	-	-	-	-	1	-	-	1	-	-	-
4 b	-	-	-	-	-	-	3	2	-	-	-	-	-	-
Teeth.														
6 a	-	2	5	4	1	-	1	5	-	3	1	2	2	2
6 b	-	1	-	-	1	-	-	-	-	1	-	1	-	-
Skin.														
8 a	-	1	-	-	-	-	-	2	-	2	1	-	-	-
8 b	-	-	3	4	-	-	8	4	-	1	2	3	-	3
Nail.														
9 a	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Muscular & skeletal systems.														
11 a	-	-	-	-	-	-	3	1	-	-	-	-	-	-
11 d	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11 g	-	-	2	1	-	-	-	-	-	-	1	-	-	-
11 h	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11 f	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Otitis.														
O	-	1	-	-	-	-	-	-	-	-	-	-	1	1
Pyoderma.														
P	-	-	-	-	1	-	-	-	-	-	-	-	1	-
LRTI.	1	-	-	1	1	2	-	-	-	-	1	-	-	2
Scabies.														
S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pb	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Mc	-	-	-	-	-	-	-	-	-	-	-	-	-	-

HEIGHT FOR AGE - HIGH WAVYS GROUP - 1979.

Name of Estate/ Division.	0 - 3 months.			3 - 6 months.			6 - 9 months.			9 - 12 months.			1 year to 1½ years.						1½ years to 2 years.					
													Male			Female			Male			Female		
	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean	N	Total	Mean.
Cloudland	4	207	51.75	9	525	58.3	5	314	62.8	5	342.5	68.5	7	501.5	71.64	9	638	70.9	9	695	77.2	8	628	78.5
Highwavys	5	272.5	54.5	9	532	59.1	12	786	65.5	13	892.5	68.7	9	639	71	13	921	70.84	4	298	74.5	10	751	75.1
Manalaar	8	423	52.88	14	841	60.07	12	770	65.16	24	1628	68.25	12	864	72	17	1188	69.88	15	1129	75.27	14	1016	72.57
Upper Manalaar	3	158	52.66	7	408	58.3	7	431	62.71	6	403	67.16	13	927	71.3	9	616	68.44	8	615	76.87	6	431	71.83
Venniar I (a)	3	153	51	5	291	58.2	3	187	62.33	3	195	65	2	129	64.5	5	350	70	4	295	73.75	8	580	72.5
Veniar I (b)	5	243	48.6	4	230	57.5	-	-	-	2	129	64.5	1	70	70	2	138	69	7	535	76.42	5	358	71.6
Veniar II	1	53	53	4	222	55.5	7	451	64.43	8	522	65.25	13	875	67.31	6	425	70.83	12	861	71.75	11	805	73.18
Veniar III	7	358	51.14	5	295	59	10	631	63.1	8	532	66.5	10	692	69.2	6	398	66.33	4	292	73	10	714	71.4
Group Total:-	36	1867.5	51.88	57	3344	58.67	56	3570	63.75	69	4654	67.44	67	4697.5	70.1	67	4674	69.76	63	4720	74.9	72	5283	73.38
Deli Study	-	-	57.4	-	-	63.0	-	-	66.5	-	-	69.0	-	-	-	-	-	-	-	-	-	-	-	-
All-India.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	70.8	-	-	69.3	-	-	74.2	-	-	73.3

Name of Estate/ Division.	2 years to 2½ years.						2½ years to 3 years.						3 years to 4 years.						4 years to 5 years.					
	Male			Female			Male			Femal			Male			Female			Male			Female		
	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean	N	Total	Mean.
Cloudland.	3	235	78.3	6	457	76.2	2	162	81	5	406	81.2	15	1325	88.3	16	1403	87.7	6	548	91.3	13	1227	94.4
Highwavys.	12	970	80.83	13	1058	81.38	9	741	82.33	10	828	82.8	21	1879	89.47	16	1370	85.62	23	2188	95.12	20	1887	94.35
Manalaar.	6	466	77.67	7	552	78.86	8	681	85.13	12	982	81.83	36	3309	89.43	23	2002.5	87.06	37	3476	98.94	48	4923	102.56
Upper Manalaar.	9	706	78.4	8	613	76.62	12	980	81.66	11	883	80.27	13	1135	87.30	23	2017	87.69	15	1400	93.33	13	1213	93.30
Veniar I (a)	1	80	80.0	4	301	75.3	2	169	84.5	1	77	77.0	9	792	88.0	6	520	86.66	4	378	94.5	3	289	96.33
Veniar I(b)	1	83	83.0	1	74	74.0	1	90	90.0	2	171	85.5	8	684	85.5	1	92	92.0	3	272	90.66	5	473	94.6
Veniar II	9	701	77.89	3	230	76.67	4	318	79.5	3	241	80.33	17	1497	88.06	9	780	86.67	13	1233	94.85	12	2046	93.0
Veniar III.	6	463	77.17	10	756	75.6	10	830	83	5	400	80	15	1306	87.07	11	972	88.36	8	728	91	16	1493	93.3
Group Total:-	47	3704	78.8	52	4041	77.7	48	3971	82.73	49	3988	81.39	135	11,927	88.35	105	9156.5	87.2	109	10,223	93.79	140	13,551	96.79
Delhi Study.	-	-	78.2	-	-	77.9	-	-	81.8	-	-	85.8	-	-	-	-	-	-	-	-	-	-	-	-
All-India.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	86.2	-	-	84.9	-	-	93.9	-	-	92.6

WEIGHT FOR AGE - HIGHWAYS GROUP - 1979.

Name of Estate/Div.	0 - 3 months.			3 - 6 months.			6 - 9 months.			9 - 12 months.			1 Year to 1½ years.						1½ years to 2 years.					
													Male			Female			Male			Female		
	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean	N	Total	Mean
Cloud Land	4	17.5	4.38	9	51.7	5.74	5	32.5	6.54	5	37.0	7.4	7	55.7	7.96	9	69.2	7.7	9	84.6	9.4	8	74.7	9.33
High Wavys	5	18.8	3.76	9	48.3	5.37	12	80.1	6.68	13	89.3	6.87	9	76.0	8.44	13	102.5	7.88	4	34.3	8.57	10	84.5	8.45
Manalaar	8	33.4	4.18	14	79.9	5.71	12	78.1	5.58	24	185.9	7.75	12	97.9	8.16	17	131.5	7.74	15	138.4	9.23	14	114.2	8.16
Upper Manalaar	3	8.83	2.94	7	33.9	4.84	7	43.5	6.21	6	42.3	7.05	13	103.6	7.96	9	66.6	7.4	8	72.8	9.06	6	50.1	8.35
Veniar I (a)	3	11.1	3.7	5	26.8	5.36	3	19.4	6.46	3	19.4	6.46	2	14.6	7.3	5	35.5	7.5	4	33.2	8.3	8	66.2	8.27
Veniar I (b)	5	17.5	3.5	4	19.6	4.9	-	-	-	2	13.4	6.7	1	7.5	7.5	2	15.0	7.5	7	62.8	8.97	5	39.2	7.84
Veniar II	1	4.3	4.3	4	17.6	4.4	7	46.9	6.7	8	54.3	6.79	13	100.0	7.69	6	45.4	7.57	12	97.7	8.14	11	88.8	8.1
Veniar III	7	28.0	4.0	5	25.2	5.04	10	62.1	6.21	8	59.6	7.45	10	78.7	7.87	6	42.1	7.02	4	32.1	8.03	10	78.6	7.86
Group Total:-	36	139.43	3.87	57	311.0	5.46	56	362.6	6.48	69	501.2	7.26	67	533.9	7.97	67	507.8	7.58	63	555.9	8.82	72	596.3	8.28
Delhi Study	-	-	4.8	-	-	6.2	-	-	6.9	-	-	7.6	-	-	-	-	-	-	-	-	-	-	-	-
All-India	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.8	-	-	7.3	-	-	8.5	-	-	8.0

Name of Estate/Div.	2 Years to 2½ Years.						2½ years to 3 Years.						3 Years to 4 years.						4 years to 5 years.					
	Male			Female			Male			Female			Male			Female			Male			Female		
	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean	N	Total	Mean.	N	Total	Mean
Cloud Land	3	27.7	9.2	6	53.3	8.9	2	18.8	9.4	5	50.5	10.1	15	167.3	11.2	16	177.7	11.1	6	76.1	12.68	13	198.8	12.2
High Wavys	12	121.1	10.09	13	121.1	9.31	9	88.8	9.86	10	97.6	9.76	21	255.7	12.17	16	178.6	11.16	23	304.0	13.21	20	257.6	12.88
Manalaar	6	54.9	9.15	7	67.2	9.6	8	88.6	11.07	12	124.2	10.35	37	443.3	11.98	23	272.8	11.86	37	505.7	13.66	48	638.71	13.30
Upper Manalaar	9	88.3	9.8	8	72.0	9.0	12	124.9	10.40	11	111.4	10.12	13	155.1	11.93	23	269.9	11.73	15	195.0	13.0	13	171.0	13.15
Veniar I (a)	1	10.4	10.4	4	36.6	9.15	2	20.7	10.5	1	10.0	10.0	9	105.5	11.72	6	68.6	11.43	4	53.0	13.25	3	45.1	15.0
Veniar I (b)	1	10.7	10.7	1	8.1	8.1	1	12.1	12.1	2	22.4	11.2	8	84.6	10.57	1	12.5	12.5	3	36.3	12.1	5	65.9	13.8
Veniar II	9	85.2	9.47	3	28.4	9.47	4	38.0	9.5	3	30.1	10.03	17	200.0	11.76	9	100.1	11.12	13	106.8	12.98	22	282.8	12.85
Veniar III	6	58.8	9.8	10	89.3	8.93	10	106.15	10.62	5	47.7	9.54	15	167.4	11.16	11	127.1	11.55	8	97.5	12.19	16	209.6	13.1
Group Total:-	47	457.11	9.73	52	476.9	9.15	48	498.1	10.38	49	493.9	10.08	135	1578.9	11.7	105	1207.3	11.5	109	1436.4	13.18	140	1829.5	13.07
Delhi Stury.		-	78.2	-	-	77.9	-	-	81.8	-	-	85.8	-	-	-	-	-	-	-	-	-	-	-	-
All-India.		-	-	-	-	-	-	-	-	-	-	-	-	-	86.2	-	-	84.9	-	-	93.9	-	-	92.6

CHEST CIRCUMFERENCE FOR AGE - HIGH WAVYS GROUP - 1979.

Name of Estate/ Division.	0 - 3 months.			3 - 6 months.			6 - 9 months.			9 - 12 months.			1 year to 1½ years.						1½ years to 2 years.					
													Male			Female			Male			Female		
	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.
Cloud Land.	4	143.5	35.88	9	352	39.1	5	203	40.6	5	217	43.4	7	309.5	44.2	9	387.5	43.1	9	426	47.3	8	372	46.2
High Wavys.	5	180.5	36.1	9	349	38.78	12	505.5	42.13	13	558.5	42.96	9	397.25	44.13	13	574	44.15	4	191.5	47.87	10	454	45.4
Manalaar.	8	282	35.25	14	545	38.93	12	488.5	40.7	24	1049.5	43.73	12	519.5	43.29	17	732.5	43.08	15	663.5	44.25	14	574	44.15
Uppor Manalaar.	3	110.5	36.83	7	272	38.85	7	287	41	6	249	41.5	13	569.5	43.8	9	382	42.4	8	365.5	45.68	6	260.5	43.41
Veniar (I) (a).	3	101.5	33.83	5	195	39	3	122	40.66	3	125	41.66	2	84.5	42.25	5	211	42.2	4	176.5	44.12	8	349	43.63
Veniar (I) (b).	5	171	34.2	4	155	38.75	-	-	-	2	83.5	41.75	1	44	44	2	87.5	43.75	7	328	46.85	5	221	44.2
Veniar II.	1	35	35	4	152.5	38.13	7	301.5	43.1	8	339	42.4	13	575.	44.2	6	267.5	44.58	12	549.5	45.79	11	493	44.82
Veniar III.	7	247	35.29	5	199	39.8	10	413	41.3	8	346	43.25	10	449.5	44.95	6	262	43.67	4	182.5	45.63	10	443.5	44.35
Group Total:-	36	1271	35.30	57	2219.5	38.93	56	2320.5	41.43	69	2937.5	42.57	67	2948.75	44.01	67	2904	43.34	63	2883	45.76	72	3167	43.98
All-India.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43.1	-	-	42.1	-	-	44.5	-	-	43.4

Name of Estate/ Division.	2 years to 2½ years.						2½ years to 3 years.						3 years to 4 years.						4 years to 5 years.					
	Male			Female			Male			Female			Male			Female			Male			Female		
	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.
Cloud Land.	3	140	46.70	6	270.50	45.10	2	95	47.50	5	239	47.80	15	731	48.70	16	760.50	47.50	6	301.50	50.25	13	626.75	48.20
High Wavys.	12	575	47.91	13	594.50	45.73	9	446.50	49.61	10	453	45.30	21	1043.5	49.69	16	769.5	48.09	23	1165.5	50.67	20	973.5	48.67
Manalaar.	6	284	47.33	7	319.5	45.64	8	389	48.63	12	561.5	46.79	36	1758.5	48.84	23	1117.5	48.58	36	1824.4	50.67	47	2310	49.14
Upper Manalaar	9	415	46.11	8	358.75	44.84	12	557	46.41	11	500.5	45.5	13	622.5	47.88	23	1098	47.73	15	738	49.2	13	635.5	48.88
Veniar I (a).	1	45	45	4	175.5	43.87	2	93.5	46.75	1	46	46	9	425	47.22	6	281.1	46.91	4	196	49	3	151.5	50.5
Veniar I (b).	1	50	50	1	46	46	1	50.5	50.5	2	97.5	48.75	8	390	48.75	1	50	50	3	146.5	48.83	5	257.5	51.5
Veniar II.	9	430	47,78	3	143	47.67	4	192	48	3	142.5	47.5	17	834.5	49.9	9	439.5	48.83	13	657.5	50.58	22	1032.55	46.93
Veniar III.	6	283	47.17	10	462	46.2	10	485	48.5	5	239	47.8	15	727.25	48.48	11	542.15	49.34	8	410.5	51.31	16	798.5	49.9
Group Total:-	47	2222	47.27	52	2369.75	45.57	48	2308.5	48.09	49	2279	46.51	134	6532.25	48.74	105	5058.65	48.18	108	5439.9	50.36	139	6685.8	48.82
All-India.	-	-	45.4	-	-	44.4	-	-	46.6	-	-	45.5	-	-	48.1	-	-	46.9	-	-	49.6	-	-	48.6

N = No. of children.

sspd.
19-2-1980.

MID-ARM CIRCUMFERENCE FOR AGE - HIGHWAVYS GROUP - 1979.

Name of Estate/ Division.	0 - 3 Months.			3 - 6 months.			6 - 9 months.			9 - 12 months			1 Year to 1½ Years.						1½ years to 2 years.					
													Male.			Female.			Male.			Female.		
	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.
Cloud Land.	4	42.25	10.56	9	109.5	12.17	5	61.5	12.3	5	60.5	12.1	7	89	12.7	9	111.5	12.4	9	115.5	12.8	8	104	13
High Wavys.	5	50	10	9	102	11.3	12	145.5	12.13	13	156.25	12	9	114.25	12.69	13	164.75	12.67	4	51.25	12.81	10	127	12.7
Manalaar.	8	83.5	10.44	14	161.5	11.54	12	145.5	12.12	24	300.25	12.51	12	149.5	12.46	17	212.5	12.5	15	194	12.93	14	165.5	12.73
Upper Manalaaar.	3	34	11.33	7	76.5	10.92	7	82	11.71	6	72.5	12.08	13	162.5	12.5	9	111	12.33	8	103	12.87	6	74	12.33
Veniar I (a).	3	28	9.33	5	57	11.4	3	36	12	3	34.5	11.5	2	25.5	12.75	5	61	12.2	4	50.5	12.62	8	100.5	12.56
Veniar I (b).	5	48.7	9.74	4	47.5	11.87	-	-	-	2	24	12	1	12	12	2	23	11.5	7	87	12.42	5	60.5	12.1
Veniar II.	1	10.5	10.5	4	42.5	10.63	7	88.25	12.61	8	95	11.88	13	159	12.24	6	72.25	12.04	12	145.5	12.13	11	132	12.09
Veniar III.	7	72.5	10.36	5	56.5	11.3	10	118	11.8	8	100.9	12.61	10	128.5	12.85	6	72	12	4	48	12	10	122.9	12.29
Group Total:-	36	369.45	10.26	57	653	11.45	56	676.5	12.08	69	843.9	12.23	67	840.25	12.54	67	828	12.35	63	794.75	12.61	72	887.4	12.32
All-India.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.5	-	-	12.1	-	-	12.7	-	-	12.5

Name of Estate/ Division.	2 years to 2½ years.						2½ years to 3 years.						3 years to 4 years.						4 years to 5 years.					
	Male.			Female.			Male.			Female.			Male.			Female.			Male.			Female.		
	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.
Cloud Land.	3	35.5	11.8	6	76	12.7	2	25	12.5	5	65.25	13.05	15	196.25	13.1	16	214.95	13.4	6	81	13.5	13	177	13.6
High Wavys.	12	152	12.66	13	164	12.61	9	124	13.77	10	127	12.7	21	282.5	13.45	16	216.75	13.54	23	323.75	14.07	20	277.5	13.87
Manalaar.	6	77.5	12.92	7	92	13.14	8	106	13.25	12	157.75	13.15	36	482.75	13.4	23	315.7	13.72	36	502.3	13.95	47	652	13.87
Upper Manalaar.	9	118	13.11	8	105	13.12	12	155	12.91	11	144	13.09	13	180.5	13.88	23	302.5	13.15	15	207.5	13.83	13	187	14.38
Veniar I (a).	1	13.5	13.5	4	50.5	12.62	2	25	12.5	1	13	13	9	119	13.22	6	78	12	4	56	14	3	46	15.33
Veniar I (b).	1	13.5	13.5	1	12	12	1	13	13	2	26.25	13.12	8	103	12.88	1	13	13	3	40.5	13.5	5	71	14.2
Veniar II.	9	115.5	12.83	3	38.5	12.83	4	53.5	13.38	3	39.5	13.17	17	230.75	13.57	9	120	13.33	13	178.25	13.33	22	307	13.95
Veniar III.	6	78.5	13.08	10	124.25	12.43	10	135.5	13.6	5	67	13.4	15	201	3.4	11	148.25	13.48	8	107.25	13.41	16	225	14.06
Group Total:-	47	604	12.85	52	662.75	12.74	48	637	13.27	49	639.75	13.05	134	1795.75	3.40	105	1409.15	13.42	108	1491.55	13.81	130	1942.5	13.97
All-India.	-	-	13	-	-	12.8	-	-	13	-	-	13	-		3.4	-	-	13.4	-		14	-	-	13.9

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HEAD CIRCUMFERENCE FOR AGE - HIGHWAVYS GROUP - 1979.

Name of Estate/ Division.	0 - 3 months.			3 - 6 months.			6 - 9 months.			9 - 12 months.			1 year to 1½ years.						1½ years to 2 years.					
													Male.			Female.			Male.			Female.		
	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.
Cloud Land	4	148.5	37.13	9	362	40.2	5	208	41.6	5	216	43.2	7	312.5	44.64	9	389.5	43.28	9	415.5	46.2	8	367	45.88
High Wavys	5	183.5	36.7	9	353.5	39.28	12	508	42.3	13	561.25	43.17	9	403.5	44.83	13	573	44.07	4	182	45.5	10	441	44.1
Manalaar	8	295	36.88	14	556.5	39.75	12	501.3	41.78	24	1051.8	43.82	12	536	44.67	17	754	44.35	15	682.5	45.5	14	578	44.46
Uppor Manalaar	3	114.5	38,16	7	276	39.42	7	291.5	41.64	6	253.5	42.25	13	577	44.38	9	386	42.88	8	362.5	45.31	6	262	43.66
Veniar I (a)	3	104	34.66	5	200	40	3	123.5	41.16	3	128	42.66	2	86.5	43.25	5	215	43	4	175.5	43.62	8	355	44.37
Veniar I (b)	5	175	35	4	157	39.25	-	-	-	2	84.5	42.25	1	44	44	2	87.5	43.75	7	321	45.85	5	215.5	43.1
Veniar II	1	37	37	4	152	38	7	292	42.71	8	343.5	42.9	13	569.5	43.81	6	262	43.67	12	531	44.25	11	485.5	44.14
Veniar III	7	257.5	36.79	5	200.5	40.1	10	414.5	41.45	8	345.5	43.19	10	442.5	44.25	6	269.5	43.25	4	180.5	45.13	10	441	44.1
Group Total:-	36	1315	36.53	57	2257.5	39.61	56	2338.8	41.76	69	2984.1	43.25	67	2971.5	44.35	67	2936.4	43.83	63	2850.5	45.25	72	3145	43.68
Delhi Study.	-	-	38.2	-	-	40.7	-	-	42.2	-	-	43.2	-	-	-	-	-	-	-	-	-	-	-	-
All-India.	-	--	-	-	-	-	-	-	-	-	-	-	-	-	43.9	-	-	43	-	-	45.1	-	-	44

	2 years to 2½ years.						2½ years to 3 years.						3 years to 4 years.						4 years to 5 years.					
	Male			Female.			Male			Female			Male			Female			Male			Female		
	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.	N	Total	Mean.
Cloud land.	3	139.25	46.42	6	266.5	44.4	2	94.5	47.25	5	229.5	45.9	15	715.5	47.2	16	744.25	46.3	6	289.5	48.25	13	610.5	47
High Wavys.	12	558	46.54	13	594	45.69	9	422	46.88	10	446	44.6	21	1022.75	48.70	16	745	46.56	23	1112	48.84	20	949.5	47.47
Manalaar.	6	276	46	7	370	45.28	8	334.5	41.81	12	553.5	46.13	36	1697.5	47.15	23	1102	47.91	36	1745.5	48.48	47	2219.7	47.22
Upper Manallar.	9	414.5	46.05	8	357.5	44.68	12	550.5	45.87	11	504.5	45.86	13	611.5	47.03	23	1071.5	46.58	15	706.25	47.08	13	613.5	47.19
Veniar I (a).	1	46	46	4	177	44.3	2	90.5	45.25	1	47	47	9	419.5	46.61	6	277.5	46.25	4	191.15	47.87	3	143	47.66
Veniar I (b).	1	46	46	1	46	46	1	47	47	2	93	46.5	8	377.5	47.18	1	48.5	48.5	3	140	46.66	5	136.5	47.3
Veniar II.	9	414.25	46.03	3	139	46.33	4	185.5	46.38	3	134.5	44.83	17	797	46.88	9	412	45.78	13	623.25	46.94	22	1039.5	47.25
Veniar III.	6	274	45.67	10	450.5	45.05	10	468	46.8	5	230	46	15	702.5	46.8	11	514.5	46.77	8	385	48.15	16	757.5	47.47
Group Total:-	47	2168	46.12	52	2347.5	45.14	48	2192.5	45.67	49	2238	45.67	134	6343.75	47.34	105	4915.25	46.81	108	5293	49	139	6571.7	47.27
~~Delhi Study~~	-	-	45.5	-	-	44.6	-	-	46.3	-	-	45.4	-	-	47.2	-	-	46.1	-	-	47.9	-	-	47.1
All-India.																								

II. BALANCED DIETS IN TERMS OF STANDARD CUPS AND SPOONS

The balanced diets for different categories of people are given in terms of standard cups and spoons in the following table:

Table-1: Balanced Diet for Adult Man(Moderate worker)

Food Stuff	Qty (g)	Approximate volume in std. cup and std. spoon.	Number
I. CEREALS			
1. Rice	335	1-3/5	
2. Wheat flour	140	1	
II. PULSES			
1. Redgram dhal	50	1/5	
2. Blackgram dhal	30	6 std. sp.	
III. GREEN LEAFY VEGETABLE			
1. Amaranthus	125	1-4/5	3 bundles
IV. Roots and Tubers			
Potato	100	3/5	2 medium sized ones
V. OTHER VEGETABLES			
Beans	75	1/2	12-15 or a handful
VI. FRUIT			
Orange	30	-	3 segments.
VII. Milk	200	4/5	-
VIII. Fats and oils	40	2/5	-
IX. Sugar & Jaggery	40	1/5	-

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Duplicate

Table-II: Balanced Diet for an Adult Women (Moderate Worker)

(1)	(2)	(3)	(4)
I. CEREAL			
1. Rice	230	1	
2. Wheat	180	-4/5	
II. PULSES			
1. Redgram dhal	45	-1/5	
2. Blaokgram dhal	25	5 std. sp.	-
III. GREEN LEAFY VEGETABLE			
Amaranth	125	1-4/5	3 bundles.
IV. ROOTS AND TUBERS			
Potato	75	1/2	1
V. OTHER VEGETABLES - Beans	75	1/2	12-15or a handful.
VI. FRUITS - Orange	30	-	3 segments or a quarter fruit.
VII. Milk	200	4/5	-
VIII. Fats and Oils	35	1/5	-
IX. Sugar and Jaggery	30	6 Std. sp.	-

Table-III: Additional Allowance for Pregnancy and Lactation

Food Stuff	Pregnancy			Lactation		
	Qty (g)	Appx.Vol. in std.cup.	No.	Qty (g)	Appx.Vol. in std.cup	No.
I. CEREALS:						
Rice	50	1/5	-	40	1/5	-
Wheat				60	1/5	-
II. PULSES:						
Redgram dhal				20	2 std.sp.	-
III. GREEN LEAFY VEGETABLE	25	2/5	3/4 bundles	25	2/5	3/4bundles
VI. Milk	125	1/2	-	125	1/2	-
V. Fats & Oils				15	4 std.sp.	
VI. Sugar & Jaggery	10	2 std.sp	-	20	4 std.sp.	

Table - IV: Balanced Diet for a Child between the Age 3-6 years (Ref. - 6 years old child)

Food Stuff	Qty (g)	Appx.Vol.in std. cup	No.
(1)	(2)	(3)	(4)
I. CEREALS			
1. Rice	140	3/5	-
2. Wheat flour	60	2/5	-
II. PULSES			
1. Redgram dhal	30	6 std. sp.	
2. Blackgram dhal	15	3 "	
3. Other grams	15	3 "	
III. GREEN LEAFY VEGETABLE:			
Amaranth	75	1-1/5 std.cup	1-½ bundles
IV. ROOTS AND TUBERS			
Potato	50	2/5 "	1 medium size
V. OTHER VEGETABLES			
Beans	50	2/5 std.sp.	8-10 in no.
VI. FRUITS			
Orange	50	2/5 std.cup.	5 segments.
VII. Milk	250	1 "	
VIII. Fats and Oils	25	7 std.sp.	
IX. Sugar and Jaggery	40	8 std. sp.	

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Table - V : Balanced Diet for a Child Between the Age 1-3 years
(Ref: 3 year old child)

(1)	(2)	(3)	(4)
I. CEREALS			
1. Rice	90	2/5	-
2. Wheat	60	2/5	-
II. PULSES			
1. Redgram dhal	25	5 std. sp.	-
2. Blackgram dhal	10	2 std. sp.	-
3. Greengram dhal	15	3 std. sp.	-
III. GREEN LEAFY VEGETABLES :			
Amaranth	50	4/5 cup	1 bundle
IV. ROOTS AND TUBERS			
Potato	30	2/5 cup	1 small
V. OTHER VEGETABLES			
Beans -	30	2/5 cup	5-7 in no.
VI. FRUITS - Orange	50		5 segments
VII. Milk	300	1-1/5	-
VIII. Fats and Oils	20	6 std. sp.	
IX. Sugar and Jaggery	30	6 std. sp.	

* * * * * *

Fortification Basics

NUT-7

Wheat Flour

Rationale

Wheat is the most widely produced cereal in the world, most of which is destined for human consumption; thus, its contribution to energy intake is significant, particularly in the Americas and the Middle East (Table 1).

The processing of whole wheat to wheat flour is generally concentrated in a few large mills . The resulting flour is used to make bread, biscuits, pasta, and other products. Because of its widespread geographic distribution, acceptance, stability, and versatility, wheat flour is a suitable vehicle for delivering micronutrients to mankind.

Table 1
Per Capita Wheat Comsumption in Selected Countries

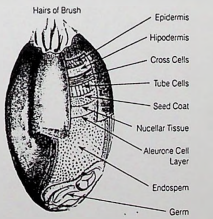
Country	Consumption (g/person/day)	% of Daily Energy Intake
Pakistan	318	45
Turkey	484	44
Syria	490	44
Chile	372	42
Egypt	397	35
Greece	371	28
Argentina	344	28
Uruguay	269	26
Bolivia	159	20
South Africa	191	18
Peru	136	17

Micronutrient Content of Wheat and Wheat Flour

In its natural state, wheat is a good source of vitamins B1 (thiamine), B2 (riboflavin), niacin, B6 (pyridoxine), E, as well as iron, and zinc.

Nevertheless, because most of these nutrients are concentrated in the outer layers of the wheat grain (Figure 1), a significant proportion is lost during the milling process. For lower extraction rates of flour (i.e. more refined flour) , the loss of vitamins and minerals is greater (Figure 2).

Figure 1
Schematic Diagram of the Wheat Grain



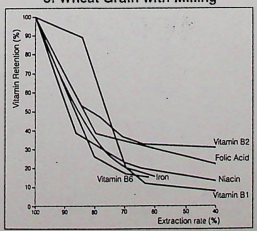
Nutrients Generally Added to Wheat Flour

In developed countries, wheat flour is generally fortified with vitamins B1, B2, niacin, and iron. In some countries calcium and folate are also added. Vitamins A and D can also be added to flour.

The levels of vitamin B1, niacin, and iron added to wheat flour is often equivalent to the amount lost in milling, i.e. these micronutrients are restored and the flour is *enriched*. For other micronutrients such as vitamin B2, the amount added is over and above that lost in milling, i.e. the flour is *fortified*.

Fortification rather than enrichment is done when the overall diet is deficient in particular micronutrients and restoring the micronutrients lost in milling will not make good this deficit.

Figure 2
Changes in Micronutrient Content of Wheat Grain with Milling



Adapted from FAO. 1970. Wheat in Human Nutrition and Thomas. B. 1968. Nutritional - physiological views in processing cereal products. Vegetables. 15: 360.

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4/1/2000

Technology

The technology for fortifying flour is simple. First, a premix

Table 2
Example of Premix Composition

Nutrient	Level (mg/Kg Flour)	Product Form	grams/ Kg Premix
Vitamin B_1	4.45	Thiamine Mononitrate	61.80
Vitamin B_2	2.65	Riboflavin	36.90
Niacin	35.62	Nicotinamide	494.70
Iron	30.20	Reduced Iron	406.60

Dosage: 72 g/ton of flour

Figure 3
Volumetric Feeder for Adding Micronutrient Premix

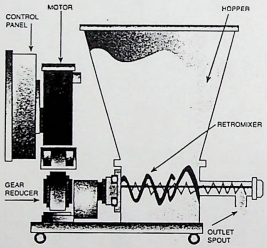
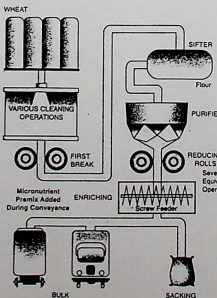


Figure 4
Simplified Flow Chart for Flour Milling



of the micronutrients to be added is needed (Table 2). The advantage of using a premix over that of adding micronutrients singly is that there is a greater likelihood of ensuring:

- The correct concentration of micronutrients
- An even distribution of micronutrients

Furthermore, the logistics of adding micronutrients to flour will be simpler and the quality assurance system is more likely to be effective.

The fortification process itself is accomplished by adding the micronutrients through a volumetric feeder (Figure 3) located towards the end of the milling process. The most commonly used feeder consists of a rotating feed screw that is driven by a variable speed motor. The screw rotates inside a chamber containing the premix and pushes the premix through an outlet spout. The amount of premix added to the flour can be modified by changing the motor speed. The concentration of premix added to the flour can be calculated by weighing the amount of premix deposited by the feeder in one minute divided by the volume of flow passing underneath in the same period of time.

The premix can be either fed directly into the flour by *gravity* or by air convection using a *pneumatic* system. The homogeneity of micronutrients in fortified flour is largely dependent on the location of the feeder and it is very important that the mixing of the micronutrients with the flour is good. In a gravity driven system, experience has shown that the best site for adding micronutrients is before the mid point along the screw conveyor that collects flour from all the mill passages, just before bulk storage or sacking (Figure 4). If the feeder is placed towards the beginning of the screw conveyor, the amount of flour in the conveyor will be too little. If, on the other hand, the feeder is located toward the end of the screw conveyor, the required homogenisation will not be achieved.

In a pneumatic system feeders can be placed in a remote centralised location.

The cost of the feeder varies between US$ 2000 and 5000, depending on whether a gravity or pneumatic system is installed and the quality of the device.

Micronutrient Stability

In foods, the stability of vitamins is more precarious than that of minerals because vitamins are sensitive to heat, oxidising and reducing agents, light, and other kinds of physical and chemical stress.

Vitamins are stable in flour as such, although high

humidity and temperatures together do adversely affect vitamin A. The use of encapsulated forms of vitamin A will help to overcome this problem. There is some evidence of minor losses of other vitamins during flour storage (Tables 3 and 4).

Most of the vitamin losses ocur during baking, which is the most common process all wheat flour products go through. Although baking temperatures are high (over 200°C), the temperature inside the product is significantly lower, and over 70 percent of the vitamins remain unaltered (Table 5). Similarly, between 65 and 85 percent of vitamins remain intact after cooking pastas (Table 6).

Table 3
Nutrient Retention in Flour with 9% Humidity at Room Temperature

Nutrient	Level per Kg				
	Label Claim	Initial	2 mo	4 mo	6 mo
Vitamin A, IU	16,534	18,078	18,078	17,681	17,526
Vitamin B6, mg	4.41	5.18	4.85	5.07	4.85
Vitamin E, IU	33.07	35.05	35.05	35.05	35.05
Folic Acid, mg	0.66	0.82	0.66	0.77	0.66
Vitamin B1, mg	6.39	7.50	NR	NR	7.50

Table 4
Nutrient Retention in Flour with 9% Humidity at 45° C

Nutrient	Level per Kg				
	Label Claim	Initial	1 mo	2 mo	3 mo
Vitamin A, IU	16,534	18,078	16,534	14,175	12,919
Vitamin B6, mg	4.41	5.18	4.85	4.85	4.63
Vitamin E, IU	33.07	35.05	35.05	35.27	35.49
Folic Acid, mg	0.66	0.82	0.66	0.57	0.75
Vitamin B1, mg	6.39	7.50	NR	NR	NR

NR=Not registered
Cort, W.M., B. Borenstein, B., J.H. Harley, M. Osadca, and J. Scheiner. 1975. Nutrient Stability of Fortified Cereal Products. 35th IFT Meeting. Chicago, Ill.

Quality Control

The determination of micronutrients in flour can be done by simple classical methods (e.g. fluorometric for B1 and B2 and spectrophotometric for iron) or by faster methods that require more sophisticated equipment (e.g. HPLC for vitamin A, folic acid, and niacin and atomic absorption for iron).

It is important to establish quality control standards for both commercial premixes and fortified flour.

Legislation

Compulsory fortification of flour is increasing throughout the world. Currently 14 countries have legislation or regulations that mandate wheat flour be fortified with various micronutrients (Table 7). Other countries are

Table 5
Nutrient Losses During Typical Bread Baking

Nutrient	% Loss during baking
Vitamin A	10 - 20
Vitamin B1	15 - 25
Vitamin B2	5 - 10
Niacin	0 - 5
Folic Acid	20 - 30

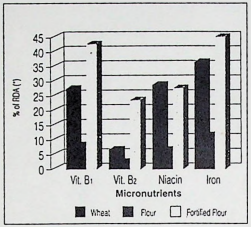
F. Hoffmann - La Roche. Unpublished Data. Basel.

Table 6
Vitamin Losses in Long Durum Wheat Pasta After Drying and Cooking.

Nutrient	% Loss After Drying (75°C)	% Loss After Cooking
Vitamin A	13	17
Vitamin B1	0	32
Vitamin B6	5	35
Niacin	0	30

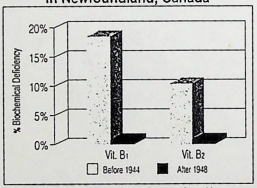
F. Hoffmann La Roche. 1990. Vitamins and Carotenoids in Pasta. Basel.

Figure 6
Nutrient Allowance per 100g of Different Wheat Products



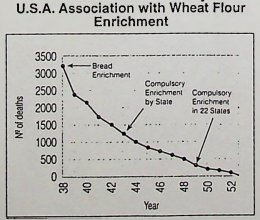
Code of Federal Regulations. 1973. Enrichment Levels of Baked Goods. Flour Farina, etc. Title 21, 15.525. Nutrient data: ESHA Research, Food Processor II NCR. 1989. Recommended Dietary Allowances.

Figure 7
Biochemical Impact of Flour Enrichment in Newfoundland, Canada



Aykroyd, WR. et al 1949. Medical Survey of Nutrition in Newfoundland 1948. The Canadian Med Assoc. Journal. 60:4

Figure 8
Deaths from Niacin Deficiency in the U.S.A. Association with Wheat Flour Enrichment



Miller, D.F. 1955. Enrichments Programs Helping Mother Nature Along Food Prod. Dev. 12: 4 30-38

considering this option. The low cost, and simplicity of the technology has made it one of the most sought after methods for combating micronutrient malnutrition. Figure 6, for example, shows the contribution that flour fortified with vitamins B1, B2 and niacin, as well as iron, makes toward meeting the Recommended Dietary Allowances (RDA) for adult men in the USA.

Table 7
Compulsory Flour Enrichment Worldwide

Country	Vitamin B1 (Mg/Kg)	Vitamin B2 (Mg/Kg)	Niacin (Mg/Kg)	Folic Acid (Mg/Kg)	Iron (Mg/Kg)
Canada	4.4 - 7.7	2.7 - 4.8	35 - 64	(0.4 - 0.5)	29 - 43
Chile	6.30	1.30	13.00		30.00
Costa Rica	4.4 - 5.5	2.6 - 3.3	35.2 - 44.0		28.7 - 36.4
Dominican Republic	4.45	2.65	35.62		29.29
Ecuador	4.45	7.48	83.58	0.59	58.65
El Salvador	4.41	2.65	35.30		28.70
Guatemala	4.0 - 6.0	2.5 - 3.5	35 - 40	0.35 - 0.45	55.65
Honduras	4.40	2.60	35.20		28.70
Nigeria	4.5 - 5.5	2.7 - 3.3	35.5 - 44.4		28.9 - 36.7
Panama	4.40	2.60	35.20		28.70
Saudi Arabia	≥ 6.38	≥ 3.96	≥ 52.91		≥ 36.30
UK	≥ 2.4		≥ 16.0		≥ 16.5
USA	6.40	4.00	52.90		44.10
Venezuela	1.50	2.00	20.00		20.00

Note: Figures in parenthesis indicate the enrichment is optional
Raunhardt, O. and A. Bowley. 1996. Mandatory Food Enrichment. Nutriview 1.

Costs

The cost of fortifying wheat flour is much lower than generally recognised. For example, the total cost of adding mandatory nutrients to flour in the USA (i.e. 6.4 mg/Kg Vitamin B1, 4.0 mg/Kg Vitamin B2, 52.9 mg/Kg Niacin and 44.1 mg/Kg Iron), is less than one US Dollar per metric ton of flour. This is about 0.1 percent of the cost of flour in the shops.

On the other hand, if the cost in the USA is calculated on a per person per year basis, and average wheat consumption is 205 g/person/day, the total cost of fortification is US$ 0.07 per person per year.

In addition to the recurrent costs for the micronutrients, there are the capital costs for the feeders, which are not great, and the recurrent costs for quality control.

Impact on Public Health

Figures 7 and 8 show the association between the introduction of fortification initiatives and the reduction in vitamin B1 and B2 deficiencies in Canada and niacin deficiency in USA, respectively.

Iron deficiency anaemia has also decreased in the USA, Great Britain, Sweden, and Chile and much of this decline is attributed to food fortification, including bread, with iron.

Fortification Basics

Sugar

NUT-7

Rationale

Sugar is an important source of energy for many people throughout the world. It is produced in over 100 countries and production of sugar is increasing, especially in South America (Table 1). Sugar processing and refining is carried out at only a few mills in sugar producing countries while sugar refining only is done in some sugar importing countries. For these reasons, fortifying sugar with micronutrients is both practical and feasible. In addition, sugar is eaten by the vast majority of people on a regular basis, although consumption levels do vary (Table 2); thus, fortification is an effective means to provide nutrients that are deficient in the population.

Among the micronutrient deficiencies, vitamin A deficiency is one of the most widespread, affecting more than 250 million children throughout the world (Fig. 1). One approach to eliminating this problem has been the fortification of sugar with vitamin A.

Fortification Criteria

The objective is to ensure that vitamin A needs are met for the groups at greatest risk of deficiency without resulting in excessive intakes for individuals having a high sugar intake.

The level of vitamin A to be added is determined by nutritional requirements and sugar consumption patterns; thus, nationally representative data disaggregated by socio-economic status and age groups are needed. Children under 5 years old are most vulnerable to vitamin A deficiency, and their recommended daily allowance is 400 µg RE (1,330 IU) per day. Pregnant women are also at high risk of deficiency, and their reccomended daily allowance is 600 µg RE (2,000 IU).

If, for example, the average sugar intake of children under five years old is 20 grams per day and that for adults in the highest consuming group is 150 grams per day, 15 µg of vitamin A per gram of sugar will both satisfy needs and remain below the maximum acceptable limit.

Technology

Because the quantity of vitamin A being added is so small, production of an homogeneously fortified product is facilitated by diluting the retinyl palmitate (the form of vitamin A used in fortification) in a small amount of sugar to form a premix.

Premix contains:

- Regular sugar.
- Cold water soluble vitamin A palmitate beadlets containing 75,000 µg /g (250,000 IU/g).
- A low peroxide, low in unsaturated fat vegetable oil (e.g. coconut or peanut), which adheres the vitamin A beadlet to the sugar crystal (Fig. 2). This prevents the separation of the vitamin A from the sugar crystal and results in an homogeneously fortified product, without noticeable changes in the sugar's organoleptic properties.

Table 1
Regional and World Sugar Production ('000MT)[1]

Region	1988	1994
Central America	15,000	11,500
S. America	13,000	17,000
Africa	8,000	7,000
Asia	26,500	33,300
Europe	31,500	27,300
N. America	6,500	7,000
Oceania	4,200	5,800
World Total	104,700	110,300

1. International Sugar Organization, 1995.

Table 2
Per Capita Sugar Consumption, and Percent of Daily Energy Intake in Selected Countries

Country (1994)	Consumption (g/person/day)	% of daily energy intake [2]
Brazil	127	17
Peru	88	14
Guatemala	110	15
Honduras	85	12
India	42	5
Indonesia	42	5
Morocco	88	11
Mali	22	2
Egypt	80	10
Zambia	31	8
Cameroon	17	3
South Africa	100	15

1. International Sugar Association, 1995.
2. FAO Food Balance Sheets. 1984 - 1986 average.

Figure 1
Countries Categorized by Degree of Public Health Importance of Vitamin A Deficiency

WHO XVII IVACG Meeting, Guatemala,1996.

Figure 2
Vitamin A Beadlet Adhered to Sugar Crystal

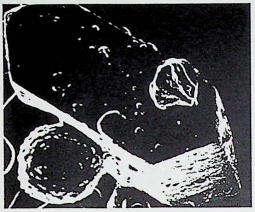


Figure 3
V-type Mixer and Oil Deposit

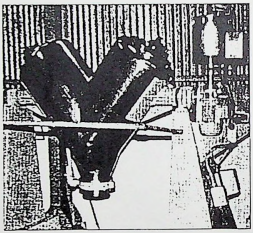
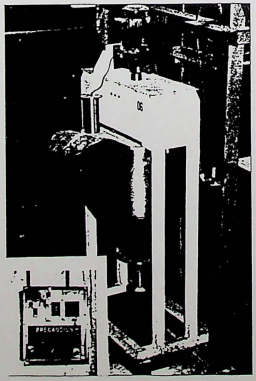


Figure 4
Automatic Dosifier and Control Panel



- An antioxidant blended from natural antioxidants (ascorbyl palmitate, DL-alpha tocopherol, and lecithin) to prevent the oil from going rancid. Rancid oil destabilizes vitamin A and has adverse effects on the sensory characteristics of sugar. Blending the oil and antioxidant in an inert, oxygen-free atmosphere, i.e., in the presence of nitrogen gas, prevents oxidation of the oil.

Premix Composition

Ingredients	Amount	Units
Sugar	76.35	Kg
Vitamin A 250 CWS	22.03	Kg
Peanut oil	2	L
Antioxidant	0.008	Kg
TOTAL	100	Kg

Premix is made by mixing the sugar and vitamin A in a blender (generally a V-type, Fig. 3), with a spraying device attached to it that allows the oil-antioxidant mixture to be added during the mixing operation.

After 10 to 20 minutes of mixing, the premix is packaged in 25 Kg black polyethylene bags covered with polypropylene bags. This minimizes exposure to light, thereby preventing the destruction of retinol. This premix is added to sugar in a ratio of 1:1000.

The addition of premix to sugar can be done manually or automatically. In manual operations, the premix is added into the centrifuges. This method is not ideal because the accuracy of the amount of premix added is dependent on the operator. In automatic operations (Fig. 4), feeders can be placed in different sites along the production line (Fig. 5). The best site is where the humidity and temperature are lowest, which would be just before packaging. This is not always possible because of limitations in the amount of space available. Fortified sugar is packaged in polyethylene bags.

Stability of Retinyl Palmitate

An industrially produced encapsulated vitamin A compound that is dry, solid, and miscible in water, facilitated the development of fortification technology. Despite its excellent stability, 250-CWS is still sensitive to air, light, moisture, heat, and acids; thus, appropriate handling and storage conditions of the premix and fortified sugar are important.

In the premix and, during the fortification process

Experimental data report retinol losses of between 10 and 20 percent during the processing of fortified sugar, and between 20 and 40 percent during storage after one year. These losses need to be compensated for by adding the appropriate overage of premix to sugar during the fortification process.

Retinyl palmitate is susceptible to oxidation in the presence of sun or artificial light. Packaging premix in bags covered with black polyethylene bags reduces exposure to light and degradation of vitamin A.

Retinyl palmitate beadlets resist temperatures of 105 °C for 10 minutes. This is important because the premix is added to sugar before it passes through the drying turbines, where temperatures are between 65 and 70 °C.

In fortified sugar

Stability tests show that fortified sugar packaged for retail sale in polyethylene bags retains between 50 and 70 percent of the initial vitamin A level after 3 months of storage (Fig. 6 and 7). Heat and moisture together are believed to be more detrimental to retinyl palmitate than either alone (Table 3).

Fortified sugar in foods

Vitamin A in fortified sugar remains stable in foods prepared at home, although moisture, heat, and acidity do reduce its activity. When fortified sugar is added to beverages such as lemonade and orangeade, 60 to 80 percent of the vitamin A remains after two days.

Vitamin A is sensitive to acids and losses can be expected. Most of the vitamin A in fortified sugar, however, can be lost in the manufacturing of soft drinks as a result of using activated charcoal and diatomaceous earth to eliminate color and impurities; thus, when non refined sugar is used in manufacturing soft drinks there is complete destruction of the vitamin. If, however, refined sugar is used two-thirds of the original retinol level remains.

The stability of vitamin A in baked foods is also good. The retention of the micronutrient after baking is in the order of 80 to 90 percent. Micronutrient interactions with vitamin A in sugar are unlikely because sugar is a pure product with minute quantities of other compounds.

Quality Control

The vitamin A content of the premix is determined using quantitative methods, while that for fortified sugar is carried out using both semiquantitative and quantitative methods.

Quantitative methods include the use of HPLC or spectrophotometric methods. The HPLC method is based on the separation of vitamin A (retinol) from other substances that absorb radiant energy at an equal or similar wavelength to retinol. Detection of retinol in the HPLC column can be done using UV light or fluorescence. This method is accurate, does not destroy retinol, and requires a small amount of sample. However, the equipment is expensive, highly trained personnel are required, and few samples can be run at a time, making the analysis expensive. The spectrophotometric method involves measuring the absorbance of retinol in sugar after its selective destruction through exposure to UV light. This method is easy to use, less expensive than the HPLC method, and results can be obtained in a much shorter period of time.

The semiquantitative colorimetric method involves adding a chromogenic reagent to a volume of solubilized sugar to produce a blue color. The intensity of this blue color is proportional to the amount of retinol in the sample, measured against a set of standards. Semiquantitative assays at 1 to 2 hours intervals during production verify that the fortified sugar contains the amount of vitamin A that falls within the range stipulated in the norms. Results are immediate and permit adjustments to the amount of premix added to sugar.

Costs

The costs of sugar fortification include the capital investments, i.e. building and equipment costs, and recurrent costs, i.e. personnel costs, premix and fortified sugar production costs, as well as monitoring and evaluation costs. In Guatemala, the cost of fortifying 1 metric ton of sugar is US$9.51, and the cost

Figure 5
Possible Points for Premix Addition During Sugar Production

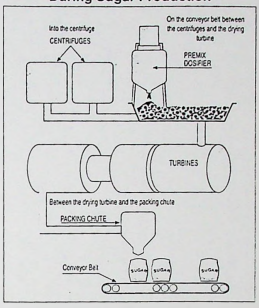
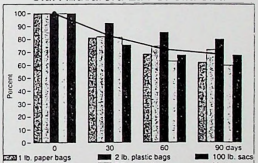
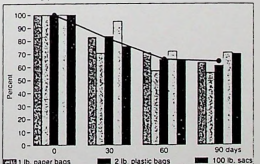


Figure 6
Stability of Vitamin A in Sugar, Cia. Azucarera La Estrella S.A.



De Gracia, M.S., F.E. Murillo. 1993. Estabilidad de Vitamina A en azucar fortificada resúmen ejecutivo. INCAP/U de P.

Figure 7
Stability of Vitamin A in Sugar, Cia. Azucarera Nacional S.A.



De Gracia, M.S., F.E. Murillo. 1993. Estabilidad de Vitamina A en azucar fortificada resúmen ejecutivo. INCAP/U de P.

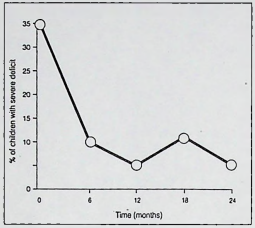
Table 3
Stability of Retinol in Fortified Sugar (% retention in 125 lb. sacs)

Location Type	Months of Storage		
	3	6	9
Cold - Humid	90	77	66
Hot - Dry	92	71	63
Temperate - Humid	83	69	43
Hot - Humid	80	62	40

Dary, O., De león, L. Conference on XVII IVACG Meeting. Guatemala, 1996

Figure 8

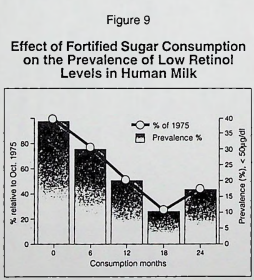
Decrease in % Children with Serum Retinol Level Below 10 mcg/dL After Consumption of Fortified Sugar



Arroyave G, Aguilar Jr. Flores M, Guzmán Ma. Evaluation of Sugar Fortification with Vitamin A at the National Level Pan American Health Organization. Scientific Publication 384 Washington, DC., 1979.

Figure 9

Effect of Fortified Sugar Consumption on the Prevalence of Low Retinol Levels in Human Milk



Arroyave G, Aguilar Jr, Flores M, Guzmán Ma. Evaluation of Sugar Fortification with Vitamin A at the National Level Pan American Health Organization. Scientific Publication 384 Washington, DC., 1979.

Table 4

Status of Legislation for Sugar Fortification in Latin America

Countries Enforcing Legislation	Countries In Process of Legislating	Countries with Interest (Private or Official)
Guatemala	Nicaragua	Brazil
Honduras	Ecuador	Dominican Rep
El Salvador		Colombia
		Bolivia

per person is US$0.36/year. Given that a kilogram of sugar costs US$0.45 before fortification, adding vitamin A increases the price to US$0.459, that is, 2 percent above the original price.
The economic analysis of a program can be presented in different ways, for example, cost per metric ton, cost per person, cost per person covered, cost per possible beneficiary, and in terms of cost-effectiveness. The cost of a sugar fortification program is inexpensive, especially when compared with the costs of vitamin A deficiency, and the cost of other interventions.

Legislation

To be successful, a fortification program requires the collaborative participation between various government sectors, food producers, private organizations, and international agencies. The strongest expression of political commitment to eliminate vitamin A deficiency is legislative action to make a vitamin A fortification program official. Such legislation shall define the norms for implementing fortification, including the responsibilities of each sector involved.
The regulations for vitamin A fortification must specify the type of vitamin A fortificant and the permitted range of retinyl palmitate in fortified sugar both at the refinery and at the point of sale when appropriate. The regulations must define the precautions and food safety conditions to be observed during production, transportation, storage, and sale of the fortified sugar.
Labeling the bags of fortified sugar at the refinery should be enforced, especially when unfortified sugar is also produced for industrial use. Sugar packaged for retail sale should be labeled in a way that is true and accurate, and provides essential information specified by the health authorities.
The official creation of a specific committee, for example, a Food Fortification Committee, with representatives from different sectors is recommended. The role of this committee would be to monitor program implementation and analyze the information coming from the different operating units, and to ensure that the operating units and those responsible at the points of sale comply with their responsibilities.

History and Successful Interventions

Guatemala was one of the first countries to implement a sugar fortification program to ensure an adequate intake by the population with satisfactory results (Fig. 8 and 9).
Other countries in Latin America are now implementing vitamin A fortification programs (Table 4). Asian countries are also considering sugar fortification.

Vitamin A is an essential nutrient and deficiency is associated with adverse health effects. Sugar fortification presents an important intervention for improving the vitamin A status of at-risk populations.
Although the current technology is adequate enough, it can still be improved in order to increase the efficiency of the fortification program. In existing refineries, space where the dosifiers can be installed is often limited. Future plant layouts should make provisions for this limitation.

Fortification Basics

Oils and Margarine

NUT-3

Rationale

Oils and fats, along with carbohydrates and proteins are major components of the human diet. Oils provide energy, fat soluble vitamins (vitamins A, D, and E), and essential fatty acids that are required for proper growth and development.

The production of vegetable oils (canola, corn, cottonseed, coconut, olive, palm, peanut, safflower, soybean, sunflower) is high throughout the world, and consumption (Table 1) is increasing, especially among the lower socioeconomic groups. A higher consumption of vegetable oils over animal fats is preferable because vegetable oils contain much less saturated fat than animal fats (Figure 1), and they contain no cholesterol.

Vegetable oils are suitable as vehicles for vitamins A, D, and E fortification, as the production and refining of the oils is a centralized process. As vitamins A, D, and E are fat soluble, they can be uniformly distributed in oil. The stability of vitamin A is greater in oils than in any other food and oil facilitates the absorption of vitamin A by the body. Vegetable oils are consumed by almost everyone; thus, it is possible to improve people's access to fat soluble vitamins through fortification.

Hydrogenation converts liquid vegetable oils into solid fats, such as margarine. The vitamin A and D content in margarine is negligible. However, fortification with these vitamins can make margarine an important source of these nutrients, as well as a source of energy.

Fortification with vitamin E may be important where the diet is high in polyunsaturated fatty acids (PUFA). PUFAs are long chain fatty acids with more than one double bond, which makes them susceptible to oxidation. The process of oxidation of fat in oils is the same as in cells.

- Food oils that are high in triglycerides can contain PUFAs, which produce hydroperoxyacids on oxidation resulting in a rancid odor in food.
- At the cellular level, oxidation results in the formation of free radicals, which have been shown to be associated with cancer and cardiovascular diseases (CVD); hence antioxidants are thought to be anticarcinogenic and cardiovascular protective. Technologies now exist to add water soluble micronutrients including vitamin C, the B-complex, iron, and calcium to margarine.

Fortification Criteria

Fortification of vegetable oils and their derivatives (margarine, mayonnaise, etc.) with vitamins A, D, and E is technologically feasible. Crude vegetable oils are a rich source of vitamin E. Processing crude oil, however, can result in the loss of this vitamin; the extent of this loss is dependent on the processing method used. Vitamin E can be added to refined oil as a nutrient or as an antioxidant. Vitamin E antioxidants, such as alpha (α) tocopherol, prevent rancidity and protect other components in the oil susceptible to oxidation, including vitamin A, but it is not a good fortificant. Alfa tocopheryl acetate, in contrast, is stable, making it a good fortificant, but it has no antioxidant activity.

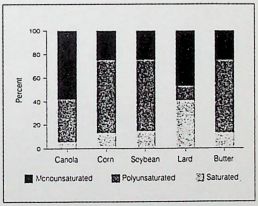
Table 2 shows that the range of vitamin A added to margarine in a number of countries varies between 3,180 and 45,000 IU/Kg, while

Table 1
Per Capita Vegetable Oil Consumption, and Percent Daily Energy Intake from Vegetable Oils in Selected Countries

Country	Consumption (g / day)	% Energy Intake
Argentina	33	9
Brazil	27	9
Mexico	30	9
Costa Rica	35	11
Central Africa	12	5
Congo	34	12
Gambia	31	11
India	16	7
Indonesia	17	6
Philippines	12	4

Source: FAO. 1991. Food Balance Sheets 1984-1986. Rome.

Figure 1
Fatty Acid Content of Different Vegetable Oils and Animal Fats



Source: Giese, J. 1996. Fats, Oils, and Fat Replacers. Food Technology 50 (4): 77-84.

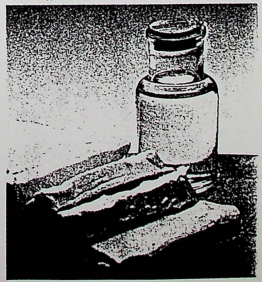
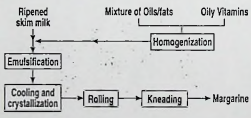


Table 2
Mandatory Fortification of Margarine with Vitamins A&D

Country	Vitamin A (IU/Kg)	Vitamin D (IU/Kg)
Belgium	22,500 - 27,000	2,500 - 3,000
Brazil	15,000 - 50,000	500 - 2,000
Canada	≥ 33,000	≥ 5,300
Chile	30,000	3,000
Colombia	3,180 - 7,950	480 - 1,200
Denmark	25,200	
Ecuador	20,000 - 30,000	2,000 - 4,000
El Salvador	15,000	
Guatemala	15,000 - 50,000	
Honduras	35,000	1,500
India	≥ 30,000	
Indonesia	25,000 - 35,000	2,500 - 3,500
Malaysia	25,000 - 35,000	2,500 - 3,500
Mexico	20,000	2,000
Netherlands	≥ 20,000	≥ 3,000
Panama	20,000	1,500
Peru	30,000	3,000
Portugal	18,000	
Singapore	≥ 28,300	≥ 2,200
Sweden	≥ 30,000	≥ 3,000
Taiwan	≥ 45,000	
Turkey	20,000	1,000
U.S.A.	33,000	2,080
UK	24,000 - 30,000	2,800 - 3,520

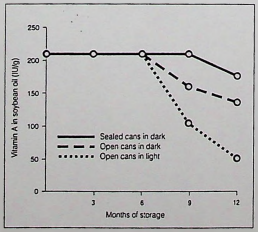
Source: Raunhardt, O. and A. Bowley. Mandatory Food Enrichment. Nutriview. Supplement to 1/1996 issue.

Figure 2
Flow Chart of Fortified Margarine Manufacturing



Source: O'Brien, A. and D. Robertson. n.d. Vitamin Fortification of Foods (Specific Applications). The Technology of Vitamins in Foods. In Micronutrient Fortification of Foods. The Micronutrient Initiative. Ontario. Canada.

Figure 3
Stability of Vitamin A Fortified Soybean Oil During Storage at 23°C Under Different Conditions



Source: Favaro, R., J. Ferreira, I. Desai, and J. Dutra de Oliveira. 1991. Studies on Fortification of Refined Soybean Oil with All-trans Retinyl Palmitate in Brazil: Stability During Cooking and Storage. J. Food Comp. Anal. 4: 237-244.

that for cholecalciferol (vitamin D_3) varies between 480 and 5,300 IU/Kg. A 15 g serving (1 tablespoon) of these margarines would provide between 4 and 51 percent of the recommended daily intake (RDI; FAO/WHO 1988) for vitamin A, and between 2 and 20 percent of the RDI for vitamin D for pre-school children.

As a nutrient, it would be appropriate to fortify oil and margarine with vitamin E at a level of 65 to 190 mg/Kg. The recommended daily intake for vitamin E increases with intake of PUFA. At a ratio of 0.4 mg α- tocopherol to 1 gm PUFA, there is enough vitamin E in normal circumstances to counteract the level of PUFA normally being consumed to prevent oxidation. At a level of 65 to 190 mg/Kg, 1 tablespoon of oil or margarine/day would provide between 15 and 50 percent of the RDI for a child between 1 and 6 years old.

The level of fat soluble vitamins in fortified oils and margarine depends on consumption patterns and nutritional requirements. Clearly, before determining the level of nutrient to add to oils and fats, the use of and consumption patterns for oil by different socio-economic and age groups need to be determined in order to ensure that the maximum safe level of intake for each nutrient is not exceeded.

Technology

The most common commercial vitamin A and D_3 blend used contains 1,000,000 IU vitamin A palmitate (300,000 mg/g) and 100,000 IU vitamin D_3 (2,500 mg/g) in a liquid form, stabilized with vitamin E (α-tocopherol) or a BHA/BHT mixture. The same vitamin A/D blend is also available with vitamin E fortificant (vitamin E acetate) as a custom-made premix.

Fortification of vegetable oil

Oil fortification consists of adding appropriate amounts of vitamin A and D_3 concentrate to clarified, degassed oil at 45-50°C. The solubility of commercially available vitamin A and D_3 blends in vegetable oils is excellent.

To ensure that the vitamins are uniformly distributed, mixing takes place in vertical tanks that contain turbines or propeller agitators. Edible antioxidants (BHA and/or BHT) or natural antioxidants (e.g. α-tocopherol or ascorbyl palmitate) may be added to protect both the vitamin A and the oil; the stability of vitamin A in the oil depends greatly on the stability of the oil itself. Vitamin A oxidizes faster and loses its activity in the presence of oxidized oils.

To maintain vitamin A activity, fortified oil needs to be packaged in light-protected, sealed containers. Replacing the container headspace with inert gas will help retain the stability of both the oil and vitamin A prior to the container being opened, but this is not usually a practical solution and adding an adequate micronutrient overage may be considered as an alternative.

The production and fortification of margarine is carried out in a batch or continuous process. The vitamin A and D_3 blend is premeasured according to the batch size of the margarine tanks and mixed with warm oil, in a ratio of 1:5, until a uniform solution is obtained. This premix is then incorporated into the margarine before the emulsifying process (Figure 2). ß-Carotene is also added to margarine (15 to 20 g/ton of a 30% oily suspension) before the emulsification step to enhance the color as well as to contribute to the vitamin A content of the product. ß-Carotene converts to vitamin A at a mean level of 555 IU/mg; thus, providing an additional 2,498 to 3,330 IU of vitamin A per kilogram, at the above mentioned level.

Stability of Micronutrients

Stability of vitamin A in storage

Studies conducted in Brazil showed that the stability of vitamin A, in fortified soybean oil stored at room temperature (23°C), depends on the presence of oxygen and light (Figure 3). The stability of vitamin A in oil, stored in sealed cans, is excellent after 9 months. However,

if the oil is stored in open containers, where it is exposed to both oxygen and light, the vitamin A becomes unstable after 6 months and just under 50 percent of the initial vitamin A remains after 9 months. Stability studies in India showed almost 100 percent retention of vitamin A in fortified soybean oil after 5 months of storage in sealed cans.

Vitamin A added to margarine is quite stable during the manufacturing process and during storage at home. Table 3 shows that there were minimal losses of vitamin A in margarine after 6 months of storage at 5°C (refrigeration conditions). When the same margarine was stored at 23°C, more than 85 percent of the initial vitamin A was retained after the same period of time.

Stability of vitamin A during cooking

The stability of vitamin A in fortified soybean oil added to plain rice or kidney beans during cooking is good (Table 4). Boiling rice and pressure cooking kidney beans did not destroy the vitamin.

Frying, however, can destroy vitamin A. The amount lost depends on the number of times the same oil is used for frying foods (Figure 4). After the initial frying about 65 percent of the original vitamin A remained, after 4 repeated fryings less than 40 percent of the original levels of vitamin A was retained, and after 12 consecutive fryings most of the vitamin A was lost. Thus, how oil is used at the household level needs to be considered in determining whether oil can be a good vehicle for vitamin A.

Vitamin A losses in margarine occur under extreme conditions. Heating it to 160°C, 180°C, or 200°C for one-half hour results in average vitamin A losses of 20, 35, and 50 percent, respectively. Vitamin A, however, survives the baking process in biscuits, cakes, and breads prepared with vitamin A fortified margarine; between 80 and 100 percent of the added vitamin remains.

Stability of vitamin D_3

The stability of Vitamin D_3 is similar to that of vitamin A; little or no loss is experienced during processing or storage.

Stability of vitamin E

Vitamin E losses occur during prolonged heating, such as frying. Furthermore, the production of hydroperoxides during frying accelerates the degradation of vitamin E.

Acceptability of Fortified Margarine and Oils

Fortifying margarine with vitamins A, D, and E does not alter its flavor, making it an excellent carrier for these micronutrients. Foods made with fortified soybean oil including mayonnaise, fried beans, cooked rice, fried potatoes, soup, wheat tortillas, and fried meat showed excellent acceptability among consumers, who were not able to distinguish between products prepared with either vitamin A fortified or unfortified oil.

Studies in humans have shown that the bioavailability of vitamin A in cooked foods, made with fortified soybean oil, is good (Figure 5).

Quality Control

Determination of vitamins A, D, and E in oil and margarine is done by HPLC. This method is based on the separation of the specific vitamins from other substances that absorb radiant energy at an equal or similar wavelength to the specific vitamin. It is accurate, but the equipment is expensive and highly trained personnel are required.

Measuring the amount of micronutrients to add, and the process of their addition to oil or margarine, requires careful attention to ensure that the final fortified product is both homogeneous and standardized.

Table 3
Retention of Vitamin A in Commercial Margarine

Brand	Initial Level (IU)	After 6 Month Storage at 5°C	After 6 Month Storage at 23°C
A	13,900	14,700	13,600
B	14,200	13,400	12,700
C	13,500	12,400	11,500
D	12,300	12,100	12,300
E	12,400	12,100	10,900

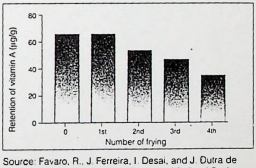
Source: Bauernfeind, J.C. 1978. The Technology of Vitamin A. Hoffmann-La Roche. Basel, Switzerland.

Table 4
Stability of Vitamin A in Soybean Oil During Cooking

Food	Type of cooking	Amount of Vitamin A (µg/g)		Recovery (%)
		Before cooking	After cooking	
White rice	Boiled	330	330	100
Kidney beans	Boiled	180	150	83
Kidney beans	Pressure cooked	120	120	100

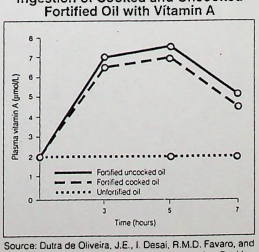
Source: Favaro, R., J. Ferreira, I. Desai, and J. Dutra de Oliveira. 1991. Studies on Fortification of Refined Soybean Oil with All-trans Retinyl Palmitate in Brazil: Stability During Cooking and Storage. J. Food Comp. Anal. 4: 237-244.

Figure 4
Stability of Vitamin A in Fortified Soybean Oil After Repeated Fryings of Potatoes at 117-170°C.



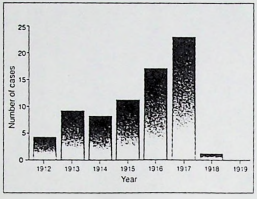
Source: Favaro, R., J. Ferreira, I. Desai, and J. Dutra de Oliveira. 1991. Studies on Fortification of Refined Soybean Oil with All-trans Retinyl Palmitate in Brazil: Stability During Cooking and Storage. J. Food Comp. Anal. 4: 237-244.

Figure 5
Serum Retinol levels in Humans After Ingestion of Cooked and Uncooked Fortified Oil with Vitamin A



Source: Dutra de Oliveira, J.E., I. Desai, R.M.D. Favaro, and J.F. Ferreira. 1994. Effect of Heat Treatment During Cooking on the Biological Value of Vitamin A Fortified Soybean Oil in Human. Int. J. Food Sci. Nutr. 45: 203-207.

Figure 6
Distribution According to Year of Appearance of Xerophthalmia in 72 Patients Admitted to the Rigshospital, Copenhagen from 1912 to 1919



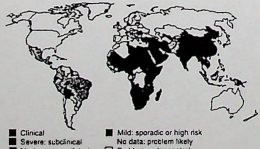
Source: Bloch, C. E. 1931. Effects of Deficiency in Vitamins in Infancy. Am. J. Diseases of Children. 42: 271.

Table 5
Vitamin A Deficiency in Newfoundland in 1944 and 1948

	1944	1948
Number of subjects	312	342
Percent of subjects with		
serum vitamin A < 20 µg/dl	48	2
serum vitamin A < 30 µg/dl	74	18
Mean serum vitamin A (µg/dl)	22	41

Source: Aykroyd, W.R. et al. 1949. Medical Resurvey of Nutrition in Newfoundland 1948. Murray Printing Company. 11-12.

Countries Categorized by Degree of Public Health Importance of Vitamin A Deficiency



Source: WHO XVII IVACG Meeting. Guatemala, 1996.

Costs

The cost of fortification includes capital costs, such as blending equipment (tanks, propellers, or agitators), and recurrent costs including those for the premix, personnel, and monitoring and evaluation.

If margarine is fortified to provide 30,000 IU of vitamin A/Kg, the cost of the fortificant would be in the order of US$ 0.0020/Kg when a vitamin A/D_3 blend is used. The cost of vitamin A alone is around US$ 0.0017/Kg of product. These estimates do not take in account the cost of new equipment and training of staff, which are one-time costs and are likely to be small, as well as the cost of quality control.

Legislation

To ensure that a fortification program is successful, an interdisciplinary task force with experts from the different, appropriate sectors should be set up. The sectors include the vegetable oil industry and trade organizations, nutrition institutes, universities, the Ministry of Health, regulatory institutions, consumer associations, and donors.

A fortification plan should specify the type of micronutrients and levels to be added based on the consumption patterns of oil by different socioeconomic and age groups. It must also define precautions and food safety conditions to be observed during production, transportation, storage, and sale of the products.

History and Successful Interventions

The prevalence of xerophthalmia in Denmark declined drastically in 1918 and disappeared in 1919 (Figure 6) following the introduction of butter rationing (which made butter available at a low price and diminished consumption of non-enriched margarine) at the end of 1917. Xerophthalmia reappeared in 1920 when butter rationing was discontinued; thus, eliminating access to an important source of natural vitamin A. Such observations on the curative effects of milk fat, but not of margarine, eventually led to the enrichment of margarine with vitamin A.

A successful intervention with vitamin A fortified margarine (45 IU vitamin A/g margarine) initiated in Newfoundland in 1944-45, led to a marked improvement in the vitamin A status, as shown by biochemical measurements made in a sample of the population (Table 5).

Thirty years ago, Pakistan agreed to fortify processed oil products with vitamin A at a level of 33,000 IU/kg. Enforcement and monitoring has been weak as reflected in the levels of vitamin A in vegetable ghee, which were on average 15,000 IU/kg. With an average vegetable ghee consumption of 30 g/person/day, the ghee would provide about 30, 24, and 15 percent of the RDI for infants, children, and pregnant women, respectively.

In the Philippines, a collaborative effort between the public and private sectors resulted in the "Star" brand margarine being fortified with vitamin A. "Star" margarine is fortified at a level of 25 µg RE/g (83 IU), and provides 95 percent of the RDI for children 1 to 10 years old when 15 grams/day (1 tablespoon) is consumed. Other countries fortifying margarine with vitamins A and D are presented in Table 2.

Sweden fortifies canola oil used in food aid programs with 15 mg vitamin A/g oil. Canada has adopted an even higher level of 22.5 mg vitamin A/g canola oil used in food aid programs.

Fortification Basics

Principles of Assay Procedures

NUT-7

Micronutrients added to foods are analyzed using various procedures depending on their nature and properties. Some micronutrients can be detected using relatively simple colorimetric methods. Where resources are available, more sophisticated methods such as high pressure liquid chromatography (HPLC) (Fig. 1), which separates the compound of interest in a pre-treated food sample, followed by spectrophotometric or fluorometric detection can also be used.

Before starting a program for micronutrient analyses, some essential elements need to be put in place:

- A quality assurance system must be set up to ensure that the manufactured food is safe, unadulterated, properly labeled, and meets all the company's specifications and government regulations (Table 1).
- Food samples must be representative and selected at random, with an adequate and reproducible sampling procedure.
- Personnel must be trained in the assay method(s), that should have been previously identified or set-up.
- Equipment required must be available on-site in working condition.

Vitamin A assays

Vitamin A is one of the most unstable micronutrients. Industrially produced vitamin A, like retinyl palmitate, is more stable than naturally occurring vitamin A, although it remains sensitive to air, light, moisture, heat, and acid conditions.

Vitamin A levels have been determined using colorimetric and spectrophotometric methods for a long time. Currently, HPLC is the method of choice (Table 2). The use of HPLC is preferred when samples have a significant amount of interfering substances such as other vitamins, minerals, proteins, and carbohydrates.

Semi-quantitative method

Colorimetric method

The colorimetric method involves adding a chromogenic reagent to a volume of solubilized fortified food sample. The reagent reacts with retinol to produce a blue color, whose intensity is proportional to the amount of retinol in the sample. The intensity of the blue color is measured against a set of known standards (Fig. 2). The formed blue color is very unstable and necessitates a fast and skillful worker. Because this assay method is inexpensive, and does not need sophisticated equipment, it is used in many countries.

Quantitative method

Spectrophotometric method

The sample is irradiated with UV light and its absorbance is measured. The absorbance is proportional to the vitamin A content in the sample. The spectrophotometric method can be used to monitor vitamin A levels in fortified products at the production level.

Figure 1
HPLC Equipment

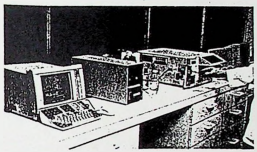


Table 1
Developing a Quality Assurance System

An effective quality assurance system includes:
• *Ingredient inspection and control* - testing all ingredients against reference standards.
• *Manufacturing control* - identifying quality criteria and chemical, microbiological, and physical hazards; establishing and monitoring the critical control points involved in manufacturing fortified food.
• *Distribution control* - ensuring that the fortified food is unadulterated, properly labeled, and packaged to minimize micronutrient losses.

Table 2
Vitamin A Assays and their Advantages and Limitations

Assay	Advantages	Limitations
Colorimetric	Simple Rapid Inexpensive	Semi - quantitative Sample pretreatment Not applicable for field
Spectro-photometric	Sensitive Rapid Inexpensive	Needs UV apparatus Sample pretreatment Not applicable for field
HPLC	Reliable High resolution No interferences Accurate	Expensive Training of personnel Sample pretreatment Not applicable for field

Table 5
List of Suppliers for Laboratory Equipment, Chemicals, and Fortificants

Aldrich P.O. Box 355 Milwaukee, WI 53201-9358	Tel:(414) 273 3852 Fax:(414) 273 4979	Chemicals, Glassware, Lab. equipment
BASF 6700 Ludwigfhafen- Rhein Ludwigfhafen, Germany	Tel:(049) 621 600 Fax:(049) 622 525	Fortificants, Premixes
Beckman Instruments, Inc. 2500 Harbor Blvd Fullerton, CA 92634	Tel:(714) 871 4848 Fax:(714) 521 3700	Spectrophotometer, Chromatography equipment
Fisher Scientific 711 Forbes Ave. Pittsburgh, PA 15219-4785	Tel:(412) 490 8300 Fax:(201) 379 7638	Chemicals Glassware
F. Hoffmann- La Roche Ltd. CH-4002, Basel Switzerland	Tel:(061) 688 1111 Fax:(061) 691 9600	Fortificants, Premixes
Millipore Intertech P.O. Box 10 Marlborough, MA 01752	Tel:(508) 624 8400 Fax:(508) 624 8630	Centrifuge, Filtration devices
NIST[a] Bldg. 202, Room 204 Gaithersburg, MD 20899	Tel:(301) 975 6776 Fax:(301) 948 3730	Standards, Reference materials
Perkin Elmer 761 Main Ave. Norwalk, CT 06859- 0012	Tel:(203) 762 1000 Fax:(203) 762 6000	AAS instrument, Chromatography equipment
Sarstedt P.O. Box 468 Newton, NC 28658- 0468	Tel:(704) 465 4000 Fax:(704) 465 4003	Biological assays
Sigma Chemical Co. P.O. Box 14508 St. Louis, MO 63178-9916	Tel:(314) 771 5750 Fax:(314) 771 5757	Chemicals, Test kits
VARIAN[b] 220 Humboldt Court Sunnyvale, CA 94089	Tel:(408) 734 5370 Fax:(408) 744 0261	Spectrophotometer, Chromatography equipment
UNICEF Supply Division UNICEF Plads, Free port DK-2100, Copenhagen Denmark	Tel:(45) 3 527 3527 Fax:(45) 3 526 9421	Iodine spot test kits

[a] National Institute of Standards and Technology
[b] Parts and supplies center
Modification of the original table by Dary, O., G. Arroyave, H. Flores, F.A.C.S. Campos, M.H.C.B. Lins. 1996. Sugar Fortification with Vitamin A. Part 3. Analytical methods for the control and evaluation of sugar fortification of vitamin A. USAID/INCAP.

personnel to optimize operating parameters. AAS can also be used to simultaneously determine the content of other minerals, including, calcium, copper, magnesium, manganese, and zinc.

The advantages and limitations of iron assays are shown in Table 3.

Iodine assays

Qualitative method
Spot tests

Spot tests can be used in qualitative determinations of iodine in salt. Qualitative iodine tests indicate only the presence or absence, not the amount, of iodine in salt (Fig. 5). Spot tests are specific to the form of iodine in salt. In the case of samples fortified with *iodide*, salt iodide is oxidized with an acidic solution to liberate free iodine which then turns starch blue. Salt fortified with *iodate* is analyzed with iodate spot tests where iodate in salt oxidizes an iodide reagent in the presence of hydrogen ions to form free iodine which turns starch blue.

Quantitative methods
Titration method

Like spot tests, titration procedures also are specific to the form of iodine in salt. In samples fortified with *iodate*, addition of an acidic solution liberates free iodine from salt iodate. Free iodine is then titrated with thiosulfate and the amount of thiosulfate used is proportional to the amount of iodine in salt. In salt fortified with *iodide*, bromine oxidizes iodide ions to free iodine, which is titrated with thiosulfate solution. It is a fairly simple and rapid technique compared with the liquid chromatography method. However, it requires personnel with good laboratory skills.

Liquid chromatographic method

Iodine can be quantitatively determined using liquid chromatography (LC). The sample is pretreated by passing it through a membrane filter to remove protein and other insoluble materials. Iodide in the filtrate is separated by ion pair liquid chromatography and detected electrochemically at 0 to 50 mV. It is a quick and sensitive method ideal for analyzing a large number of samples. However, it is an expensive method and requires skilled personnel to perform the analyses.

The advantages and limitations of iodine assays are presented in Table 4.

References

For details on any of the methods above, please refer to:
1. AACC. 1994. Approved methods of the American Association of Cereal Chemists. Eighth edition. American Association of Cereal Chemists, Inc. Minnesota, USA.
2. AOAC. 1993. Methods of analysis for nutrition labeling. Edited by D.M. Sullivan and D.E. Carpenter. Association of Official Analytical Chemists International, Arlington, Virginia, USA.
3. Dustin, J.P. and Ecoffey, J.P. 1978. A field test for detecting iodine-enriched salt. Bulletin of the World Health Organization. 56(4):657-658.

Anthropometric Assessment (Cont.)

Use Harpenden calipers. If other types of caliper are used the standards for these calipers must be used as calipers with different pressures and area of cross section at jaws give different results.

The standard measurements are:

1. Biceps: over the mid-point of the muscle belly with the arm resting supinated on the subject's thigh.

2. Triceps: over the mid-point of the muscle belly, mid-way between the olecranon and the tip of the acromion, with the upper arm hanging vertically (Edwards, Hammond, Healy, Tanner and Whitehouse, 1955 , Brit.J.Nutr. volume 9, p.133, 1955.)

3. Subscapular: just below the tip of the inferior angle of the scapula, at an angle of about 45° to the vertical.

4. Suprailiac: just above the iliac crest in the mid-axillary line.

At these four sites, the skinfold is pinched up firmly between the thumb and forefinger and pulled away slightly from the underlying tissues before applying the calipers for the measurement.

If only a single measurement is taken, the triceps skinfold is the most useful. If several measurements are made an estimate of total body fat can be made from the total of four skinfolds (Durnin and Rahaman. Br.J.Nutr. 1967, vol.21, p.681).

The differences in fat percentages become progressively smaller for each 5 cm. difference in skinfold as the skinfolds increase in size.

Percentages of fat corresponding to the total value of skinfolds at four sites (biceps, triceps, subscapular and suprailiac)

Total skinfold (mm)	Fat (% body weight) Men	Women	Boys	Girls
15	5.5	-	9.0	12.5
20	9.0	15.5	12.5	16.0
25	11.5	18.5	15.5	19.0
30	13.5	21.0	17.5	21.5
35	15.5	23.0	19.5	23.5
40	17.0	24.5	21.5	25.0
45	18.5	26.0	23.0	27.0
50	20.0	27.5	24.0	28.5
55	21.0	29.0	25.5	29.5
60	22.0	30.0	26.5	30.5
65	23.0	31.0	27.5	32.0
70	24.0	32.5	28.5	33.0
75	25.0	33.5	29.5	34.0
80	26.0	34.0	-	-
85	26.5	35.0	-	-
90	27.5	36.0	-	-
95	28.0	36.5	-	-

(Rounding off in the percentages of fat accounts for the differences between adjoining values not being uniform)

The following measurements of triceps skinfold thickness are those which can be considered as including the range of "normal" values for French-Canadian schoolchildren measured in 1970.

	Lower limit 3rd percentile		Upper limit 97th percentile	
	Boys	Girls	Boys	Girls
6	5.6	6.4	12.6	15.0
7	5.5	6.1	11.9	16.0
8	5.4	6.3	12.9	17.5
9	5.3	6.5	14.5	19.5
10	5.3	6.7	16.4	21.0
11	5.4	6.8	18.0	21.5
12	5.5	6.9	19.0	22.0
13	5.6	7.0	19.8	22.3
14	5.5	7.3	19.8	22.8
15	5.3	7.9	19.0	23.3
16	5.1	8.5	18.0	23.8

Read from grapsh of Jenicek and Demirjan, Amer. J. Clin. Nutr. 1972, 25, 576.

Robson et al (Amer. J. Clin. Nutr. 1971, 24, 864) have found that Black children in Dominica have much thinner triceps skinfolds than London White schoolchildren although the subscapular measurements of the two groups are the same. A racial difference in triceps skinfolds has therefore been suggested and would certainly explain the very high proportion of West Indian Black children with thin triceps values. However, American Black and White children show no differences in their response in triceps or subscapular skinfolds to changes in weight, and this suggests that the differences in West Indian children's subcutaneous layer of fat may be determined by environmental rather than ethnic factors.

Differences in other skinfolds have been found e.g. subscapular skin thickness is different in French-Canadian and London children but the triceps measurements are approximately equal.

Changes in skinfold thickness have been observed over the years e.g. secular changes in triceps measurements have been very marked in Canadian children with an increase from 6 to 10mm average in boys' values in the last 17 years. Nutritional factors rather than genetic control therefore may be more important.

Most London and Canadian children are weaned early onto diets containing very high quantities of protein and energy. This will produce faster growth rates with an increased likelihood of childhood obesity. Many young obese adults were obese in childhood and have an excessive number of fat cells in their bodies. This excess, which is probably determined in the first six to 24 months of life, "programmes" the body for life-long obesity and perhaps an earlier death. Present values for skinfold measurements although "normal" may not be "ideal", and we cannot be certain of the significance of thin triceps skinfold measurements in community surveys. Sequential changes in an individual's measurements will be significant, however, and the finding of a low percentage of body weight as fat means that a subject's energy reserves are limited.

W.P.T. James

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45	18.5	26.0	23.0	27.0
50	20.0	27.5	24.0	28.5
55	21.0	29.0	25.5	29.5
60	22.0	30.0	26.5	30.5
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NUT-7
18-22

Assessment of Protein-energy Malnutrition (PEM)

a) Biochemical tests

Changes in the body's composition in malnutrition are most readily assessed in general terms by anthropometric techniques which measure the mass of tissue in the body or arm etc. Many biochemical tests are indirect measures of the processes which are in progress during the course of developing malnutrition. Biochemical tests may therefore be more sensitive to recent dietary experience and may revert rapidly towards normal when a malnourished child has only just started to recover.

Tests can be categorised into measurements on i) blood and ii) urine. Blood tests are not always acceptable in population studies but provide the opportunity for other useful tests eg. Hb.

Blood tests

1. Circulating proteins of liver origin
   a) Albumin: insensitive but important when low
   b) Transferrin: studied only in severe PEM
   c) Lipoproteins: no more sensitive than albumin
   d) Thyroxine binding pre-albumin: preliminary studies only
   e) Pseudocholinesterase and other liver enzymes: insensitive

Liver-produced proteins are particularly sensitive to a fall in the dietary protein intake but the concentration in the blood depends not just on the rate of synthesis but also on the breakdown rate of each protein. The breakdown rate of albumin adjusts as the synthesis rate falls thus minimising the effect of the reduced intake of protein. Transferrin does not show this phenomenon - nor probably does T.B.P.A. but little work on this protein so far. Both proteins may prove more sensitive than albumin which is often near normal in marasmus. Transferrin and T.B.P.A. show greater falls than albumin in kwashiorkor but their levels have not been reported in marasmus. Both tests are time consuming and expensive. Lipoproteins behave rather like albumin: although both are rather insensitive any fall is important. At albumin levels below 3.0 gm/100 ml a whole range of other disorders of hormonal and amino acid concentration are evident and reflect impaired hepatic function.

Albumin is the simplest and most useful blood test for PEM but is still of no value in demonstrating the extent of growth failure or wasting in marasmic children.

2. Indices of recent absorption: urea, cholesterol.

3. Amino acid levels a) valine reduced particularly in kwashiorkor

   b) alanine low in starvation states eg. marasmus but too variable. Tends to rise in protein deficiency.

   Non-essential amino acids

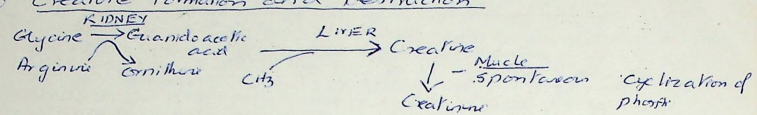
   c) Ratio essential amino acids . Low in kwashiorkor, normal in marasmus. Likely to change within 2-3 days of altering the diet.

only in certain communities in East Africa

(1) Body Composition in Marasmic Child.

i) Fat - markedly reduced 5% of original
ii) Muscle = 30% iii) Heart 60%. Bones 80%. Brain 90%
iv) Body - 50%.

(2) Creatine Formation and Destruction



Creatinine excretion and muscle mass

1. 70 Kg adult excretes about 1·2g of creatinine daily
2. 1 Kg muscle contains 3gm creatine.
3. 2% Creatine spontaneously changes to creatinine daily. Therefore 1 Kgm muscle "produces" 52 mgm creatinine daily
4. Muscle Mass = 24 Hr Creatinine Excretion Kg.
52

Problem of measurement

1. variability 2. Nutritional state.

Recent

(3) Hydroxyproline excretion & collagen breakdown rate and & growth rate.

- Creatine excretion & muscle mass
- H.P. Index.

Normal value 2-5

- not a very satisfactory measurement

(4) Nitrogen output in Urine

Urinary tests

1. Creatinine excretion. Creatinine is spontaneously formed by the cyclization of creatine phosphate (C.P.) present as a high-energy compound in muscle. Creatinine is excreted unchanged in the urine, the rate reflecting the mass of C.P. in the body. Since the concentration of C.P. is constant in muscle, its exclusive site, the excretion rate of creatinine reflects muscle mass. Creatinine excretion is, however, somewhat variable, and in field studies accurate urine collections for long times are impracticable. Three hour collections have been tried - coefficient of variation 25%; 24 hour collections - 10% coefficient. Most meaningful method is to express the creatinine in terms of the child's height in cm. since this will indicate the amount of muscle that a child has for his size. Muscle mass in Kg = creatinine excretion in mgm. ÷ 50. Creatinine is theoretically one of the best indices of malnutrition since it does reflect the extent of muscle atrophy - a key feature of the whole spectrum of PEM from kwashiorkor to marasmus. Creatinine excretion is increased for a short time during stress eg. trauma or infection.

2. Urinary tests indicating recent dietary intake.

   a) Total Urinary N

   b) $\frac{\text{Urea N}}{\text{N}}$ % falls on a low protein diet

   c) $\frac{\text{Urea N mg}}{\text{mg creatinine}}$ suitable for single urine but limited usefulness.

   d) Urinary SO_4/creatinine: ? reflects intake of S-amino acids. Limited usefulness.

3. a) Urinary Hydroxyproline 24 hr excretion: reflects the rate of growth and related to the turnover of collagen. Increased excretion in infection; not easy to measure.

   b) Hydroxyproline index $\frac{(\text{OHPs x body wt})}{\text{creatinine}}$

   Disadvantage of two variables each of which may affect index. Useful for single urine. Index age dependent and thought to reflect growth.

4. Methylhistidine excretion.

Significance of biochemical values

	Deficit	At risk	Acceptable
Serum albumin	< 2.8	2.8 - 3.5	> 3.5
Amino acid ratio	> 3.0	2.0 - 3.0	< 2.0
Other index	< 2	-	> 2
Urea N/creatinine	< 10		> 10

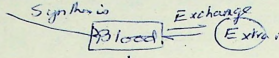
Serum albumin is the most commonly used biochemical index but it reflects the extent of liver synthesis which appears well maintained in starvation states and the index although simpler is less sensitive than the T.B.P.A. and transferrin blood concentrations. Urinary creatinine is the biochemical test of choice for showing the extent of the nutritional deficit but it is impracticable to obtain an accurate estimate of muscle mass by this technique.

W.P.T. James,
February, 1973

Blood Tests

Amino acid contents.

Albumin metabolism



Comparison of Anthropometric and Biochemical indices of nutrition in children of 3 communities (1969)

1. Index	A	B	C
2. Weight (Kg)	11·3	11·6	11·9
3. Height (cm)	82·5	91·3	86·9
4. Triceps skin fold. mm	8·3	6·9	9·6
5. Plasma Albumin gm/100ml	5·7	6·3	3·3
6. Amino acid ratio	3·2	2·3	2·6
	2·1	1·6	1·9

Children aged 2·3 yrs

Rutishauser and Whitehead (1969)

5. Hydroxy proline area

NUT-57.

visit the centre only during the meal timings. But provision of nutrition too has been an objective of the programme. Infant Mortality Rate (IMR) has declined from 110 in 1981 to 58 per thousand live birth in 2004. Similarly, under-5 mortality has declined from 161 in 1983 to 87 in 2003. Various surveys have revealed that there has been significant impact of the scheme. Many non-monetary benefits like insurance, incentives, preference in other jobs (teachers) have been given to the AWW and AWH. There is certainly a scope of enhancing the honorarium offered to these grass root workers.

Summary

After independence the government of India took many initiatives to ensure food security for the country. National nutritional programmes were a firm step in that direction. Ministry of Social Welfare runs the ICDS programme. Balwadi nutrition programme and special nutrition programme. Ministry of Health and Family Welfare runs the programmes for prophylaxis against nutritional anaemia, vitamin A prophylaxis programme and the iodine deficiency disorders control programme. The mid day meal programme is run by the Ministry of Education. The programmes have achieved improvement in the nutritional status of the children, pregnant and lactating women. More specifically the ICDS programme that has a strong nutritional component can be termed as a successful programme.

Study Exercises

Long Question : What are the objectives of the ICDS scheme? Discuss the benefits offered to various vulnerable groups under the scheme.

Short Notes : (1) Mid day meal programme (2) Anganwadi worker (3) Iodized salt (4) Services under National Nutritional Anaemia Prophylaxis Programme (5) Supplementary Nutrition under ICDS.

MCQs

1. Mid day meal programme offers (a) Half of daily protein and one third of calorie requirement (b) Half of daily protein and half of calorie requirement (c) One third daily protein and half of calorie requirement (d) One third of daily protein and one third of calorie requirement.
2. To a child under 3 years of age, ICDS provides : (a) 300 Kcal energy and 8-10 g protein (b) 500 Kcal energy and 16-20 g protein (c) 500 Kcal energy and 8-10 g protein (d) 500 Kcal energy and 16-20 g protein.
3. In rural areas, the administrative unit for the location of ICDS Project is (a) Gram Panchayat (b) Community Development Blocks (c) District head quarter (d) Primary Health Centre.
4. Which of the following is not run by the Ministry of Health and Family Welfare (a) Prophylaxis against nutritional anaemia (b) Vitamin A prophylaxis programme (c) Iodine Deficiency Disorders Control programme (d) ICDS Programme.
5. Which of these is not carried out at the Anganwadi centre (a) Supplementary nutrition (b) Non-formal pre-school education (c) Immunization (d) Nutrition and Health Education.

Answers : (1) a; (2) a; (3) a; (4) b; (5) c.

136 Nutritional Assessment and Surveillance of a Community

Rajul K Gupta

Assessment of Nutritional Status of Individuals and Communities

Aims of Assessment of Nutritional Status

The assessment of nutritional status is carried out with the following aims :

- To map out distribution and geography of nutritional disorders
- To identify high risk groups with respect to nutritional vulnerability
- To assess various epidemiological factors for nutritional deficiencies
- Make recommendations to rectify shortcomings leading to nutritional deficiencies
- To project for financial allocations and budget for food materials at a large administrative level e.g. at the national level.

Various methods are available for the assessment of nutritional status. These are enumerated in Box - 1. These can be further sub-classified into direct and indirect methods of nutritional status assessment.

Box - 1 : ABCD... of Nutritional Status Assessment
Anthropometry
Biochemical & lab methods
Clinical assessment
Diet survey
Ecological studies
Functional assessment
G - - Vital statistics

Direct Assessment of Nutritional Status

The term 'direct assessment' refers to methods in which individuals or communities are investigated directly. The various methods that are available for the direct assessment are summarized in Box - 2.

Box - 2 : Direct Assessment of Nutritional Status
Clinical signs
Laboratory Tests • Biochemical • Haematological • Parasitological
Biophysical Methods
Anthropometry

Assessment of Nutritional Status using Clinical Signs : Clinical examination is a widely practiced direct method to assess the nutritional status of individuals and communities. Assessment of clinical signs is based on the examination for changes believed to be related to inadequate or excessive nutritional intake, that can be observed in superficial tissues (skin, eyes, hair, mouth) or in organs close to the surface (thyroid, skull).

Caution with Clinical Examination : The cheapness and the relatively easy organization of clinical examination for nutritional assessment, might sometimes lead to the assumption that the method is simple, can be quickly mastered by a beginner, and yield results that are quick to interpret. But this is not the case. This method has got its own limitations, advantages and disadvantages. Expertise is required to select it as a valid method in a given situation, to conduct it and to interpret the results obtained.

Classification of Clinical Signs : Based on their importance with regard to suggesting a nutritional etiology the clinical signs can be classified into three groups (1) :

Group 1 - Potentially Nutritionally Significant (Signs 'strongly suggestive' of dietary deficiency or excess) : Some signs are strongly suggestive of a particular nutritional deficiency or excess e.g. Bitot's spots (Vitamin A), Flag sign (PEM). A list of these is summarized in Table - 1.

Group 2 - Signs that are of probable nutritional significance : There are some signs that are of uncertain nutritional significance. These have to be appreciated and interpreted in correlation with the case. e.g. Xanthomata eye might indicate high blood cholesterol, Corneal scar (previous infection, trauma, malnutrition, avitaminosis A), Fissure tongue, recession of gums, transverse ridging of nails, etc.

Group 3 - Signs that have no nutritional significance : These signs are not nutritionally significant but required to be differentiated from other nutritionally relevant signs. e.g. pterygium (an insignificant sign) is to be differentiated from Bitot's spots, geographic tongue, pyorrhea.

Assessment of Nutritional Status using Biochemical and Laboratory Methods : We have seen previously that clinical signs are often non specific and develop rather late in the disease process. Biochemical changes, on the other hand can be expected to take place prior to clinical manifestations. Hence tests that can be conducted on easily accessible body fluids (blood and urine), can help to detect disease at a sub-clinical level even in a community setting.

Table - 1 : Signs 'strongly suggestive' of dietary deficiency or excess

Deficiency Sign	Suggested nutrient abnormality
Pale conjunctiva	Iron
Bitot's spots	Vitamin A
Angular stomatitis	Riboflavin
Spongy, bleeding gums	Vitamin C
Bilateral edema (young children)	PEM
Thyroid enlargement	Iodine
Bilateral epiphyseal enlargement of wrists	Vitamin D
Sign of Excess	*Suggested nutrient abnormality*
Mottled enamel	Fluoride
Dental caries	Sugar

Available laboratory tests : Three groups of laboratory tests are available, namely, haematological tests, parasitological tests and biochemical tests. The haematological tests include the commonly done hemoglobin estimation, parasitological tests would include stool examination for intestinal parasites and biochemical tests include many tests like the urine examination for albumin, sugar, etc. Advanced biochemical test are taken up for vitamin, minerals and enzyme estimations as well, that indicate nutritional status. Normal range of some of these tests is given in Table - 2.

Assessment of Nutritional Status through Anthropometry : Nutritional anthropometry is the measurement of human body at various ages and levels of nutritional status. It is based on the principle that appropriate measurements should reflect any morphological variation occurring due to a significant functional physiological change. For example, a low Fat Fold Thickness reflects a shift in energy balance. The advantages of anthropometry are that it is simple, quick to do, easy to reproduce and objective. In some cases it identifies even subclinical changes resulting from nutritional variations.

Common Methods of Anthropometry : The common anthropometric methods should be quick, simple and easy to reproduce. Minimum training should be required to conduct the measurement. The commonly used methods are : Height; Crown-heel length and standing height; body weight, mid upper arm circumference; and fat fold thickness. Head and chest circumference are measured for children under five years of age.

Body Weight : Body weight is the commonest and simplest anthropometric measure used for the evaluation of nutritional status. It is a reflection of total body mass comprising of all

body constituents. It is measured for both children and adults. Definite body weight standards are available to us. Body weight is an indicator of 'current' nutritional status of the individual, as weight fluctuates with nutrition. Unlike height which is irreversible, it reflects the nutrition state of the present day. It is therefore a useful indicator for acute disorders. Small illnesses like childhood diarrhoea is also good enough to alter the weight, it is thus a sensitive indicator.

Measurement of Weight : The ideal weighing instrument is the lever actuated balance or a beam balance. The balance must have a least count of not more than 100g. Balances using a 'spring' are not advisable as the spring loses its tension due to prolonged use and an error is inevitable. Commonly used bathroom scales are based on the 'spring' principle, thus they must be best avoided for scientific work. The balance which is in use must be calibrated frequently for best results. The precautions to be taken while measuring weight are given in the Box - 3.

Height : Height is an indicator of the linear growth of the individual. It is widely accepted that height is determined genetically. Environmental factors, most importantly nutrition and morbidity determine the extent to which the genetic potential will be harnessed, to achieve the maximum possible height. Growth retardation resulting from any environmental factors like infections, malnutrition, etc. result in a retarded height, resulting in stunting (or short stature). Height is affected by long standing nutritional deprivation. A short or retarded height is thus indicative of chronic food insufficiency over a longer duration, unlike a reduced weight which indicates a short term nutritional deprivation or infection.

Box - 3 : Precautions while measuring weight
Use the right balance. Avoid bathroom scales.
Weight must be taken in minimum clothing.
Remove shoes before weight is recorded
The zero-error must be checked and corrected before using a machine.
It is advisable to record weight in the morning (in basal conditions)
These precautions must be applicable in a standardized manner for all subjects (within a study group)

Measurement of Height : In young children, height is referred to as length or Crown-heel length in young children who cannot stand with ease (say up to 2 years of age). An infantometer is use to measure their recumbent 'length' (in lying position). In adults and older children, the height is measured using a vertical measuring rod, the Anthropometric rod.

The subject should remove his shoes and stand erect. He must keep his heels together and toes apart. He must look straight.

Table - 2 : Normal range of some biochemical tests (2)

Nutrient	Test	Normal (Acceptable)	Low (Medium risk)	Deficient (high risk)
Albumin (g/100ml) for age 6-17 yrs	Serum levels	>3.5	2.8-3.4	<2.8
Vitamin A μg/dl)	Serum levels	>30	20-30	<20
Vitamin D (ng/ml)	Serum levels of 25-Hydroxy cholecalciferol	>10	05-10	<5
Vitamin E	Ratio of serum vitamin/total lipids	>0.8		
Vitamin K	*PIVKAS accumulation			If PIVKAS accumulates
	Prothrombin time			Delayed **
Thiamin	Urinary thiamin	100μg/24 hrs or 65μg/g creatinine		
Riboflavin	Urinary Riboflavin	80μg/g creatinine		
Niacin	2-Pyridone to NI-methyl nicotinamide ratio	1 to 4		<1
Vitamin B_6	Vitamin B_6 urinary excretion			<20μg/g creatinine
	Pyridoxic acid excretion			<0.5mg/day
Folic Acid	Serum folate (ng/ml)	>6.0	3.0-5.9	<3
	RBC Folate (ng/ml)	>160	140-159	<140
Vitamin B_{12}	Serum B_{12} (pg/ml)			<80
Ascorbic acid	Plasma (mg/dl)	>15	08/15/09	<8

* PIVKAS: Protein Induced by Vitamin K Absence. ** Prothrombin time is a functional test

given level are taken into account in this method. Effectively the difference between receipt (of food various sources) and expenditure over a given period of time gives the food consumed by population. The consumption per capita/day is worked out as :

$$\frac{\text{Food consumed by population}}{\text{Mid yr pop x 365}}$$

These figures are used for various types of planning and budgeting, namely plans for agriculture, fertilizers, productions, imports and Public Distribution System (PDS). The method has got certain demerits. It is a gross method. Secondly the consumption of rich and poor is equated and averaged out when this method is used. It gives the consumption pattern but doesn't include purchasing power of the individual.

Inventory Method : As mentioned earlier the inventory method is carried out at an institutional level, on a homogenous group as present in a hostel, jail, mess, army barrack, orphanage etc. It is essentially done from books. Amounts of various food stuffs available as per records are taken into consideration. The balance of various food items is again checked after a reference point of say 7 days (one week).

$$\text{Individual consumption / day} = \frac{\text{Stocks at beginning of week + Stocks at end of week}}{\text{No. of individuals x No. of days}}$$

The Merits are that it is fast, much easier, less cumbersome and faster than the weighment methods. It is also fairly accurate. It may not indicate an accurate individual food consumption but is fairly satisfactory for the purposes of planning.

The Demerits are that it doesn't account for wastage. Secondly, it gives only the mean individual consumption but actual individual consumption is not reflected. Thirdly, the estimates are as good as the food records made available. Lastly, the results will be affected if the subjects are eating some food stuff obtained from any source other than the common kitchen under question.

Weighment Method : In this method the foods are actually weighed using a grocer's balance. Both raw and cooked food are weighed. In community surveys (at a family level), the raw food is weighed rather than the cooked food, since weighing cooked food is not acceptable to the families. In an institution however, the cooked food can also be weighed, since cooking is carried out at a central kitchen. While using weighment method at a family level the following points are important :

1. Convince the housewife of the need of the survey for the benefit of the family.
2. Avoid holidays/fares/festivals/feasts as the dietary practice of these days does not reflect the actual dietary practices.
3. It should be carried out for 3 to 7 days consecutively.
4. At least two visits a day for lunch and dinner have to be made.
5. Two investigators should be available - one talks and weighs and the other records observations.
6. Any pets, breast fed children, guests etc. should be considered.

The method : Weigh the raw food before cooking. It is preferable to weigh the food again after cooking. A conversion factor is arrived at. For example let's assume that the weight of raw rice is 100 g. The weight of cooked rice becomes 400g. Thus a conversion factor of 100/400 or ¼ is arrived at. In other words 1 g cooked rice represents 1/4 g of raw rice. Or if a person eats 400g cooked rice it is equivalent to 100g of raw rice. The nutrient contents of raw rice are extracted from standard Food Composition Tables. The same process is employed to estimate the nutrient contents of all food preparations.

Ideally both, raw and cooked foods must be weighed. But if it is not possible to weigh the cooked foods an approximate conversion factor can be taken. Obviously this will lead to some degree of error. Another alternative is to measure the volumes of raw and cooked foods and subject them to weight conversions. In practice measuring volumes of cooked portions actually eaten by the individuals is easier than weighing the portions eaten. The volumes can be converted into weights and subsequently into nutrients, through standard tables. The merits of this method are that it accounts for the non edible parts of food as well. The wastage is also taken into account. This method is more accurate than the inventory method. The demerit is that it is a very cumbersome, time consuming and tedious process as it involves weighing of all foods.

24 hour Recall (or Questionnaire) Method : The 24 recall (questionnaire) method is a relatively easy method based on the recall capabilities of the individual over a period of the past 24 hours. Since it is a short term retrospective method it is more prone to errors.

A set of cups and ladles standardized for volume are used. The housewife is asked about the types of food items prepared at the time of breakfast, lunch and dinner. The raw ingredients used for cooking each meal are noted. The cups are exhibited to the housewife. The cooked food items are noted in terms of these cups. The intake of each food item by the specific individual in the family is also assessed by using these cups.

The method is fairly accurate. It take lesser time than the weighment method. However, the disadvantage is that the method is based on recall capability of the respondent so there is a likelihood of 'inaccurate recall' and error in derivation of nutrients. A fair degree of cooperation is to be sought from the respondent. The process is a cumbersome.

Food Frequency Questionnaire (FFQ) Method : Food frequency questionnaire (FFQ) method is based on the principle as to how frequently an item is consumed over a period of time. It is an epidemiological technique used to study the meal patterns and dietary habits of people. It can be used to assess the specific dietary intakes during pregnancy, lactation, etc. It can even be conducted through post. For example a FFQ may read "In one week how often do you consume the following items...."

Item	Frequency (Consumption Per Week)
Meat	1 2 3 4.....
GLV	1 2 3 4.....
Sprouts	1 2 3 4.....

This filled up questionnaire is then analysed, using pre-decided values of for nutrients for different food items.

The Indian Academy of Paediatrics (IAP) classification on the other hand puts the degree of malnutrition into four grades (Table - 4). This classification is used by the ICDS in India.

Table - 4 : Indian Academy of Paediatrics (IAP) Classification

Malnutrition grade	Weight/Age (%) of normal
Normal	> 80%
I Grade	70-80%
II Grade	60-70%
III Grade	50-60%
IV Grade	<50%

Weight for height : The weight for height classification doesn't take age into consideration. Weight is also related to height. Many a times age is not known. Weight for height is an age independent parameter. It is a good prognostic indicator of severe PEM and an index of current nutritional status. Weight for height of less than 80% of normal is considered to indicate wasting in preschool children.

Wasting and Stunting : In the Waterlow classification weight for height and height for age are used to classify children as normal, wasted, stunted and wasted and stunted. Children with low weight for height are considered as wasted and those with low height are 'stunted' (Table - 5).

Table - 5 : Wasting and Stunting - Waterlow classification

Weight for height	Height for age	Nutritional status	Interpretation
Normal	Normal	Normal	Normal
Low	Normal	Wasted	Acute malnutrition
Normal	Low	Stunted	Nutritional dwarf
Low	Low	Wasted and stunted	Acute on Chronic malnutrition

Body Mass Index (BMI) : Body Mass Index (BMI) is the ratio of weight in Kg to square of height in metre

$$BMI = \frac{\text{Mass (Kg)}}{\text{Height (m)}}$$

It gives an indication of the nutritional status, esp. obesity. Now-a-days in context of lifestyle diseases, BMI is taken as an indicator of risk of cardiovascular diseases as well.

BMI does not measure the body fat but relates well with the degree of obesity. The categories of obesity as pronounced by the WHO are depicted in Table - 6. A BMI of 25-30 is considered as a warning sign and may warrant intervention, especially in the presence of additional risk factors. A BMI of 30 or higher is generally considered the point at which some form of treatment is required. Obesity Class III i.e. BMI >40 or morbid obesity, is a medical condition that impairs a person's overall health and therefore requires medical attention.

Table-6:Grades of obesity based on BMI (WHO, 1998) (3)

BMI	Classification	Risk of co-morbidities
< 18.5	Underweight	Low
18.5-24.9	Healthy/normal weight	Average
25 – 29.9	Pre-obese (Overweight)	Mildly increased
30 – 34.9	Obesity Class I	Moderate
35 - 39.9	Obesity Class II	Severe
> 40	Obesity Class III	Very severe

The guidelines have been revised and made more stringent lately for Asians, considering the fact that Asians (esp. South East Asians including Indians) are more susceptible to metabolic syndrome. These are summarized in Table - 7.

Table - 7 : Grades of obesity for Asians (5)

BMI	Classification	Risk of co-morbidities
< 18.5	Underweight	Low
18.5-23	Normal weight	Increasing but acceptable
23 – 27.5	Pre-obese	Increased
>27.5	Obese	High

Dietary Assessment for Nutritional Status

A nutritional survey is never complete without a diet survey. We may be able to find out that there is a nutritional deficit through clinical, laboratory or anthropometric methods, but in order to find out if this nutritional deficiency is because of diet and which particular diet/nutrient, we have to invariably resort to a diet survey. It is thus an integral part of nutritional survey. A diet survey objectively defines importance of diet in various health state and disease (2). Diet survey is nothing but the scientific assessment of food consumption, and using this data for various purposes including assessment of nutritional status.

Methods : Various methods are there to undertake diet surveys. These are appropriate in different settings (6) and are summarized in the Box - 4.

Box - 4 : Methods of Diet survey

- Food balance sheet method
- Inventory method
- Weighment method
- 24 hr Recall method (Questionnaire method)
- Dietary score method
- Food Frequency Questionnaire method
- Duplicate sample (chemical analysis) method

Diet Balance Sheet Method : This method is used when information regarding availability and consumption of food is required at a macro level like at the global, national, region or state levels. The total food supplies available and used up at a

body constituents. It is measured for both children and adults. Definite body weight standards are available to us. Body weight is an indicator of 'current' nutritional status of the individual, as weight fluctuates with nutrition. Unlike height which is irreversible, it reflects the nutrition state of the present day. It is therefore a useful indicator for acute disorders. Small illnesses like childhood diarrhoea is also good enough to alter the weight, it is thus a sensitive indicator.

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Nutrient	Test	Normal (Acceptable)	Low (Medium risk)	Deficient (high risk)
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Vitamin E	Ratio of serum vitamin/total lipids	>0.8		
Vitamin K	*PIVKAS accumulation			If PIVKAS accumulates
	Prothrombin time			Delayed **
Thiamin	Urinary thiamin	100μg/24 hrs or 65μg/g creatinine		
Riboflavin	Urinary Riboflavin	80μg/g creatinine		
Niacin	2-Pyridone to NI-methyl nicotinamide ratio	1 to 4		<1
Vitamin B_6	Vitamin B_6 urinary excretion			<20μg/g creatinine
	Pyridoxic acid excretion			<0.5mg/day
Folic Acid	Serum folate (ng/ml)	>6.0	3.0-5.9	<3
	RBC Folate (ng/ml)	>160	140-159	<140
Vitamin B_{12}	Serum B_{12} (pg/ml)			<80
Ascorbic acid	Plasma (mg/dl)	>15	08/15/09	<8

* PIVKAS: Protein Induced by Vitamin K Absence. ** Prothrombin time is a functional test

He stands against the anthropometric rod kept at his back, placed perpendicular to the ground. The investigator standing to the left holds the subject's chin with his left hand and the occiput with the right little finger in the Frankfurt horizontal plane (an imaginary line joining the tragus of the ear to the eye). The moving head piece of the anthropometric rod is brought down and placed on the head with little pressure, in the saggital plane. The reading is taken. Average of three readings is recorded. The disadvantage of height as a measure of nutritional status is that it doesn't indicate present nutritional status of the individual, but indicates only the past history of a chronic disease.

Mid-Upper Arm Circumference (MUAC) : Mid-upper arm circumference indicates the muscle development. Since poor muscle development is seen in PEM, the lower MUAC indicates poor nutrition. MUAC correlates well with weight, weight for height and clinical signs of malnutrition. It can be used to calculate the mid arm muscle circumference using a simple formula, if the value of fat fold at triceps is also estimated simultaneously. The mid calf circumference can also be used instead of MUAC.

The mid-upper arm circumference is measured on the non-dominant arm (left arm in case of right handed subjects and vice-versa) of the subject. The mid point between the tip of the acromion (of scapula) and olecranon process of ulna is located with the arm flexed at the elbow. It should be marked with a pen. The arm is now held hanging freely by the side of the subject and a fiberglass tape is placed gently but firmly embracing the arm without 'squeezing' the soft tissue, at the point marked in pen. The reading is taken to the nearest millimeter.

Interpretation : The usefulness of MUAC is based on the principle that MUAC remains almost constant between 1 to 5 years of age (increasing only approx 1.5 cm between 1 and 5 years of age). Thus fair degree of standardization can be achieved even if the age is not known in a preschool child. A cut off point of 12.5 cm is taken. MUAC of less than 12.5 cm is taken as low. To make the procedure of measurement even simpler and usable at the grassroot level, Shakir introduced a simple tricoloured tape in 1975, called as the Shakir's tape. The red colour in the tape (which fell in the less than 12.5 cm zone) marked Danger, yellow or white colour, fell in 12.5-14 cm zone marked Caution and green colour more than 14.0 cm is considered as OK or normal.

MUAC can be used as an efficient technique for screening large population of children for malnutrition. Children thus screened, can be subjected to further anthropometric measurements and other (Clinical/biochemical) tests for specific nutritional deficiencies.

The biggest advantage of using the MUAC is that it is easy to conduct and it is age independent till about 5 years of age. A modified tape (Shakir's Tape) can be used easily even by a village health worker.

Body Fat : Body Fat indicates reserve of energy in the body. The quantity of fat present subcutaneously at various sites indicates the gross nutritional status of the person. The thickness of fat can be correlated to the body content of fat. Fat distribution in and around the body varies with age, sex, physiological, nutritional and health status of the individual.

Anthropometric Measurement of Body Fat : Fat fold thickness

Anthropometric measurement of body fat can be carried out at various subcutaneous sites. These sites are commonly undertaken : Two sites on the trunk namely sub scapular and supra-iliac and three sites on the extremities namely triceps, thighs and mid calf. Biceps fat fold is also done. The fat fold thickness at triceps is the most sensitive (to socioeconomic changes) and most reliable (indicator of obesity).

Fat fold at triceps is the commonest measure. It is carried out at the dorsal side at the same mid point where MUAC is measured. The skin fold is picked up between the thumb and the forefinger 1 cm above the midpoint, taking care not to include the underlying muscle. The tips of the skin fold calipers must be applied at the mid point at a depth equal to the skin fold. The skin fold is held gently in the left hand throughout the measurement. Average of two measurements must be taken.

Head and Chest Circumference : Head and chest circumferences are measures used in children. A neonate is born with a bigger head. The chest grows faster than the head in a normally nourished child in the 2nd and 3rd years of life. As a result, the chest circumference overtakes the head by about 1 year of age. In a child suffering from PEM, the chest grows at a lower rate and it remains smaller than the head even till 2 ½ to 3 years of age. This indicates a poor state of nutrition.

Head and chest circumferences are measured using a fiberglass tape. Head circumference is taken at the supraorbital ridges of the frontal bone (just above the eyes) in front and the most protruding point of the occiput in the back. The chest circumference is taken at the level of the nipples in mid inspiration.

Classification of Nutritional Status Based on Anthropometric Parameters

Weight for age : There are standard weights laid down for a particular age. Thus a given child's weight (for his particular age) is compared to the 'standard' weight of a 'normal' child. This standard is taken as per the 50th centile of the Boston standard. The Gomez classification is one of the commonest classifications used to classify malnourishment into various grades.

$$\text{Weight for age}(\%) = \frac{\text{Weight of child}}{\text{Weight of 'normal child' of same age}} \times 100$$

The grades as per Gomez classification are given in Table - 3.

Table - 3 : Gomez Classification

Malnutrition grade	Weight/Age (%) of normal
Normal	>90%
Grade I (Mild)	75 – 89 %
Grade II (Moderate)	60 – 74 %
Grade III (Severe)	< 60 %

Direct Assessment of Nutritional Status

The term 'direct assessment' refers to methods in which individuals or communities are investigated directly. The various methods that are available for the direct assessment are summarized in Box - 2.

Box - 2 : Direct Assessment of Nutritional Status
Clinical signs
Laboratory Tests • Biochemical • Haematological • Parasitological
Biophysical Methods
Anthropometry

Assessment of Nutritional Status using Clinical Signs : Clinical examination is a widely practiced direct method to assess the nutritional status of individuals and communities. Assessment of clinical signs is based on the examination for changes believed to be related to inadequate or excessive nutritional intake, that can be observed in superficial tissues (skin, eyes, hair, mouth) or in organs close to the surface (thyroid, skull).

Caution with Clinical Examination : The cheapness and the relatively easy organization of clinical examination for nutritional assessment, might sometimes lead to the assumption that the method is simple, can be quickly mastered by a beginner, and yield results that are quick to interpret. But this is not the case. This method has got its own limitations, advantages and disadvantages. Expertise is required to select it as a valid method in a given situation, to conduct it and to interpret the results obtained.

Classification of Clinical Signs : Based on their importance with regard to suggesting a nutritional etiology the clinical signs can be classified into three groups (i) :

Group 1 - Potentially Nutritionally Significant (Signs 'strongly suggestive' of dietary deficiency or excess) : Some signs are strongly suggestive of a particular nutritional deficiency or excess e.g. Bitot's spots (Vitamin A). Flag sign (PEM). A list of these is summarized in Table - 1.

Group 2 - Signs that are of probable nutritional significance : There are some signs that are of uncertain nutritional significance. These have to be appreciated and interpreted in correlation with the case. e.g. Xanthomata eye might indicate high blood cholesterol, Corneal scar (previous infection, trauma, malnutrition, avitaminosis A), Fissure tongue, recession of gums, transverse ridging of nails, etc.

Group 3 - Signs that have no nutritional significance : These signs are not nutritionally significant but required to be differentiated from other nutritionally relevant signs. e.g. pterygium (an insignificant sign) is to be differentiated from Bitot's spots, geographic tongue, pyorrhea.

Assessment of Nutritional Status using Biochemical and Laboratory Methods : We have seen previously that clinical signs are often non specific and develop rather late in the disease process. Biochemical changes, on the other hand can be expected to take place prior to clinical manifestations. Hence tests that can be conducted on easily accessible body fluids (blood and urine), can help to detect disease at a sub-clinical level even in a community setting.

Table - 1 : Signs 'strongly suggestive' of dietary deficiency or excess

Deficiency Sign	Suggested nutrient abnormality
Pale conjunctiva	Iron
Bitot's spots	Vitamin A
Angular stomatitis	Riboflavin
Spongy, bleeding gums	Vitamin C
Bilateral edema (young children)	PEM
Thyroid enlargement	Iodine
Bilateral epiphyseal enlargement of wrists	Vitamin D
Sign of Excess	*Suggested nutrient abnormality*
Mottled enamel	Fluoride
Dental caries	Sugar

Available laboratory tests : Three groups of laboratory tests are available namely, haematological tests, parasitological tests and biochemical tests. The haematological tests include the commonly done hemoglobin estimation, parasitological tests would include stool examination for intestinal parasites and biochemical tests include many tests like the urine examination for albumin, sugar, etc. Advanced biochemical test are taken up for vitamin, minerals and enzyme estimations as well, that indicate nutritional status. Normal range of some of these tests is given in Table - 2.

Assessment of Nutritional Status through Anthropometry : Nutritional anthropometry is the measurement of human body at various ages and levels of nutritional status. It is based on the principle that appropriate measurements should reflect any morphological variation occurring due to a significant functional physiological change. For example, a low Fat Fold Thickness reflects a shift in energy balance. The advantages of anthropometry are that it is simple, quick to do, easy to reproduce and objective. In some cases it identifies even subclinical changes resulting from nutritional variations.

Common Methods of Anthropometry : The common anthropometric methods should be quick, simple and easy to reproduce. Minimum training should be required to conduct the measurement. The commonly used methods are : Height; Crown-heel length and standing height; body weight, mid upper arm circumference, and fat fold thickness. Head and chest circumference are measured for children under five years of age.

Body Weight : Body weight is the commonest and simplest anthropometric measure used for the evaluation of nutritional status. It is a reflection of total body mass comprising of all

visit the centre only during the meal timings. But provision of nutrition too has been an objective of the programme. Infant Mortality Rate (IMR) has declined from 110 in 1981 to 58 per thousand live birth in 2004. Similarly, under-5 mortality has declined from 161 in 1983 to 87 in 2003. Various surveys have revealed that there has been significant impact of the scheme. Many non-monetary benefits like insurance, incentives, preference in other jobs (teachers) have been given to the AWW and AWH. There is certainly a scope of enhancing the honorarium offered to these grass root workers.

Summary

After independence the government of India took many initiatives to ensure food security for the country. National nutritional programmes were a firm step in that direction. Ministry of Social Welfare runs the ICDS programme, Balwadi nutrition programme and special nutrition programme. Ministry of Health and Family Welfare runs the programmes for prophylaxis against nutritional anaemia, vitamin A prophylaxis programme and the iodine deficiency disorders control programme. The mid day meal programme is run by the Ministry of Education. The programmes have achieved improvement in the nutritional status of the children, pregnant and lactating women. More specifically the ICDS programme that has a strong nutritional component can be termed as a successful programme.

Study Exercises

Long Question : What are the objectives of the ICDS scheme? Discuss the benefits offered to various vulnerable groups under the scheme.

Short Notes : (1) Mid day meal programme (2) Anganwadi worker (3) Iodized salt (4) Services under National Nutritional Anaemia Prophylaxis Programme (5) Supplementary Nutrition under ICDS

MCQs

1. Mid day meal programme offers (a) Half of daily protein and one third of calorie requirement (b) Half of daily protein and half of calorie requirement (c) One third daily protein and half of calorie requirement (d) One third of daily protein and one third of calorie requirement.
2. To a child under 3 years of age, ICDS provides : (a) 300 Kcal energy and 8-10 g protein (b) 300 Kcal energy and 16-20 g protein (c) 500 Kcal energy and 8-10 g protein (d) 500 Kcal energy and 16-20 g protein.
3. In rural areas, the administrative unit for the location of ICDS Project is (a) Gram Panchayat (b) Community Development Blocks (c) District head quarter (d) Primary Health Centre.
4. Which of the following is not run by the Ministry of Health and Family Welfare (a) Prophylaxis against nutritional anaemia (b) Vitamin A prophylaxis programme (c) Iodine Deficiency Disorders Control programme (d) ICDS Programme.
5. Which of these is not carried out at the Anganwadi centre (a) Supplementary nutrition (b) Non-formal pre-school education (c) Immunization (d) Nutrition and Health Education.

Answers : (1) a; (2) a; (3) a; (4) b; (5) c.

136 Nutritional Assessment and Surveillance of a Community

Rajul K Gupta

Assessment of Nutritional Status of Individuals and Communities

Aims of Assessment of Nutritional Status

The assessment of nutritional status is carried out with the following aims :

- To map out distribution and geography of nutritional disorders
- To identify high risk groups with respect to nutritional vulnerability
- To assess various epidemiological factors for nutritional deficiencies
- Make recommendations to rectify shortcomings leading to nutritional deficiencies
- To project for financial allocations and budget for food materials at a large administrative level e.g. at the national level.

Various methods are available for the assessment of nutritional status. These are enumerated in Box - 1. These can be further sub-classified into direct and indirect methods of nutritional status assessment.

Box - 1 : ABCD... of Nutritional Status Assessment
Anthropometry
Biochemical & lab methods
Clinical assessment
Diet survey
Ecological studies
Functional assessment
G - - Vital statistics

Nutritional Surveillance

It is clear from the earlier chapters that the state of nutriton of an individual or a community depends on a variety of (unrelated) factors. These could be as diverse as the 'health' of the crops, state of rainfall, GDP, per capita income, efficiency of the public distribution system, availability of food and the health state of the community.

Given this dynamic and ever changing state of availability and use of food, it is vital to keeping a constant watch over all these factors concerning nutrition, in order to continuously assess the situation, give an early warning and take appropriate decisions that will lead to improvement in the nutritional status of population. This on-going process of constant scrutiny of the nutritional situation and factors influencing them and its application in the public health interest is termed as nutritional surveillance. The word was used first in 1974 with respect to drought relief, during a World conference in nutrition. A nutrition surveillance programme was developed for the developing countries 1976. The term has been used extensively by the UNO since 1980. The process of nutritional surveillance finds the following applications :

a) It provides inputs for health and development planning
b) It is useful for programme management and evaluation
c) It provides timely warning and intervention to prevent (short term) food consumption crisis and plan for long term action

Steps : The various steps of nutritional surveillance are :

a) Identify community/population
b) Data collection
c) Data transit
d) Data processing
e) Interpretation
f) Responses and Planning
g) Improvement
h) Further implementation

Methodology of Nutritional Surveillance : The methodology of the nutritional surveillance can be outlined through answering the following basic questions :

- What is the problem? → Define & describe the type of nutritional problem e.g. malnutrition (acute or chronic), micronutrient deficiency, etc.
- Who is at risk? → Describe the population groups affected by area, socioeconomic status, biological/physiological status, etc.
- Why is this population at risk? → Identify the causal factors. These causes could be immediate (non availability of food, poor health, etc) or of long standing nature like unequal resource distribution, poor sanitation and infections.
- Where to get the data from? → Identify the data sources. These will depend on the purpose for which surveillance has been undertaken.

Purpose of surveillance	Data source
Health and development planning	Household survey
Data from records	Programme management and evaluation
Interviews and records	Timely warning and intervention programme
Rainfall, prices, employment	Health system surveys

- Define food supply system. The food can be obtained mobilizing the existing stores, through national and international aid, improving the agricultural production, etc.
- Obtain the data, analyse and provide feedback to decision makers. Finally evaluate the nutritional surveillance system.

Nutritional Rehabilitation

The cases of severe malnutrition are treated in a hospital setting. Such a treatment no doubt, does make the child survive; it doesn't guarantee that he will live a life free of malnutrition and disease in future. Besides only medical additional inputs like those of social, physical, psychological and emotional rehabilitation have to go in, if the child is to live a life of positive health.

Principle : More often than not it is seen that after a short spell in the hospital, once the child returns back to the original social milieu, the condition recurs. The child either dies or becomes extremely vulnerable to subsequent infections, malnutrition, disease and death. The basic principle of nutritionally rehabilitating a child is not only to treat his malnutrition and related acute complications, but to prevent a recurrence of the condition.

Methods : The process of rehabilitation is to be dove-tailed with treatment. It can be undertaken at three levels, depending on the severity of the condition and the facilities available.

(a) Hospital : The child is hospitalized in severe cases or when he has concomitant complications. Special standardized dietary regimes (intensive feeding with high proteins and energy dense diets) are required to be instituted and continued for a long time to come. Systematic education of parents in food selection and cooking has also to be imparted. The standardized dietary regimes and specific nutritional education it is initiated in the hospital but is required to be followed up either at the day care centre or at home.

(b) Day Care Centre : A day care facility is an intermediate arrangement between the hospital and home. Children who are not required to be admitted to a hospital or those who have been discharged from the hospital are expected to visit the day care centre. This centre may be run by a health worker who is trained in preparation of special feeds for malnourished children and who could educate the mothers on preparation of special feeds suitable to the particular child (as discussed in last paragraph). Any health facility like an anganwadi centre, sub-centre or a PHC can be used as a day care centre. The advantage of a day care centre (over hospital) is that it

is cheaper; the mother can spend the day at the centre under supervision of a trained health worker, learn sufficient skills in specialized feeding and child-craft, in an informal setting, closest to her home environment and really imbibe it.

(c) Domiciliary : In case the child is not severely affected, after medical consultation, he can be treated at home. He could also be one who has been weaned off a hospital or a day care set-up. To maintain health of child it is important that the mother is trained in handling the 'special' nutritional needs of this child.

Summary

The condition of the body resulting from intake, absorption and utilization of food and the effect of pathological factors is termed as nutritional status.

Nutritional status is assessed too map out distribution and geography of nutritional disorders, identify high risk groups and to assess various epidemiological factors for responsible for nutritional deficiencies. It is also an administrative tool used to allocate budget for food materials at a large scale. The important methods are anthropometry, biochemical and laboratory methods, clinical assessment, diet survey, ecological studies, functional assessment and indirect assessment from vital statistics data.

There are clinical signs that may be 'strongly suggestive' of dietary deficiency or excess (e.g. Bitot's spots), of probable significance (e.g. corneal scar) and those that are of no nutritional significance (e.g. pterygium). Clinical signs might develop rather late and are subjective and non specific.

Biochemical tests on the other hand give objective and quantitative indication of nutritional status, but these are costly and instrument intensive.

Anthropometry remains the sheet anchor of nutritional assessment. Weight, height, head and chest circumference, MUAC and fat fold thickness are the common anthropometric parameters used. Many derived parameters like the BMI, weight for age, weight for height, etc are also used in different situations.

Various methods of diet survey are used to ascertain as to what an individual or a group of people are eating. This indicates the deficiency of nutrients in the diet and thus appropriate measures can be suggested to improve it. The main methods Food balance sheet method are inventory method, weighment method, 24 hour recall method (Questionnaire method), dietary score method, food frequency questionnaire method and duplicate sample (chemical analysis) method. The inventory method, weighment method and 24 hour recall method are the most commonly used dietary survey methods.

Nutritional Surveillance is an on-going process to keep a constant watch over all the nutrition related factors, in order to continuously assess the situation, give an early warning and take appropriate actions.

Nutritional Rehabilitation aims at re-establishing the severely malnourished child medically, nutritionally and psychologically into the family and society. The aim is to prevent a recurrence of acute malnourishment. This can be achieved through appropriate measures begun at the hospital. Subsequently the child may be managed at a day care centre or at home.

Study Exercises

Long Questions : (1) Enumerate the various methods for nutritional assessment. Describe any one in detail. (2) What is nutritional surveillance? Outline the methodology of nutritional surveillance. (3) What are the various anthropometric techniques available to assess nutritional status of a 5 year old child? How can weight for age be useful to ascertain malnutrition in this child?

Short Notes (1) Mid Upper Arm Circumference (2) 24 hour recall method (3) FFQ (4) Using BMI to assess CED in adults (5) Disadvantages of using clinical signs for nutritional status assessment

MCQs

1. All can indicate nutritional status except : (a) Fall in weight (b) Falling hair (c) Failure to gain height (d) Flag sign
2. All are signs of PEM except (a) Flag sign (b) Unilateral pedal edema (c) Low weight for age (d) Dermatoses
3. Stunting is _____ weight for height but _____ height for age : (a) Normal, Low (b) Low, Normal (c) Low, Low (d) High, low
4. Acute malnutrition may be indicated by : (a) Stunting (b) Wasting (c) Stunting and wasting (d) All of the above
5. Which of these is not true for nutritional surveillance : (a) It is an ongoing process (b) It can be used as a nutritional survey technique (c) It is a close scrutiny of events related to nutritional changes (d) It provides timely warning for action

Match the following

	Age		Suitable anthropometric measure
6.	New born	(a)	MUAC
7.	3 years	(b)	Weight
8.	42 years	(c)	BMI
9.	8 years	(d)	Head & chest circumference
10.	1 ½ years	(e)	Weight for age

Answers : (1) b; (2) b; (3) a; (4) b; (5) b; (6) b; (7) a; (8) c; (9) e; (10) d.

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Comparative study of Guwahati, Ahmedabad

Sivasish Thakur

GUWAHATI, Jan 3 - A comparative study of underdeveloped belts in the hearts of the cities of Guwahati and Ahmedabad has shown how the state contributes to creating a structural violence of deprivations with regard to housing, basic services, citizenship rights, etc.

The study – 'Does Urban Planning Create or Mitigate Conflicts and Violence in Indian Cities? Findings from Ahmedabad and Guwahati' – conducted by the Centre for Urban Equity, CEPT University, Ahmedabad, has found many similarities in the perpetuation of underdevelopment in the two areas of the two different states.

"Some of our case studies within the two cities – Bombay Hotel area in Ahmedabad and hill settlements in Guwahati – represent this type of local informal actors-led or people-led housing developments without basic services access and formal status of their housing. They are prone to evictions any time the state wants to redevelop the area.

In Guwahati, the instrumental state has stepped in to assist capture of the hill settlements' land for real estate interest or reportedly for ecological protection. These settlements, therefore, suffer from structural violence in the form of deprivations and insecurity in their day-to-day life and occasional physical violence in the form of eviction drives," the report noted.

Noting that the idea of 'urban' was on the upsurge and so was the zeal to make cities that are visually appealing and functionally productive, the report found that the urban constituency had become more vocal than before and was being wooed by the political class more than before.

The outcome, it says, is national governments (Centre's) pre-eminent focus and funding of urban development projects since mid-2000 and the economically-advanced states projecting their cities as their brand ambassadors, upcoming Amravathi city for Andhra Pradesh, Ahmedabad and her urban projects such as the BRTS, Riverfront, etc., for Gujarat, and so on.

This thrust also resulted, for the first time, in major urban development programmes being introduced in the mission mode by the previous Central Government under the name Jawaharlal Nehru National Urban Renewal Mission (JNNURM) and Rajiv Awas Yojana (RAY), both discontinued now. The present government has launched the Atal Mission for Rejuvenation & Transformation (AMRUT), Pradhan Mantri Awas Yojana – Housing for All (Urban) (PMAY) and Smart Cities Mission.

The study chose Ahmedabad, the brand ambassador of the Gujarat development model and Guwahati, the gateway to the Northeast and also a city located in a state that is a site of ethnic conflicts and conflicts with immigrants from Bangladesh.

"Their specific dynamics have influenced the way urban development programmes have been implemented, conflicts ensuing on account of the same and tipping of some of the conflicts into occasional physical violence in the form of eviction drives," it said.

It added that in Guwahati, the hill settlements had been evicted many times and people had experienced violence from the state. The residents are mostly the tribal communities, who

have been mobilized by an organisation named Krishak Mukti Sangram Samiti (KMSS) for land rights. Their movement has faced state repression and violence and there have been instances of counter violence from the hill residents. The most recent incident was in February 2014 when during a protest demonstration, a hill settler died through self-immolation.

"The state's neglect in supporting the poor to realize their rights and exclusions has led to informal settlements' residents making claims for survival rights or claims over their 'life space' in a subtle manner of organising for demanding water rights, approaching local politicians for such claims, making demands before elections and so on. There are local actors, often NGOs and local leaders and CBOs, as in the case of Bombay Hotel area in Ahmedabad as well as hill settlements in Guwahati, that assist residents to organise for issues and stake claims," it said.

The report noted three types of conflicts in the case of the street vendors' market in Guwahati – (a) of the vendors with the local State in the form of evictions, (b) of the vendors with the non-state actors to whom the state has outsourced management of the markets and (c) among the vendors for vending space.

"NGO and local Welfare Association (WA) intervention mitigated the conflict with the state by organising the evicted street vendors into a new informal market elsewhere in the city. But then, the state has once again clamped down and evicted the vendors from this market which was part of our study, namely Ulubari market," it observed.

The attempt often is to expand the rights but only in certain situations, such as in the KMSS movement in the hill settlements, it turns into a political movement, which can in turn lead to occasional counter-violence when the state remains unresponsive to its concerns and demands.

"In the informal settlements like Bombay Hotel, there is near absence of the welfare state. Instead, informal non-state actors step in. They draw their power from their links with the local state apparatus and politicians. They have provided land for housing and water solely for their own profit and they govern these activities through threat of violence and occasional violence," it said.

Even 'welfare' interventions for rehabilitation of evicted people are subverted from the beginning by the local state. The rehabilitation in Ahmedabad in general and the BSUP housing in Vatvain particular was so badly planned and managed that the Vatvasites are now replete with various crimes including gender violence, illicit and illegal activities, and actors engaging in them.