

INVESTIGATIONS ON NUTRITIONAL ANEMIA OF THE FARMERS IN NORTH-EASTERN PART OF THAILAND

PART 2

MEDICAL SURVEY

by

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Introduction

A high incidence of nutritional anemia among farmers has been noted in Thailand as reported previously by the Interdepartmental Committee on Nutrition for National Defense in 1962.¹⁾ In the north-east district, anemias are also prevalent. Many factors such as hookworm infestation, poor iron intake, malabsorption etc. had been supposed to be causes of the anemia, but no investigation had been carried out in this district to elucidate the etiology of the anemia.

A co-ordinative study of Japan and Thailand was planned by the Nagoya Women's University and the Division of Nutrition, Department of Public Health Promotion, Thailand in 1972.

Medical staffs from the Department of Internal Medicine, Okayama University Medical School participated in this research by the request of Nagoya Women's University.

Subjects and Methods

1) Subjects

Eleven villages in Khon Kaen province in Thailand were selected for this study. Location of this area is north-eastern part of Thailand. All the villages locate in rural area and economic basis of almost all families is

Table 1. Subjects and Villages

	Name of village	Tambon	Ampur	Population			Surveyed family	
				Total	Male	Female	Socio. econ.	Dietary
1	Ban Kota	Sila	Muang	81	41	40	15	6
2	Ban Nonghuaua	Koksee	„	70	32	38	10	6
3	Ban Koklahm	Sarapoe	„	48	26	22	9	6
4	Ban Han	Ban Han	Banpai	114	51	63	19	6
5	Ban Torpadoo	Nonsila	„	71	33	38	16	6
6	Ban Faleum	Nongroa	Nongroa	121	55	66	22	—
7	Ban Huabeung	Jorakae	„	69	31	39	15	6
8	Ban Lawkokhung	Suanmon	Munjakeree	121	51	69	27	—
9	Ban Nongwengpeng	Ban Fang	Kranuan	90	47	43	12	—
10	Ban Koksoong	Nampong	Nampong	150	68	82	26	6
11	Ban Nong-oa-noi	Muangvan	„	91	26	65	17	—
Total				1,026	465	561	188	42

agriculture, especially rice cultivation. The name of the villages and the extent of the survey examinations are presented in Table 1. Total number of the families examined was 188 and the population 1,026. They were selected randomly in proportion to the population of each village.

Socio-economic and sanitation surveys were performed for 173 families (945 personnels) except village No. 1.

2) Items of the investigation

- a) Socio-economic survey
- b) Sanitary survey
- c) Stool examination
- d) History taking
- e) Physical examination including assessment of blood pressure
- f) Body measurment

Height, Body weight, Girth of chest, Girth of upper arm, Strength of grip, Thickness of skinfold

g) Blood examination

Hemoglobin, Hematocrit, Peripheral blood film, Serum iron, Percent saturation of transferrin, Serum vitamin B₁₂, Serum folate, Serum protein

h) Dietary survey

i) Water analysis

Methods and results of the dietary survey and water analysis are described in other chapters of this report.

3) Field survey

The Thai members interviewed someone of the families appointed for the

Khon Kaen - Nutritional Anemia Research Project

Table 2.

General information (Ask from the head of family ; Husband, wife, head man)

Head family's name _____ House No. _____ Village _____ Tambon _____

Person, interviewer's name _____ Ampur _____

Interviewer _____

No.	Name	Sex	Age	Marritus status	Relation with the head of family	Religion	Literacy	Education (level)	Occupation	Income/year	Past illness (Immunization if under 7 years age)	Remark
1.												
2.												
3.												
4.												
5.												
6.												
7.												
8.												
9.												
10.												

1. Socio-economic Status of the family

1. house owner hire dependant

2. land owner hire dependant

3. How many rais of the land (include for Housing)

has rai none

What are those land used for

.....

4. Number of the land used for cultivation

.....

5. Last year income

a. From agriculture production (from rice, corns, beans, vegetable, jute etc.)

has income no income

name of crops.....

last year income bahts

b. From paultry, animals and their products

has income no income

animals

total income bahts

c. Home industry (silk, cotton, mat)

industry.....

total income bahts

d. Labour (last year)

total income no income

..... bahts

e. Trade income

has income no income

f. Others

has income bahts

from

no income

g. Total last year income bahts

(a+b+c+d+e+f)

2. Animals & Paultry

buffalo none

cattle none

pork none

duck none

chicken none

dog none

others

.....

Sanitation

Water supply

for drinking tap water rain pond boil

for use tap water rain pond boil

Excretion disposal latrine pit privy, others

Refuse disposal decompose cover with dirt cover

dumping on land

dumping in water feed

Surrounding excellent good fair poor very poor

Building excellent good fair poor very poor

Food hygiene excellent good fair poor very poor

3. Nutritional Anemia Sheet

No. Village date

Name age male, female, single, married
female only: para pregnant,months, suckling

Occupation income baht per month

Where their income came from: rice, clothe making,
others etc.

Dietary history

1. Do you eat any particular food, such as

1.

2.

3.

2. Do you eat, usually, occasionally, seldom?

meat, raw, cooked

fish, raw, cooked

egg

milk

3. Under 5 years old

1. breast milk

2. other milk

3. weaning food

4. food for child

5. the same food as adult

4. Food taboo — for pregnant or lactating woman

Sanitary problems

1. Latrine yes no use yes no

2. Drinking water — well, pond, river, canal, water supply
(including cooking water)

3. Teeth cleaning using :

1. tooth brush

2. finger

3. others

4. no

4. Washing of bodies — how often

How do you wash

- plain water
- soap
- detergent

5. Washing of clothes — how often

How do you wash

- plain water
- soap
- detergent

6. Washing hands before eating <yes..... how do you wash plain water
no soap
detergent

7. Wash of dishes <yes..... how do you wash plain water
no soap
detergent

8. Foot wear <yes.....
no

9. Drainage system

Past history

1. Have you had any sickness?

yes <When?
What is the diagnosis?
no

2. Family member's death

yes <of what disease
at what age
no

Present condition

1. Have you any trouble?

no

- yes — diarrhea
- abdominal pain
 - nausea
 - vomiting
 - anorexia
 - fever
 - headache
 - fatigue
 - dizziness
 - cough
 - sputum
 - menstrual disorder
 - skin disease

medical examination. General informations about the members of the families, the socio-economic state of them, number of animals and paultries, the sanitational problems, dietary histories and personal records about foot wear, washing of body, clothes, dishes, tooth using were recorded in the sheet shown in Table 2.

Stools were gathered on another day. The medical examination was carried out at the school or the temple of each village. After the villagers were called together, history taking, body measurements, physical examinations and drawing of blood were performed. Total 8 to 10 ml of blood was taken by venipuncture and one drop of it was spread on glass plates. One ml of blood was poured into the testing tubes that contain one drop of 3.5 % EDTA-2Na as anticoagulant. Remaining blood was let cougulated in the tubes in which no anticoagulant was added.

These samples were brought to the Khon Kaen Health Center, where a laboratory was set up. In this laboratory, hemoglobin and hematocrit were estimated. The blood films were stained and serum was separated. After the separation of serum, total protein was measured immediately. Remaining serum was divided into two part, one was frozen with ascorbic acid (5 mg/ml) and the other without it. Serum for the assay of folic acid is required to keep with ascorbic acid to avoid oxidative destruction of folate. Serum without ascorbate is for the assays of vitamin B₁₂, iron and iron binding capacity. All sera were brought to Japan to assay these elements.

4) Methods and equipments

a) Body measurement

Heights, body weights and girth of chest were measured by the ordinary methods. The girth of upper arm was measured at the middle point between the elbow and the shoulder joint of the right arm. The strength of grip was measured by using the "Smedley's hand dynamo-meter". The thickness of the skinfold was measured at the back (just below the scapula) and at the extensor side of the right upper arm by using the "Eiken type skinfold caliper" (Meikosha Co. Ltd.). The result of it was expressed by the mean of the two values.

b) Hemoglobin

Hemoglobin levels were measured by the cyanmethohemoglobin method²⁾ using "Hemokit-N" (Nippon Shoji Co. Ltd.) as test reagent. The Hitachi spectrophotometer Model 101 (Hitachi Seisakusho Co. Ltd.) was equipped for the photometry.

c) Hematocrit

The microhematocrit method³⁾ using "Kubota Hematocrit Meter Model KH 120 (Kubota Seisakusho Co. Ltd.) was applied.

d) Staining of the blood film

After being stained with the Wright's solution,³⁾ the blood films were examined microscopically for the morphology of red cells and for the differentiation of neutrophils.

e) Serum protein

The "Hitachi protein meter" (Hitachi Seisakusho Co. Ltd.) was used for the estimation.

f) Serum iron and total iron binding capacity

The bathophenanthroline method⁴⁾ using "Fe-test" (Wako pure chemicals Co. Ltd.) as the test reagent was applied.

g) Serum vitamin B₁₂

The assay was made by the micorbiological assay⁵⁾ using *Lactobacillus leichmannii* (ATCC 7830) as test organism. Normal range in this laboratory is 150-900 pg/ml.

h) Serum folate

Serum folate levels were assayed microbiologically⁶⁾ by using *Lactobacillus casei* (ATCC 7469) as test organism and "Bact-casei FA" Difco as assay media. Normal range in this laboratory is 3-20 ng/ml.

Results

1) Socio-economic survey

As Table 3 shows, almost all the families (83.2 %) have their own houses and lands in this area. Width of their lands ranges from less than 1 rai to over 100 rai (Table 4). Their incomes are shown in Table 5. The incomes in 28.3 % of the families range from 2,001 to 4,000 Baht per year. Range of incomes in each village is shown in Table 6. It is evident from this table that the richest village is No. 4 and the poorest No. 6. Table 7 shows how these incomes were earned. Mean total iocome per year range from 1,329 Baht of the village No. 6 to 9,030 Baht of No. 4. Income from crops ranges from 832 to 4,790 Baht. It is also apparent from this table that incomes were derived from different sources in each village. Generally speaking, income from other sources than crops seems to contribute to the increase of total incomes of each family. Table 8 shows the numbers of the paultry in 10 villages. Though income from paultry is abundant in village No. 2, 3 and 4, total number of the paultry is not so many in these villages. The reason is not clear.

2) Sanitation survey

Table 9-1 shows the results of the investigation on drinking water and water for use. Most villages except No. 4 and 5, wells were utilized for that purposes. It is shown that more than half of the families do not use any

Table 3. Ownership of House and Land

Owner of House and Land	144	Families	83.2 %
Owner of House, Land dependent	22	"	17.2 %
Owner of House, Land hire	2	"	1.2 %
Dependence of House and Land	1	"	0.6 %
Dependence of House, Owner of Land	1	"	0.6 %
House hire	2	"	1.2 %
Land hire	1	"	0.6 %

Table 4. Area of Land

Land Area in rai	Total		Cultivation	
	Family	%	Family	%
Less than 1	10	5.8	4	2.3
1 — 4	16	9.2	15	8.7
5 — 9	21	12.1	22	12.7
10 — 19	32	18.5	31	17.9
20 — 29	22	12.7	18	10.4
30 — 39	22	12.7	21	12.1
40 — 49	8	4.6	7	4.0
50 — 99	18	10.4	19	11.0
over 100	4	2.3	2	1.2
No answer	20	11.6	21	12.1
No cultivation	—	—	13	7.5

Table 5. Income per Year

Baht	Family	Percent
500 and below	15	8.7
501 — 1,000	14	8.1
1,001 — 2,000	29	16.8
2,001 — 4,000	49	28.3
4,001 — 6,000	27	15.6
6,001 — 8,000	15	8.7
8,001 — 10,000	7	4.1
10,001 — 15,000	9	5.2
15,001 — 20,000	3	1.7
20,001 — 25,000	2	1.2
No answer	3	1.7

Table 6. Range of Income

Village No.	Minimum	Maximum
2	2,000 Baht	14,360 Baht
3	800	19,800
4	3,000	25,900
5	1,000	8,500
6	400	6,850
7	1,000	18,000
8	800	29,000
9	500	8,200
10	1,900	8,900
11	400	7,464

Table 7. Details of Income in Baht

Village No.	Crops	Poultry	Industry	Labour	Others	Total
2	4,790 (65.6) [%]	1,240 (17.0) [%]	42 (0.6) [%]	50 (0.7) [%]	1182 (16.2) [%]	7,304 (100) [%]
3	1,547 (36.0)	1,678 (39.1)	344 (8.0)	122 (2.8)	600 (14.0)	4,291 (100)
4	3,563 (39.5)	1032 (11.4)	172 (1.9)	458 (5.1)	3,805 (42.1)	9,030 (100)
5	1,300 (35.7)	188 (5.2)	1.9 (0.05)	241 (6.6)	1,914 (52.5)	3,645 (100)
6	927 (69.8)	92 (6.9)	69 (5.2)	104 (7.8)	136 (10.2)	1,328 (100)
7	2,397 (56.9)	396 (9.4)	120 (2.8)	497 (11.8)	801 (19.0)	4,211 (100)
8	2,770 (60.8)	120 (2.6)	39 (0.9)	70 (1.5)	1,557 (34.2)	4,556 (100)
9	1,332 (45.7)	392 (13.4)	—	433 (14.9)	758 (26.0)	2,915 (100)
10	1,288 (38.4)	150 (4.5)	688 (20.5)	721 (22.4)	504 (15.0)	3,351 (100)
11	832 (27.6)	181 (6.0)	806 (26.7)	1021 (33.8)	177 (5.9)	3,017 (100)
Mean	2,074.6(47.5)	547 (12.5)	228 (5.2)	372 (8.5)	1,143.4(26.2)	4,365 (100)

Table 8. Animal Poultry

Village No.	Cattle	Pig	Duck	Chicken	Dog	Buffalo	Cat	Others
2	30	11	38	92	12	1	—	—
3	6	3	—	63	8	1	—	2
4	100	13	65	121	39	9	9	6
5	20	3	5	37	10	4	2	2
6	67	13	20	168	29	9	2	1
7	18	4	24	119	7	14	—	—
8	29	11	15	197	23	5	1	5
9	31	—	12	154	7	—	5	1
10	29	8	27	64	27	4	1	2
11	16	14	3	153	15	—	3	—
Total	356	80	209	1,168	177	47	23	19

Table 9-1. Sanitation Survey

Village No.	2	3	4	5	6	7	8	9	10	11	Total	%
Families	10	9	19	16	22	15	27	12	26	17	173	
Drinking Water supply												
boil	—			2							2	1.16
rain	—		1							5	6	3.4
well	6	7	3	1	20	13	24	12	22	7	115	66.5
pond	—		8	12	1						21	12.13
canal	—										0	
stream	—						1				1	0.57
well+rain	3	2	6			1			4	5	21	12.13
well+pond	1	—					2				3	1.73
pond+rain	—		1								1	0.57
rain+boil	—			1							1	0.57
no answer	—				1	1					2	1.16
Water for use												
boil	0	—	—	2	—	—	—	—			2	1.16
well	3	9	3	1	12	9	21	12	25	17	112	64.73
pond	7		14	12	9	—	—	—			42	24.2
canal				—	—	1	—	—			1	0.57
stream				—	—	4	5	—			9	5.2
well+rain				—	1	—	—	—			1	0.57
well+pond									1		1	0.57
no answer			2	1		1	1				5	2.89

Table 9-2. Sanitation Survey

Village No.	2	3	4	5	6	7	8	9	10	11	Total	%
Families	10	9	19	16	22	15	27	12	26	17	173	
Excreta disposal												
latrine	4		7		8		12		5	8	44	25.4
pit privy			8		4		10		8	7	37	21.4
others	6	5	2	15	10	12	5	12	13	2	82	47.4
no answer	—	4	2	1		3					10	5.8
Refuse disposal												
decompose	1	1	2		1	1	2	2	5	2	17	9.8
burn	5	2	11	12	16	7	17	6	15	12	103	59.5
decompose+burn	2	4	4		5	5	2	2	2	1	27	15.6
dumping		1	1			1	1	2	3		9	5.2
cover with dirt				1			2			1	4	2.3
burn+cover with dirt							1				1	0.57
no answer	2	1	1	3		1	2		1+	1	12	6.9

Table 10. Judgement of Surroundings, Buildings and Hygiene

Village No.	2	3	4	5	6	7	8	9	10	11	Total	%
Families	10	9	19	16	22	15	27	12	26	17	173	
Surroundings												
good						1	1			3	5	2.9
fair	4		6	4	1	3	5	2	5	12	42	25.4
poor	6	9	12	10	21	11	21	10	19	2	121	69.9
very poor									2		2	1.1
no answer			1	2							3	1.7
Buildings												
good				1			1				2	1.1
fair	4		11	5	3	5	4	1	5	6	44	25.4
poor	6	8	7	8	18	10	22	11	18	10	118	68.2
very poor		1			1				3	1	6	3.5
no answer			1	2							3	1.7
Hygiene												
good							1				1	0.6
fair	4		8	5		4	4		2	4	31	17.9
poor	6	8	9	9	20	11	27	12	16	13	126	72.8
very poor		1	1		2				8		12	6.9
no answer			1	2							3	1.8

Table 11-1. Personal Record

Tooth cleaning

Village	Tooth brush		Finger		Other		No		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Ban Nonghuaua	47	65.3	4	5.5	—	—	21	29.2	72	100
Ban Han	74	53.6	25	18.1	—	—	39	28.3	138	100
Ban Koksoong	41	28.1	68	46.6	—	—	37	25.3	146	100
Ban Topradoo	26	32.5	18	22.5	—	—	36	45.0	80	100
Ban Khoklahm	11	23.4	27	57.4	—	—	9	19.2	47	100
Ban Lawkokhung	39	60.0	13	20.0	—	—	13	20.0	65	100
Ban Nongwengpeng	28	31.5	34	38.2	—	—	27	30.3	89	100
Ban Faleum	49	37.4	36	27.5	24	18.3	22	16.8	131	100
Ban Nong-oa-noi	45	44.5	24	23.8	—	—	32	31.7	101	100
Ban Sawang	24	36.9	22	33.9	—	—	19	29.2	65	100
Ban Huabeung	27	36.0	32	42.7	—	—	16	21.3	75	100

Table 11-2. Personal Record

Washing of bodies

Village	Plain Water		Soap		Detergent		Total	
	No.	%	No.	%	No.	%	No.	%
Ban Nonghuaua	12	16.7	60	83.3	—	—	72	100
Ban Han	49	35.5	89	64.5	—	—	138	100
Ban Koksoong	60	41.1	81	55.5	5	3.4	146	100
Ban Topradoo	58	52.5	22	27.5	—	—	80	100
Ban Khoklahm	16	34.0	31	66.0	—	—	47	100
Ban Lawkokhung	3	4.6	61	93.8	1	1.5	65	100
Ban Nongwengpeng	36	40.5	52	58.4	1	1.1	89	100
Ban Faleum	62	47.3	67	51.2	2	1.5	131	100
Ban Nong-oa-noi	15	14.8	86	85.2	—	—	101	100
Ban Sawang	11	16.9	53	81.6	1	1.5	65	100
Ban Huabeung	28	37.3	47	62.7	—	—	75	100

Table 11-3. Personal Record

Washing of bodies

Village	1 time a day		2 times a day		3 times a day		No answer		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Ban Nonghuaua	15	20.8	33	45.9	6	8.3	18	25.0	72	100
Ban Han	40	29.0	77	55.8	2	15.2	—	—	138	100
Ban Koksoong	61	41.8	84	57.5	1	0.7	—	—	146	100
Ban Topradoo	32	40.0	42	52.5	5	6.3	1	1.2	80	100
Ban Khoklahm	11	23.4	29	61.7	7	14.9	—	—	47	100
Ban Lawkokhung	20	30.8	43	66.1	2	3.1	—	—	65	100
Ban Nongwengpeng	35	39.3	54	60.7	—	—	—	—	89	100
Ban Faleum	93	71.0	35	26.7	3	2.3	—	—	131	100
Ban Nong-oa-noi	34	33.7	61	60.4	6	5.9	—	—	101	100
Ban Sawang	24	36.9	41	63.1	—	—	—	—	65	100
Ban Huabeung	25	33.3	48	64.0	2	2.7	—	—	75	100

Table 11-4. Personal Record

Washing of clothes how often

Village	Everyday		Every 2 days		Every 3 days		Every 4 days		Every 5 days		Every 6 days		Every 7 days		Every 10 days		Every 14 days		No answer		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Ban Nonghuaua	—	—	16	22.2	17	23.6	1	1.4	—	—	—	—	18	25.0	—	—	—	—	20	27.8	72	100
Ban Han	40	29.0	23	16.7	38	27.5	—	—	1	0.7	—	—	36	26.1	—	—	—	—	—	—	138	100
Ban Koksoong	12	8.2	—	—	50	34.2	—	—	22	15.1	1	0.7	61	41.8	—	—	—	—	—	—	146	100
Ban Topradoo	4	5.9	4	5.0	17	21.3	14	17.5	2	2.5	—	—	38	47.5	—	—	—	—	1	1.2	80	100
Ban Khoklahm	—	—	5	10.7	36	55.3	4	8.5	—	—	—	—	11	23.4	—	—	—	—	1	2.1	47	100
Ban Lawkokhung	7	10.8	—	—	21	32.3	—	—	7	10.8	—	—	30	46.1	—	—	—	—	—	—	65	100
Ban Nongwengpeng	1	1.1	9	10.2	23	25.8	—	—	8	9.0	1	1.1	32	36.0	15	16.8	—	—	—	—	89	100
Ban Faleum	5	3.8	2	1.5	16	12.2	—	—	—	—	—	—	99	75.6	3	2.3	6	4.6	—	—	131	100
Ban Nong-oa-noi	8	7.9	11	10.9	52	51.5	—	—	—	—	—	—	30	29.7	—	—	—	—	—	—	101	100
Ban Sawang	5	7.7	4	6.1	30	46.2	1	1.5	—	—	—	—	25	38.5	—	—	—	—	—	—	65	100
Ban Huabeung	3	4.0	8	10.7	24	32.0	—	—	4	5.3	—	—	36	48.0	—	—	—	—	—	—	75	100

Table 11-5. Personal Record

How to wash of clothes

Village	Plain water		Soap		Detergent		No answer		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Ban Nonghuaua	—	—	—	—	72	100.0	—	—	72	100
Ban Han	2	1.4	—	—	136	98.6	—	—	138	100
Ban Koksoong	—	—	1	0.7	145	99.3	—	—	146	100
Ban Topradoo	6	7.5	—	—	74	92.5	—	—	80	100
Ban Khoklahm	—	—	—	—	46	97.9	1	2.1	47	100
Ban Lawkokhung	—	—	—	—	65	100.0	—	—	65	100
Ban Nongwengpeng	3	3.4	1	1.1	85	95.5	—	—	89	100
Ban Faleum	3	2.3	—	—	128	97.7	—	—	131	100
Ban Nong-oa-noi	2	2.0	8	7.9	91	90.1	—	—	101	100
Ban Sawang	2	3.1	1	1.5	62	95.4	—	—	65	100
Ban Huabeung	—	—	—	—	75	100.0	—	—	75	100

Table 11-6. Personal Record

Washing hand before eating

Village	Yes		No		Total	
	No.	%	No.	%	No.	%
Ban Nonghuaua	68	94.4	4	5.6	72	100
Ban Han	123	89.1	15	10.9	138	100
Ban Koksoong	105	72.0	41	28.0	146	100
Ban Topradoo	65	81.3	15	18.7	80	100
Ban Khoklahm	42	89.4	5	10.6	47	100
Ban Lawkokhung	62	95.4	3	4.6	65	100
Ban Nongwengpeng	69	77.5	20	22.5	89	100
Ban Faleum	123	93.9	8	6.1	131	100
Ban Nong-oa-noi	83	82.2	18	17.8	101	100
Ban Sawang	55	84.6	10	15.4	65	100
Ban Huabeung	70	93.3	5	6.7	75	100

Table 11-7. Personal Record

Wash of dishes

Village	Yes		No		No answer		Total	
	No.	%	No.	%	No.	%	No.	%
Ban Nonghuaua	68	94.4	4	5.6	—	—	72	100
Ban Han	133	96.4	5	3.6	—	—	138	100
Ban Koksoong	133	91.1	13	8.9	—	—	146	100
Ban Topradoo	70	87.5	10	12.5	—	—	80	100
Ban Khoklahm	42	89.4	5	10.6	—	—	47	100
Ban Lawkokhung	60	92.3	5	7.7	—	—	65	100
Ban Nongwengpeng	67	75.3	22	24.7	—	—	89	100
Ban Faleum	118	90.1	13	9.9	—	—	131	100
Ban Nong-oa-noi	83	82.2	18	17.8	—	—	101	100
Ban Sawang	59	90.8	6	9.2	—	—	65	100
Ban Huabeung	67	89.3	3	4.0	5	5.7	75	100

Table 11-8. Personal Record

Foot wear

Village	Yes		No		Total	
	No.	%	No.	%	No.	%
Ban Nonghuaua	50	69.4	22	30.6	72	100
Ban Han	88	63.8	50	36.2	138	100
Ban Koksoong	84	57.5	62	42.5	146	100
Ban Topradoo	34	42.5	46	57.5	80	100
Ban Khoklahm	17	36.2	30	63.8	47	100
Ban Lawkokhung	44	67.7	21	32.3	65	100
Ban Nongwengpeng	30	33.3	59	66.7	89	100
Ban Faleum	63	48.3	68	51.7	131	100
Ban Nong-oa-noi	40	45.5	55	54.5	101	100
Ban Sawang	30	46.1	35	53.9	65	100
Ban Huabeung	52	69.3	23	30.7	75	100

Table 11—9. Personal Record

Village	Yes		No		Total	
	No.	%	No.	%	No.	%
Ban Nonghuaua	—	—	65	100	65	100
Ban Han	—	—	138	100	138	100
Ban Koksoong	—	—	146	100	146	100
Ban Topradoo	—	—	80	100	80	100
Ban Khoklahm	—	—	47	100	47	100
Ban Lawkokhung	—	—	65	100	65	100
Ban Nongwengpeng	—	—	89	100	89	100
Ban Faleum	—	—	131	100	131	100
Ban Nong-oa-noi	—	—	101	100	101	100
Ban Sawang	—	—	65	100	65	100
Ban Huabeung	—	—	75	100	75	100

latrine or pit privy. Refuse disposals are burned in almost every cases. General judgements on surroundings, buildings and hygiene are listed in Table 10. About 70 % of the families live in poor sanitation. In Table 11, personal records for tooth cleaning, washing of bodies, clothes, hands and dishes, and foot wear are shown.

3) Present complaints and physical examinations

As shown in Table 12, abdominal pain was the most frequent complaint recorded. Headache, fever and cough may be the symptoms of common cold. Skin disease was also commonly seen in the villagers. Dizziness is considered

Table 12. Present Complaints

Village No.	Abd. pain	Vomiting	Nausea	Anorexia	Diarrhea	Fatigue	Fever	Cough	Headache	Dizziness
1	12	9	2	8	12	1	12	19	14	5
2	16	3	5		8	3	17	18	22	2
3	9		2		2	2	7	5	5	17
4	27	1	1			4	29	17	20	27
5	7		1	1	1		4	17	1	1
6	27	1	3	2	1	1	20	9	29	6
7	17			5	2		9	8	11	
8	16	1		11	1	2	13	3	18	1
9	5			3		1	2	6	2	
10	3			1	1		8	13	4	1
11	3			2			1	4	1	
Total	132	15	14	33	28	14	122	116	126	60

to be a expression of anemia. The physical examinations revealed that there were few persons who were severely ill among the subjects (Table 13). Loss of tendon reflex, a sign of thiamine deficiency, was found in 39 persons. Angular lesions at the corner of the mouth were infrequently observed, though the result of the dietary survey suggested that riboflavin intake was not enough. Anemia was frequently observed as anticipated. Apparently poor nutrition was seen in 47 persons.

Table 13. Physical Examinations

Village No.	Poor nutrition	Anemia	Skin disease	Angular cheilosis	Liver enlargement	Loss of tendon reflex
1	5	7	10	1	7	5
2	9	8	4		5	3
3	3	11	5		2	2
4	13	8	10	3	6	4
5	6	11	4		1	2
6	4	7	9	1	1	8
7	1	8	6		1	5
8		8	8			4
9	3	7	6	1		4
10	3	12	2		1	1
11		7	2			1
Total	47	94	66	6	24	39

4) Blood pressure

Distribution of blood pressure in each age and sex group are shown in Table 14. Among 479 adult villagers, systolic pressure of only 5 persons exceeded 160 mm Hg. and diastolic pressure of 11 subjects exceeded 90. Hypertension was extremely rare compared with data on Japanese. In Japanese men, 3 % of over 20 to 30 years old, 10 % of over 30 to 40, 18 % of over 40, 30 % of over 50 and 45 % of over 60 have hypertension.

Many factors may be ascribable to the great difference of the occurrence of hypertension between the two countries. The most important factor may be the difference of salt intake. In Japan, average salt intake is about 3.1 g (actual table salt) according to the recent survey. The present dietary survey revealed that mean salt intake of the villagers is 0.9 g, though this is only the results of calculation from actual table salt or salt added during cooking. In the previous survey in Thailand, the average intake of total salt among civilians was reported to be 9.1 g/day.

Although salt intake is lower in Thailand than in Japan, this fact may not be enough to explain the difference of the incidence of hypertension.

Table 14. Distribution of Blood Pressure

Maximum

Age (years)	20-24		25-29		30-39		40-49		50-59		60≤		Total
B. P. (mmHg) \ Sex	M	F	M	F	M	F	M	F	M	F	M	F	
— 79	0	0	0	0	0	0	0	0	0	0	0	0	0
80 —	1	0	0	0	0	0	1	0	0	0	0	0	2
90 —	3	2	1	5	2	1	2	1	1	3	2	2	25
100 —	7	8	5	10	13	9	7	5	3	1	1	1	70
110 —	7	5	15	16	20	19	10	10	4	7	2	2	117
120 —	8	11	19	18	13	26	12	8	2	9	9	4	139
130 —	2	1	7	9	7	11	4	5	7	2	4	3	62
140 —	4	1	4	3	10	4	3	3	2	1	2	4	41
150 —	3	0	4	0	9	1	0	1	0	0	0	0	18
160 —	0	0	0	0	0	0	0	0	1	1	1	0	3
170 —	0	0	0	0	0	1	0	0	0	0	0	1	2

Minimum

Age (years)	20-24		25-29		30-39		40-49		50-59		60≤		Total
B. P. (mmHg) \ Sex	M	F	M	F	M	F	M	F	M	F	M	F	
50 —	0	0	0	1	0	0	0	0	0	2	1	0	4
60 —	15	6	10	8	7	13	5	3	5	4	4	4	84
70 —	12	13	28	38	43	33	22	19	8	15	10	8	249
80 —	6	9	11	13	16	15	19	11	5	3	6	5	119
90 —	2	0	4	2	1	0	1	0	0	0	0	0	10
100 —	0	0	0	0	0	1	0	0	0	0	0	0	1

Influence of hot weather, racial difference and many other factors may be concerned with the low incidence of hypertension in Thailand. Further study is required to elucidate this problem.

5) Body measurement

Results are shown in Table 15-1 and 15-2. In Table 16-1 and 16-2, data on Japanese in 1971 quoted from "The Japan national nutrition research" which has been regularly carried out since 1946 are listed.

The heights of adults show that the Thai have almost equal stature to Japanese. Nevertheless, the heights of the younger age groups are significantly less than that of Japanese. This fact suggests that nutrition of infants and children is especially inadequate in this district.

Average weights of the Thai in this district are less than those of Japanese in all age and sex groups except adult females. Above all, the Thai males attain a maximum body weights in the early twenties subsequent to which there is

Table 15-1. Results of Body Measurement

(Male) Mean and S. D.

Age (years)	Height (cm)		Weight (kg)		Girth of chest (cm)		Girth of upper arm (cm)		Skinfold thickness (cm)		Strength of grip (kg)		No.
< 1	59.8	9.1	6.2	1.9	40.4	3.8	12.2	1.5	8.9	5.3			18
1 —	72.6	7.2	9.0	1.8	43.5	6.8	13.4	1.2	7.4	1.8			16
2 —	80.2	3.9	10.2	0.9	46.9	1.9	13.1	0.6	6.9	0.8			9
3 —	86.7	5.7	11.3	1.6	46.6	2.3	13.7	1.3	7.1	1.8			17
4 —	90.0	5.8	13.6	3.8	50.3	2.1	14.2	1.5	6.8	1.5			12
5 —	97.6	4.1	14.3	1.4	51.3	2.3	13.5	1.6	5.7	1.3	6.0	1.4	17
6 —	101.4	6.6	14.9	1.6	52.7	2.1	14.5	0.7	6.4	1.7	6.7	2.0	13
7 —	109.0	4.9	17.4	2.2	53.6	3.0	14.9	1.2	5.7	1.6	9.8	2.1	18
8 —	114.2	7.1	19.2	3.1	54.9	4.0	15.2	1.0	5.5	1.4	9.9	3.4	20
9 —	121.4	6.2	21.1	3.4	56.9	2.9	15.4	1.3	5.3	1.4	13.6	3.9	12
10 —	119.1	7.5	21.3	3.9	59.1	4.8	15.8	1.9	5.5	2.0	13.2	3.6	21
11 —	123.1	5.3	24.6	4.5	59.2	4.3	16.0	1.6	6.5	4.0	15.8	3.1	8
12 —	129.3	8.9	26.9	6.9	60.2	6.6	17.3	2.2	6.0	3.5	17.3	4.6	16
13 —	137.6	4.7	30.1	3.2	64.1	6.3	17.7	1.5	5.3	1.6	20.1	3.5	8
14 —	137.9	9.8	31.4	6.8	64.2	3.9	17.9	2.0	5.8	1.5	20.2	3.4	7
15 — 19	155.3	7.7	46.8	6.2	78.3	3.3	22.8	1.9	8.4	3.6	30.9	8.3	28
20 — 24	166.0	5.8	55.9	3.8	81.8	4.6	24.8	1.8	6.9	2.4	35.7	5.6	21
25 — 29	162.4	10.4	53.2	7.2	81.7	3.6	24.6	1.9	5.9	0.9	37.7	6.3	16
30 — 39	160.3	6.8	53.5	6.5	82.4	5.6	25.2	2.0	7.8	3.2	34.8	5.4	51
40 — 49	161.4	6.7	53.7	8.0	81.3	4.2	24.6	2.2	7.6	3.2	34.3	3.2	37
50 — 59	159.6	6.7	53.2	9.0	81.5	6.1	24.2	2.2	9.3	3.9	30.7	6.0	15
60 ≤	159.7	5.0	47.5	7.3	78.5	5.1	22.7	2.5	7.2	1.5	26.6	7.8	20

Table 15-2. Results of Body Measurement

(Female) Mean and S. D.

Age (years)	Height (cm)		Weight (kg)		Girth of chest (cm)		Girth of upper arm (cm)		Skinfold thickness (cm)		Strength of grip (kg)		No.
< 1	62.9	4.8	6.7	1.2	40.8	5.1	12.9	1.1	7.2	2.1			12
1 —	70.4	6.3	8.2	1.3	43.9	2.9	12.6	0.9	7.2	1.4			18
2 —	74.1	10.7	8.9	3.5	45.3	3.5	13.0	1.1	7.6	1.3			10
3 —	86.2	7.2	11.6	2.2	49.2	3.0	14.1	1.2	7.5	1.5			20
4 —	90.8	7.3	12.8	2.4	49.6	2.3	14.0	1.0	7.1	1.3			20
5 —	95.6	5.3	14.0	2.1	49.5	1.9	14.5	1.4	7.1	1.6	4.8	1.6	15
6 —	104.1	7.1	16.3	2.8	53.7	3.3	15.1	1.5	6.9	2.0	7.1	2.2	15
7 —	109.8	4.6	16.8	3.1	54.3	2.5	14.8	0.8	6.1	2.1	8.6	3.7	20
8 —	113.5	6.8	18.7	2.9	54.5	3.9	15.1	1.2	6.8	2.7	9.7	1.9	13
9 —	117.6	8.6	19.8	4.3	56.5	6.9	16.6	2.6	6.7	2.5	10.7	3.6	18
10 —	121.2	6.0	21.8	4.4	57.2	3.3	16.6	1.6	6.6	1.6	11.2	4.0	17
11 —	126.5	9.8	26.7	6.5	60.5	5.9	17.1	1.7	6.2	1.1	13.6	3.6	13
12 —	130.9	7.9	26.6	4.9	61.1	3.9	17.6	1.3	6.8	2.1	14.4	4.1	15
13 —	135.9	8.0	30.8	5.7	65.1	6.9	18.1	1.5	6.6	1.7	17.8	5.6	16
14 —	138.1	11.0	34.5	12.9	70.0	9.5	20.0	3.8	8.5	1.6	20.7	7.8	6
15 — 19	148.2	6.6	46.3	6.7	78.6	8.2	22.8	2.2	10.3	4.1	26.1	5.7	29
20 — 24	151.8	8.4	48.9	5.8	83.1	4.8	22.5	2.0	10.9	2.8	24.2	5.8	31
25 — 29	152.7	6.5	49.2	6.0	81.7	5.4	22.9	1.8	9.7	3.1	26.0	5.6	22
30 — 39	151.1	5.0	47.6	6.2	80.2	6.0	23.2	2.1	11.4	4.4	22.8	6.6	55
40 — 49	150.3	5.8	49.9	9.5	80.7	5.9	23.5	2.4	10.2	3.4	21.7	6.7	35
50 — 59	150.3	4.7	46.0	9.9	76.2	6.1	22.3	2.2	8.4	3.0	21.3	5.6	21
60 ≤	147.2	5.2	41.4	5.0	74.8	3.8	20.9	1.9	8.5	3.1	15.1	7.2	15

Table 16-1. Body Measurement (Japanese Males)

Age (years)	Heights (cm)		Body weights (kg)		Girth of chest (cm)		Strength of grip (kg)	
	Mean	S. E.	Mean	S. E.	Mean	S. E.	Mean	S. E.
< 1	67.7	7.4	8.2	1.9	44.3	4.2		
1 —	79.8	4.4	10.7	1.4	48.1	2.9		
2 —	88.6	3.7	12.7	1.5	50.8	2.7		
3 —	95.7	4.9	14.4	1.8	52.4	2.9		
4 —	101.6	3.9	16.3	6.1	53.9	3.3		
5 —	108.7	4.8	18.4	1.9	56.1	2.6		
6 —	113.9	5.0	20.0	2.7	57.2	3.0		
7 —	120.2	5.4	22.4	3.1	59.2	3.2		
8 —	123.4	16.5	25.0	3.8	61.5	3.4		
9 —	130.5	6.0	27.6	4.8	63.7	4.2		
10 —	135.7	6.0	31.2	5.4	65.8	5.1	16.5	5.5
11 —	139.8	8.7	34.3	7.8	68.5	6.5	19.2	5.5
12 —	147.0	11.1	39.1	6.4	71.9	5.0	23.1	5.8
13 —	152.9	12.6	43.4	7.6	73.9	5.2	27.4	7.8
14 —	158.7	11.8	49.6	8.9	78.5	5.9	34.0	8.5
15 —	163.6	11.1	53.8	7.0	81.6	5.1	38.9	6.9
16 —	166.6	6.4	55.7	8.4	82.4	5.1	42.0	7.0
17 —	167.6	6.1	56.9	7.0	84.0	4.6	45.0	8.6
18 —	167.5	5.3	57.8	6.4	86.0	5.1	45.6	8.7
19 —	166.1	5.7	57.2	6.7	85.5	5.4	45.4	9.8
20 —	165.9	11.2	57.6	5.9	85.9	5.1	47.1	8.6
21 —	165.4	18.9	58.2	7.2	87.0	5.0	46.1	7.3
22 —	166.7	5.0	58.6	7.3	86.9	5.7	47.2	9.7
23 —	166.8	5.7	59.1	6.9	87.2	5.0	47.3	7.8
24 —	166.8	4.8	59.5	7.5	88.1	5.3	49.5	9.3
25 —	164.6	6.3	58.9	9.6	86.8	7.3	44.7	8.4
26 — 29	164.4	10.8	59.5	8.5	88.2	5.7	45.1	8.6
30 — 39	163.2	10.5	59.8	9.3	88.3	5.7	44.2	8.0
40 — 49	161.7	10.8	58.9	9.2	88.0	5.7	42.1	7.8
50 — 59	160.1	7.4	56.6	8.1	87.2	5.7	37.9	7.8
60 — 69	157.0	12.8	54.7	8.9	86.8	5.9		
70 ≤	155.7	5.7	50.7	8.0	85.0	5.8		

Table 16-2. Body Measurement (Japanese Females)

Age (years)	Heights (cm)		Body weights (kg)		Girth of Chest (cm)		Strength of grip (kg)	
	Mean	S. E.	Mean	S. E.	Mean	S. E.	Mean	S. E.
< 1	66.2	6.7	8.1	5.1	44.2	5.4		
1 —	79.2	4.5	10.3	1.4	47.1	2.5		
2 —	87.1	4.2	12.9	9.4	49.7	2.4		
3 —	95.0	4.0	14.1	1.6	51.7	3.2		
4 —	102.3	5.1	15.9	1.8	52.8	2.5		
5 —	108.2	4.9	17.8	2.3	54.5	2.6		
6 —	113.1	5.1	19.7	2.5	56.5	2.9		
7 —	118.1	9.8	21.6	2.8	57.8	3.3		
8 —	124.4	5.7	24.6	5.8	59.9	3.9		
9 —	131.3	6.6	27.8	5.7	62.7	6.3		
10 —	135.4	6.8	30.6	5.8	65.2	5.8	14.3	4.5
11 —	142.0	10.8	35.6	6.5	68.9	6.2	17.9	5.2
12 —	148.1	10.1	40.9	6.4	73.5	5.3	20.9	6.3
13 —	150.5	9.4	44.0	6.7	75.7	5.1	23.3	5.7
14 —	152.6	10.5	46.8	6.0	77.6	4.6	26.3	5.2
15 —	153.1	13.7	50.7	6.8	80.0	5.0	28.2	5.5
16 —	155.3	4.8	50.8	6.5	80.3	4.4	27.7	5.1
17 —	154.4	13.8	51.5	6.5	80.2	4.8	27.7	5.3
18 —	152.7	14.3	50.9	6.6	81.2	5.5	28.1	5.4
19 —	154.0	12.8	51.9	5.9	82.0	4.4	28.2	5.3
20 —	154.5	11.3	51.5	6.8	81.4	6.1	27.7	5.9
21 —	152.5	10.6	49.7	6.5	81.0	4.8	26.7	6.4
22 —	153.6	10.6	50.1	5.0	81.0	4.5	26.3	6.4
23 —	153.4	10.8	51.3	6.9	82.4	5.2	26.9	5.4
24 —	154.4	5.0	51.1	7.1	82.5	5.5	27.3	5.8
25 —	153.2	6.2	49.9	7.1	81.3	5.8	26.1	6.3
26 — 29	152.5	8.1	50.4	7.1	82.2	5.6	26.7	5.5
30 — 39	151.4	9.9	51.9	7.7	83.8	6.4	26.6	5.8
40 — 49	150.0	9.3	52.1	8.3	84.0	6.9	25.3	5.9
50 — 59	148.1	8.3	50.6	8.2	83.7	7.4	22.1	5.9
60 — 69	145.0	8.9	47.8	8.4	82.7	7.5		
70 ≤	141.6	9.0	44.3	8.1	81.3	7.6		

a gradual decline in weight as one approaches the old ages as pointed out by the previous survey in Thailand.¹⁾

This is not true for females, in whom maximum body weight is observed in the age of 40 to 50.

It is of particular interest that obesity is rarely seen in this area as shown in the Broca's index (Table 17, Fig. 1) and the Kaup's index (Table 18). Those who show the level of Broca's index of over 110 are thought to be obesity. Only 2-7 % of adult males are judged as obesity by this criteria. In females, it is known that this index tends to have much greater values than in males. Therefore, comparison between the both sexes are not reasonable. But comparison between Japanese and Thai in the same sex is possible.

The data of the girth of upper arm and the skinfold thickness could not be compared between the two nations because data of Japanese were not available. As Table 15 and 16 show, the strength of grip of the Thai is significantly less than that of Japanese. But the present data seem to be inaccurate because explanations how to use the grip meter were not enough for the villagers.

6) Blood examinations

The criteria of WHO on nutritional anemia⁸⁾ (Table 19) was adapted for this research. Pregnant women was included in the adult females as data whether they were pregnant or not were incomplete.

The criteria for low values in serum iron, % saturation of transferrin, serum vitamin B₁₂ and folate are those recommended by WHO^{8) 9) 10)} shown in Table 20. The upper limit of normal percentage of eosinophils is 8 % in the present research.

Results are shown in Table 21 and 22. Table 23, Figure 1 and 2 show the distribution of hemoglobin. The incidence of anemia judged from hemoglobin and hematocrit is 32.5 % and 31.3 % respectively. It ranged from 14.6 % to 49.2 % in each village. The proportion of anemia is illustrated in Fig. 3. The incidence of anemia is the highest in the age group of children below 6 years old and the lowest in the adult males.

Low serum iron levels were observed in 36.2 % of 698 subjects and low % saturation in 35.4 %. Among the four groups, low serum iron and % saturation were most frequently observed in the children group below 6 years old, next in the adult females as Fig. 4 illustrates.

Low serum vitamin B₁₂ levels below 80 pg/ml were detected in only 4 cases in the total 607 persons. Serum folate levels were low in 3.1 % of the children, 2.0 % of the boys and girls, 12.1 % of the adult males and 6.5 % of the adult females.

These data suggest that anemia is prevalent in this area in all age groups

Table 17-1. Broca's Index

Sex	Age (years)	<80	80≤	90≤	100≤	110≤	120≤	Total	Mean±S. D.
Male	15—	13(43.3)	11(36.7)	5(16.7)	1 (3.3)	0	0	30(100)	81.7± 8.1
	20—	6(11.5)	36(69.2)	6(11.5)	3 (5.8)	1(2.0)	0	52	86.4± 7.8
	30—	16(28.1)	18(31.6)	16(28.1)	3 (5.2)	4(7.0)	0	57	88.1±11.2
	40—	10(26.3)	15(39.5)	8(21.1)	4(10.5)	0	1(2.6)	38	87.5±11.2
	50—	4(20.0)	9(45.0)	6(30.0)	1 (5.0)	0	0	20	87.5± 9.1
	60—	9(39.1)	12(52.2)	2 (8.7)	0	0	0	23	79.9± 9.3
Female	15—	5(10.2)	14(28.6)	13(26.5)	10(20.4)	4(8.2)	3(6.1)	49	95.5±16.3
	20—	3 (4.5)	24(36.4)	13(19.8)	22(33.3)	1(1.5)	3(4.5)	66	94.9±12.3
	30—	3 (4.8)	21(33.9)	20(32.3)	13(21.0)	4(6.4)	1(1.6)	62	94.9±11.0
	40—	4 (9.5)	11(26.2)	12(28.6)	8(19.1)	4(9.5)	3(7.1)	42	94.2±14.7
	50—	10(35.7)	10(35.7)	4(14.4)	2 (7.1)	0	2(7.1)	28	87.4±14.3
	60—	5(25.0)	8(40.0)	3(15.0)	4(20.0)	0	0	20	79.9± 9.3

* Percentage in parentheses

Table 17-2. Broca's Index of Japanese (1971)

Sex	Age (years)	<80	80≤	90≤	100≤	110≤	120≤	Total
Male	20—	16.5%	38.1%	30.3%	11.1%	3.1%	0.8%	100%
	30—	9.5	31.3	31.6	17.5	6.8	3.4	100
	40—	9.4	27.9	32.7	20.0	6.5	3.4	100
	50—	9.8	28.8	30.3	21.8	6.6	2.7	100
Female	20—	7.5	31.3	33.5	17.2	6.4	4.2	100
	30—	4.4	19.3	31.5	21.9	14.1	8.8	100
	40—	3.6	13.9	27.6	24.1	16.9	13.9	100
	50—	3.9	15.8	21.5	22.0	18.7	18.2	100

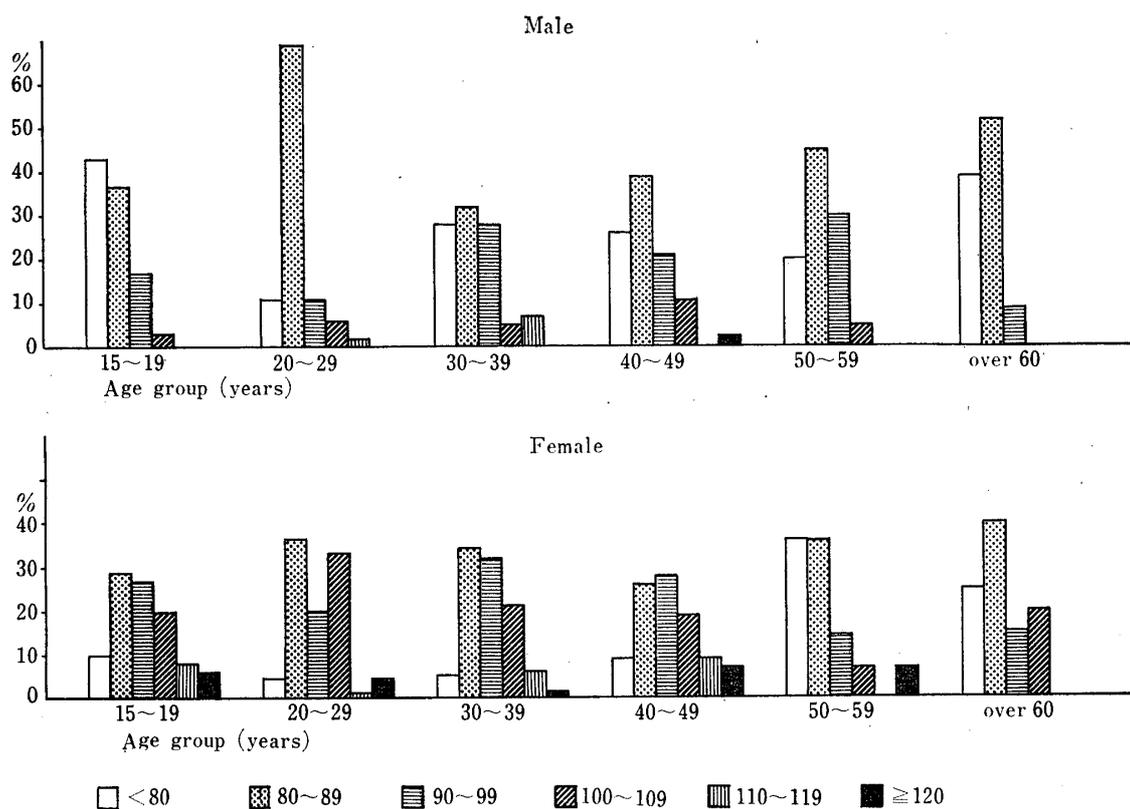


Fig. 1 Distribution of Broca's Index

except the adult males. The anemia proved to be due to iron deficiency in almost every cases, because examinations of the peripheral blood films revealed that red blood cells were hypochromic and microcytic and low serum iron levels were seen in almost the same percentage of the incidence of the anemia.

In addition, low serum vitamin B₁₂ and folate levels were rarely observed.

As fig. 5 illustrates, increase of eosinophils in the peripheral blood films were frequently seen in all age groups. As infestation of the hook worm is extremely common in this area (see the chapter of stool examination), it is reasonable to conclude that the increase of eosinophils is due to infestation of the parasites.

The mean total serum protein levels in each age groups are shown in Table 22. In the children below 6 years old, the mean total protein level was significantly lower than that of the other generations.

It is very interesting that this fact is well coincident with our impression that protein nutrition of infants and small children was insufficient and inadequate in most of the families in which the dietary survey was made.

A case of protein calorie malnutrition was detected among the children examined. Further study is needed to clarify the causal relation of protein malnutrition to the anemia of the children.

Table 18. Kaup's Index

(Male)								
Age (years)	Total No.	<13	13—	15—	17—	19—	21≤	Mean±S. D.
< 1	19	1	2	7	2	3	4	17.9±3.1
1 —	19	0	6	5	4	2	2	17.1±3.7
2 —	14	0	4	6	2	2	0	16.1±1.3
3 —	18	0	13	3	2	0	0	15.0±1.4
4 —	15	1	4	7	3	0	0	15.4±1.8
5 —	19	0	11	5	2	0	1	15.6±2.7
6 —	17	2	5	9	1	0	0	14.9±1.9
7 —	18	1	11	6	0	0	0	14.6±1.1
8 —	22	1	14	7	0	0	0	14.7±1.2
9 —	15	1	8	6	0	0	0	14.5±1.4
10 —	23	3	7	13	6	0	0	14.8±1.8
11 —	8	0	4	1	2	0	0	16.4±2.9
12 —	18	2	5	9	1	0	1	15.4±1.2
13 —	8	0	2	4	1	0	1	16.9±3.3
14 —	7	0	1	2	4	0	0	16.5±1.5

(Female)								
Age (years)	Total No.	<13	13—	15—	17—	19—	21≤	Mean±S. D.
< 1	16	0	3	3	5	4	1	17.3±2.2
1 —	14	0	3	8	1	2	0	16.3±2.0
2 —	13	0	5	4	4	0	0	15.7±1.5
3 —	24	1	5	14	3	0	1	15.9±1.7
4 —	17	2	7	6	1	0	1	15.2±2.1
5 —	17	1	8	5	1	1	1	15.3±2.6
6 —	15	1	10	3	0	1	0	14.7±1.5
7 —	21	3	13	4	1	0	0	14.4±0.6
8 —	16	3	6	6	0	1	0	15.0±1.6
9 —	19	3	9	7	0	0	0	14.0±1.8
10 —	18	0	9	8	0	1	0	15.2±1.8
11 —	12	0	4	3	4	0	1	16.7±2.6
12 —	16	1	4	8	3	0	0	15.4±1.6
13 —	17	0	3	9	2	3	0	16.5±1.4
14 —	7	1	2	1	0	2	1	17.1±3.9

Table 19. Criteria of Anemia (WHO)

	Hemoglobin g/dl	Hematocrit %
6 months~6 years	11	33
6~14 years	12	36
Adult males	13	39
Adult females	12	36

Table 20. Limits of Low Values

Iron	50 µg/dl
% Saturation	15 %
Vitamin B ₁₂	80 pg/ml
Folate	3 ng/ml

Table 21. Analysis of Results

Hb.		Total No. Examined	Low Hb. (%)	Village No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11
Age														
< 6 years	86 (40.2)	214	14/17 (82.5)	7/15 (46.7)	2/10 (20.0)	11/27 (40.7)	9/24 (37.5)	9/22 (40.9)	7/12 (58.3)	10/20 (50.0)	3/17 (17.6)	8/26 (30.8)	6/21 (28.6)	
6-14 years	96 (35.4)	271	8/19 (42.1)	5/17 (29.4)	5/14 (35.7)	5/24 (20.8)	10/18 (55.6)	13/34 (38.2)	11/23 (47.8)	16/36 (44.4)	5/29 (17.2)	13/36 (36.1)	5/28 (17.9)	
Adult males	33 (14.8)	223	5/16 (31.3)	5/16 (31.3)	1/9 (11.1)	2/24 (8.3)	1/11 (9.1)	4/28 (14.3)	5/14 (35.7)	5/29 (17.2)	0/20 (0.0)	3/40 (7.5)	2/16 (12.5)	
Adult females	103 (38.3)	269	6/19 (31.6)	9/20 (45.0)	2/12 (16.7)	11/30 (36.7)	5/16 (31.3)	17/36 (47.2)	11/20 (55.0)	14/34 (41.2)	5/23 (21.7)	10/29 (34.5)	13/26 (50.0)	
total No.	318 (32.5)	977	33/71 (46.5)	26/68 (38.2)	10/45 (22.2)	29/105 (27.6)	25/69 (36.2)	43/120 (30.8)	34/69 (49.2)	45/119 (37.8)	13/89 (14.6)	34/131 (25.9)	26/91 (28.5)	

Ht		Total No. Examined	Low Ht. (%)	Village No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11
Age														
< 6 years	60 (28.0)	214	5/17 (29.4)	8/15 (53.3)	3/10 (30.0)	9/27 (33.3)	9/24 (37.5)	2/22 (9.1)	2/12 (16.7)	5/20 (25.0)	1/17 (5.9)	5/26 (19.2)	3/21 (28.6)	
6-14 years	103 (38.0)	271	10/19 (52.6)	8/17 (47.1)	8/14 (57.1)	5/24 (20.8)	12/18 (66.7)	8/34 (23.5)	9/23 (39.1)	14/36 (38.9)	6/29 (20.7)	12/36 (33.3)	9/28 (32.1)	
Adult males	36 (16.1)	223	5/16 (31.3)	6/16 (37.5)	0/9 (0.0)	2/24 (8.3)	2/11 (18.2)	4/28 (14.3)	3/14 (21.4)	6/29 (20.7)	0/20 (0.0)	6/40 (15.0)	2/16 (12.5)	
Adult females	107 (39.8)	269	12/19 (63.2)	7/20 (35.0)	5/12 (41.7)	9/30 (30.0)	6/16 (37.5)	15/36 (41.7)	12/20 (60.0)	15/34 (44.1)	5/23 (21.7)	9/29 (31.0)	12/26 (46.2)	
total No.	376 (31.3)	977	32/71 (45.1)	29/68 (42.6)	16/45 (35.6)	25/105 (23.8)	29/69 (42.0)	29/120 (24.2)	26/69 (37.7)	40/119 (33.6)	12/89 (13.5)	32/131 (24.4)	26/91 (28.6)	

S-Iron		Total No. Examined	<50 µg/dl (%)	Village No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11
		698	253 (36.2)	22/49 (44.9)	15/50 (30.0)	18/33 (54.5)	36/85 (42.4)	26/49 (53.1)	31/85 (36.5)	25/56 (44.6)	24/81 (29.6)	20/60 (33.3)	28/96 (29.2)	8/54 (14.8)

% Saturation		Total No. Examined	<15% (%)	Village No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11
		582	206 (35.4)	21/46 (45.7)	9/45 (20.0)	12/25 (48.0)	29/83 (34.9)	19/36 (52.8)	25/83 (30.0)	12/46 (26.1)	21/78 (26.9)	12/43 (27.9)	28/90 (31.1)	18/53 (34.0)

V. B ₁₂		Total No. Examined	<80 pg/ml (%)	Village No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11
		607	4 (0.7)	0/40 (0.0)	0/48 (0.0)	1/24 (4.2)	0/72 (0.0)	0/37 (0.0)	1/81 (1.2)	1/45 (2.2)	1/75 (1.3)	0/48 (0.0)	0/84 (0.0)	0/53 (0.0)

S-Folate		Total No. Examined	<3 ng/ml (%)	Village No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11
		618	47 (7.6)	4/40 (10.0)	2/46 (4.3)	2/27 (7.4)	2/75 (2.7)	1/39 (2.6)	9/67 (13.4)	4/45 (8.9)	2/73 (2.7)	3/53 (5.7)	9/100 (9.0)	9/53 (17.0)

Eosinophils		Total No. Examined	>8% (%)	Village No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11
		988	680 (68.8)	49/71 (69.0)	36/69 (52.2)	32/44 (72.7)	95/113 (84.1)	57/69 (82.6)	70/121 (57.9)	52/69 (75.4)	74/119 (62.2)	64/90 (40.6)	91/132 (68.9)	60/91 (65.9)

(%) : No. low level / Total number × 100

Table 22. Blood Examination in Each Age Group

Age	Low Hb	Low Ht	Total	High Eo.	Total	Low iron	Total
< 6 years	86 (40.2)	60 (28.0)	214	131 (63.0)	208	29 (67.4)	43
6 — 14 years	96 (35.4)	103 (38.0)	271	227 (83.2)	273	69 (37.9)	182
Adult males	33 (14.8)	36 (16.1)	223	177 (75.3)	235	41 (19.2)	213
Adult females	103 (38.3)	107 (39.8)	269	187 (68.0)	275	112 (42.6)	263
Total	318 (32.5)	306 (31.3)	977	722 (72.9)	991	251 (35.8)	701

Age	Low % satu.	Total	Low folate	Total	Mean total protein	Total
Under 6 years	11 (45.8)	26	1 (3.2)	31	6.8 ± 0.50	123
6 to 14 years	50 (32.5)	154	3 (2.0)	146	7.21 ± 0.42	228
Adult males	36 (17.9)	201	24 (12.1)	198	7.38 ± 0.46	215
Adult females	107 (43.0)	249	15 (6.5)	232	7.33 ± 0.57	264
Total	204 (32.4)	630	43 (7.1)	607	Mean ± S. D.	

* Percentage in parentheses

Table 23. Distribution of Hemoglobin

Hemoglobin (g/dl)	< 6 years	6—14 years	Adult males	Adult females
< 6	1 (0.5)			1 (0.4)
6 —	3 (1.4)	2 (0.7)		2 (0.7)
7 —	1 (0.5)	1 (0.4)		5 (1.9)
8 —	11 (5.2)	4 (1.4)	1 (0.4)	6 (2.2)
9 —	18 (8.5)	7 (2.5)	3 (1.3)	11 (4.1)
10 —	43 (20.4)	33 (11.9)	2 (0.9)	24 (8.9)
11 —	61 (28.9)	51 (18.3)	8 (3.6)	53 (19.7)
12 —	55 (26.1)	95 (34.2)	19 (8.5)	77 (28.6)
13 —	11 (5.2)	66 (23.7)	50 (22.4)	57 (21.2)
14 —	6 (2.8)	15 (5.4)	48 (21.5)	25 (9.3)
15 —	0	3 (1.1)	57 (25.6)	3 (1.1)
16 —	1 (0.5)	0	28 (12.6)	1 (0.4)
17 — 17.9	0	1 (0.4)	7 (3.1)	0
Total	211	278	223	269

* Percentage in parentheses

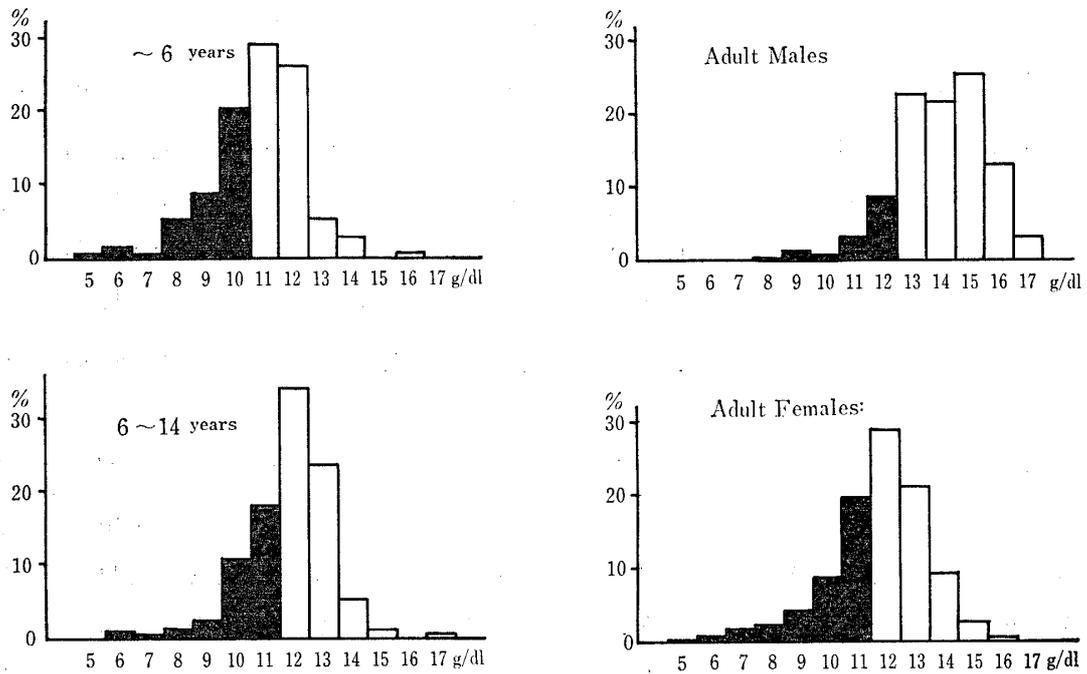


Fig. 2 Distribution of Hemoglobin

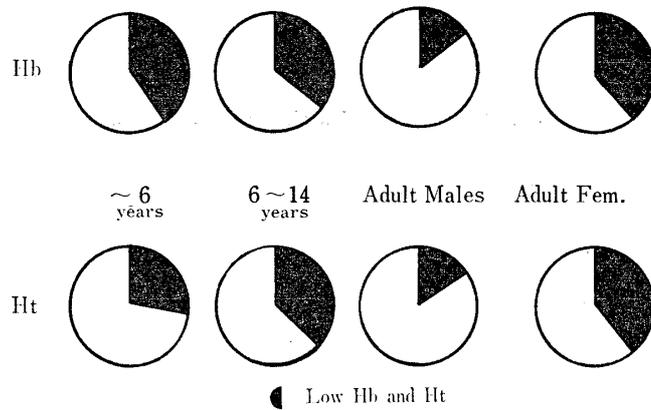


Fig. 3 Proportion of Anemia

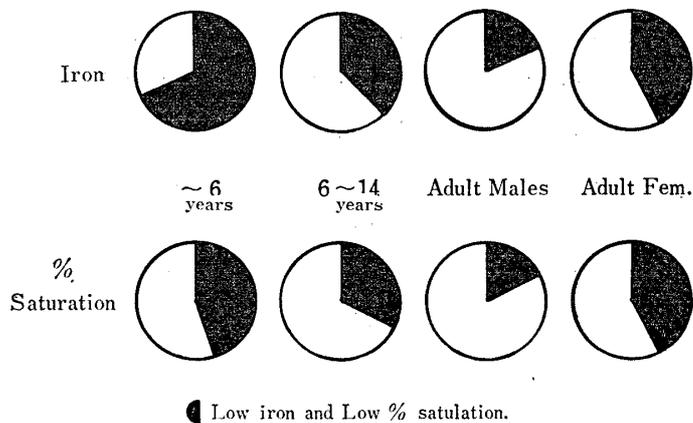


Fig. 4 Proportion of Low Serum Iron and Low % Saturation

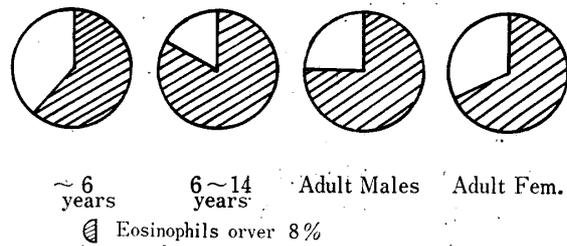


Fig. 5 Rate of Eosinophilia

Investigation on Parasite Infestation

1) Subjects and methods

Stools were examined for 1,004 villagers. On 819 (81.9 %) of them, the medical examinations including blood analysis were made.

The floating method using saturated salt solution and the thick smear method using cellophane cover (Kato) were applied. The centrifugation method using tween 80 citric acid ether was tried for some of the specimens.

2) Results and discussion

In Table 24, parasitic rates of the 11 villages are shown. They ranged from 41 % to 89.2 %. The mean was 73.9 %. High rate of infestation over 80 % was seen in 6 villages.

Mixed infestation of two kinds of parasites was seen in 485 subjects (65.4 %). High incidence of mixed infestation was recorded in Ban Sawang (79.3 %) and in Ban Nongwengpeng (79.5 %). Three kinds of eggs were seen in 125 (17.3 %) and four kinds in 16. In 2 persons, as many as 5 kinds of eggs was detected.

Parasitic rates of various eggs are shown in Table 25. hookworm (67.5 %) and *Opisthorchis viverrini* (49.5 %) were the eggs most frequently observed. Infestation of *Hypoderaeum conoideum* was seen in 16 % and that of *Taenia saginata* in 4.5 %. *Trichuris trichiura* and *Ascaris lumbricoides* were rarely detected in this district.

High infestation rate of hookworm can be explained well by their habits of not wearing shoes and not using latrines. The prevalence of liver flukes is due to their dietary habits of eating fishes, frogs, and ducks.

Hypoderaeum conoideum was rather frequently seen in Ban Nongwengpeng, Ban Koksoong and Ban Topradoo. *Taenia saginata* was most prevalent in Ban Nongwengpeng. Only one case of *Diphylidium caninum* was observed in Ban Nongwengpeng.

As shown in Table 26, infestation rate of the infants and the children below 3 years old is very low. It increases prominently at the age of 3-5 and reaches to the level of 81.7 % after 6 years old. This phenomenon can be explained by the fact that hookworm infestation from their skins occurs after children begin to walk without footwears.

Table 24. Parasitic Rate

Village	No. of Persons	Positivity (%)	2 spp.	3 spp.	4 spp.	5 spp.	Negative
Ban Khota	144 (144)	59 (41.0)	27	2	1		85
Ban Nonghuaua	71 (71)	34 (47.6)	10	6	1		37
Ban Khoklahm	48 (48)	37 (77.1)	20	1	1		11
Ban Han	126 (90)	88 (69.8)	47	11			38
Ban Topradoo	76 (34)	67 (88.2)	25	17		1	9
Ban Faleum	124 (31)	96 (77.4)	48	7			28
Ban Huabeung	70 (7)	59 (84.3)	26	4	1		11
Ban Lawkokhung	60	51 (85.0)	35	3			9
Ban Sawang	63	53 (84.1)	36	6			10
Ban Nongwengpeng	93	83 (89.2)	35	22	8	1	10
Ban Koksoong	129 (11)	115 (89.1)	48	33	2		14
Total	1004 (436)	742 (73.9)	357	112	14	2	262

() Showing No. of persons by flotation in saturated salt solution only.

Table 25. Examination on Infection

Village	Hook-	Ov.	Ts.	Hc.	Tt.	Ev.	Al.	He.	Hn.	Dc.	Total	No. of Persons
Ban Khota	59	30	1	3							93	144
Ban Nonghuaua	34	13		7		1					55	71
Ban Khoklahm	37	21	1	3							62	48
Ban Han	78	63	4	2	5	1		3			156	126
Ban Topradoo	64	37	6	15	2	1	3				128	76
Ban Faleum	80	64	6	4	2	2			3		161	124
Ban Huabeung	55	34	1		3	3					96	70
Ban Lawkokhung	46	42	2				2				92	60
Ban Sawang	48	47	3	2	1						101	63
Ban Nongwengpeng	77	64	14	24	2	2	2	2		1	188	93
Ban Koksoong	100	82	7	40	2	3		1			235	129
Total	678	497	45	100	17	13	7	6	3	1	1367	1004
%	67.5	49.5	4.5	10.0	1.7	1.3	0.7	0.6	0.3	0.1		

Remarks	Hook-	<i>Necator americanu</i>
		<i>Ancylostoma duodenale</i>
	Ov.	<i>Opisthorchis viverrini</i>
	Ts.	<i>Taenia saginata</i>
	Hc.	<i>Hypoderaeum conoideum</i>
	Tt.	<i>Trichuris trichiura</i>
	Ev.	<i>Enterobius vermicularis</i>
	Al.	<i>Ascaris lumbricoides</i>
	He.	<i>Heterophyes spp.</i>
	Hn.	<i>Hymenolepis nana</i>
	Dc.	<i>Diphylidium caninum</i>

Table 26. Number of Infested Persons by Age

Age		0~	1~	3~	6~	10~	15~	20~	30~	40~	50~	60~	Total
Parasite	Male	3	4	31	58	69	29	50	41	29	16	19	349
"	Female	0	8	33	66	62	51	57	48	30	24	14	393
Negative	Male	12	22	22	13	6	4	19	13	12	5	7	135
"	Female	17	19	21	5	10	12	11	11	11	4	6	127
Total		32	53	107	142	147	96	137	113	82	49	46	1,004
P/T %		9.4	22.6	59.8	87.3	89.1	83.3	78.1	78.8	72.0	81.6	71.7	73.9

Table 27. Relation of Hookworm's Parasite and Hb Value

Age		Low Hb				Acceptable				Total No. L/T (%)
		0~	6~	15~	Total	0~	6~	15~	Total	
Hok-Worm	Male	10	47	20	77	26	57	112	195	272 (28.3)
	Female	10	33	62	105	22	67	101	190	295 (35.6)
Negative	Male	23	4	12	39	17	14	44	65	104 (37.5)
	Female	25	4	22	51	30	14	35	79	130 (39.2)
Total		68	88	116	272	95	152	292	539	811 (33.5)
H/T %		29.4	90.9	70.7	66.9	50.5	81.6	72.9	71.4	69.9

Remarks 6>M, F 11 g/dl
6≤M, F<15 12 g/dl
15≤F 12 g/dl
15≤M 13 g/dl

Table 28. Relation of Parasite and Eosinophil

	Eosinophil value (%)								Mean	Total
	0~	10~	20~	30~	40~	50~	60~			
Parasite (all species)	196	272	115	31	10	3	1	14.9	628	
Negative	92	80	15	2	1	0	0	9.9	191	
Total	289	352	130	33	11	3	1	13.7	819	
P/T %	67.8	77.3	88.5	93.9	90.9	100.0	100.0		76.7	
Parasite (Hookworm)	168	253	110	30	10	2	1	15.1	574	
Negative	121	99	20	3	1	1	0	10.5	245	
Total	289	352	130	33	11	3	1	13.7	819	
P/T %	58.1	71.9	84.6	90.9	90.9	66.7	100.0		70.1	

The infestation rates are 72.1 % in males and 75.6 % in females respectively. The difference is not significant.

The parasitic rate showed no difference between the anemic and non-anemic persons (see Table 27).

Table 28 shows that mean percentage of eosinophils was 13.7 %. The increase

of eosinophils is due to the infestation of parasites because other causes of eosinophilia were not revealed among the villagers.

Discussion

As the purpose of the present research is to elucidate the cause of the anemia in this district, discussion is limited to hematological problems and other data on the nutrition and the stool examinations.

Anemia was prevalent among the villagers except the adult males. Nearly one third of the subjects were anemic. Results of the estimations of serum iron, % saturation of transferrin, vitamin B₁₂ and folate revealed that the cause of the anemia was iron deficiency in almost every cases. In the children below 6 years old, protein malnutrition seemed to play some role for the pathogenesis of the anemia.

Nevertheless, most important factor is thought to be iron deficiency. What is the cause of the iron deficiency?

Two factors can be postulated. One is hookworm infestation and the other malnutrition. Mean infestation rate of hookworm was 67.5 %. But even in those villages where the infested rate of hookworm was extremely high, the incidence of the anemia was not higher than that of the other villages. In addition, hookworm infestation was prevalent in the adult males in whom incidence of the anemia was rather low. These facts suggest that hookworm infestation is not the sole cause of the anemia but it is one of the underlying factors that reduces iron stores of all the villagers in this area.

Nutritional factor may be more important. The nutritional survey on 42 families revealed that the mean intake of iron was 7.9 mg. The present result was quite different from that of the previous report in Thailand which showed that average iron intake exceeded 18 mg/person/day. The recommended daily allowance of Thailand and the recommended intake of WHO are shown in Table 29. As the present dietary survey was performed for the family, individual iron intake was not able to be obtained directly. Therefore following formula was utilized to calculate the iron intake of the individual person.

$$\text{Intake} = \frac{\text{Iron intake of the family}}{\text{Number of the member of the family}} \div \frac{\text{Standard man ratio of the family based on Table 30}}{\text{Standard man ratio for the individual based on Table 30}}$$

Results of the calculation are shown in Table 31. It is obvious from this Table that iron intake of the females in the age of 13 to 49 and the pregnant

and lactating women is below the levels shown in Table 29. Though the intake seems to be enough in the children below 6 years old according to the allowance of Thailand, it is less than the amount of daily intake recommended by WHO. Therefore only the adult males and the boys over 10 years old take enough amount of iron in this district.

Table 29. Recommended Daily Iron Allowance of Thailand and Recommended Daily Intake of WHO

Age (years)		Thailand	WHO (Cal. from Animal food/Total Cal. <0.1)
		Iron (mg)	Iron (mg)
Infants	< 1	1.0/body wt. kg	10
Children	1- 9	4	10
	10-12	8	10
Boys	13-16	11	18
	17-19	11	9
Girls	13-16	16	18
	17-19	16	24
Male	20≤	6	9
Female	20-49	16	28
	50≤	6	9
Pregnant & lactating women		26	28

Table 30. Standard Man Ratio

Age (years)	Standard Man Ratio	
	(Male & Female)	
< 1	0.25	
1 - 3	0.35	
4 - 6	0.50	
7 - 9	0.65	
10 - 12	0.75	
	Male	Female
13 - 15	1.00	0.75
16 - 19	1.20	0.70
20 - 59	1.00	0.80
≥ 60	0.75	0.55
Pregnant women	—	1.00

Table 31. Iron Intake Calculated from Standard Man Ratio

Age (years)	Sex	n	Iron intake (mg/day)	
			Mean	S. D.
1 ~ 3	Male } Female }	20	5.6	1.6
4 ~ 5	Male } Female }	17	8.6	3.2
6 ~ 9	Male } Female }	30	10.3	3.4
10 ~ 12	Male } Female }	14	11.2	3.6
13 ~	Male	46	16.1	6.3
13 ~ 49	Female	35	12.5	4.7
50 ~	Female	11	11.2	4.6
Pregnant and lactating women		17	17.0	6.9

This can explain well the fact that the anemia was frequently observed in this district except adult males.

In addition to low iron intake, the degree of iron absorption should be taken into account. As reported by Layrisse et al.,¹²⁾ the absorbability of iron is known to be excellent with animal foods and inferior with cereals and vegetables. It has also been postulated that phytates interfere with iron absorption.¹³⁾

It was revealed in the present survey that only 22.8 % of iron was taken from animal sources. Above all, 40 % of iron was derived from rice in which the content of phytate was rather abundant.

Therefore, amount of available iron is considered to be less than the calculated level of intake.

Among other factors than iron, low protein intake may play some role for the pathogenesis of the anemia of the infants and children below 6 years old.

Vitamin B₁₂ and folate are less concerned with the anemia in this district. It is interesting that vitamin B₁₂ deficiency proved to be rare in Thailand. Pernicious anemia is also very rare in Japan. Presumably this is due to ethnical property of the oriental race.

Folic acid intake was calculated after the assay of some of Thai foods and by the application of the previous data¹⁴⁾ about Japanese foods. Mean intakes of free folate is 156.3 $\mu\text{g}/\text{day}$ and total folate 252.1 $\mu\text{g}/\text{day}$ respectively. This amount is greater than the minimum requirements for health. In fact, no person showed clinical folic acid deficiency. The present survey also confirmed the observation that folate and vitamin B₁₂ deficiencies were rare in pregnant

women in Bangkok.¹⁵⁾

As previously suggested in Japan,¹⁶⁾ folic acid deficiency is rather rare among those ethnical groups whose diets consists primarily or exclusively of rice. These findings are contrary to the description of Dr. V. Herbert.¹⁷⁾ In Thailand and Japan, as large amount of rice is taken daily, folic acid intake from rice exceed the minimum level of daily requirement in spite of rather low folic acid content of cooked rice.

Tropical malabsorption syndrome has been reported to exist in Thailand.¹⁸⁾ Though the present survey did not include any absorption study, digestion of foods seemed to be insufficient according to the observation of the appearance of stools at the time of parasite examinations. It is assumed that the mal-absorption of iron also played some role for the pathogenesis of the anemia.

Abnormal hemoglobin (Hb. E) has been reported to exist in Thailand.¹⁹⁾ Unfortunately, no investigation was included in the present survey. Further study is needed.

Recommendations

1) The prevalence of infestation of intestinal parasites particularly of hookworm appears to remain a serious public health problem. Loss of iron by bleeding due to hookworm seems to play some role for the deficiency of this nutrient.

Therapy of each person by administration of vermicides may be ineffective unless the procedure is made repeatedly and widely for all the villagers of the area. It is very expensive and not practical. More fundamental and easy way is to settle lavatories and to educate villagers to use them. Though some projects are underway in some of the villages, it should be done more thoroughly. Education of sanitation such as washing of hands, foot wear, knowledge on the intermediate hosts of the parasites etc. should be given sufficiently at school.

2) Many nutrients are known to be concerned with anemia. Among them, iron and protein seems to be most important in this area. Folic acid and vitamin B₁₂ are less concerned with the anemia. Present nutritional survey revealed that the intake of iron is not sufficient except adult males. Protein malnutrition is suggested to exist among children. Heights and body weights of children are significantly lower in Thailand than in Japan though the difference are not so apparent in adults. This fact also suggests that nutrition of infants and children is particularly inferior and this inferiority is not recovered until they have grown up. Well-balanced protein should be given for the weaning infants and growing children preferentially in the family. Therefore, education of mothers seems to be most important. Mothers should

be taught what kinds of diet is necessary for the weaning baby.

The sources of well-balanced protein such as meat, eggs, fishes and fish-products may not readily available because of economic problems in the farmers of this district, but education is possible. Education should be made not only for pupils but also for mothers at each home during the pregnancy and the lactation period. Education by "Rounding school for mothers and pregnant women" is recommended.

This system is carried out as follows. A doctor, nurse or midwife go round village to village, and give regular lectures once a week or a month to mothers and pregnant women.

Knowledges on nutrition, sanitation, diseases of babies, vaccination and so on can be given there. This system is very practical and proved to be very fruitful for improvement of nutrition of the babies in rural area in Japan.

As for the sources of animal protein, duck or eggs are expensive for the farmers. Fishes and frogs are available as rather cheaper sources of animal protein in this district.

So it is recommended to teach mothers to give them by appropriate cooking for their babies and children preferentially.

3) Control of the anemias in this area is a very important problem. Improvement of nutrition and conquest of hookworm may be necessary. But it will take an indefinite period of time. The anemias of children will be diminished if nutrition of weaning period is improved. More difficult problem is iron deficiency of adult females. Frequent pregnancy should be avoided by the birth control. Iron intake is not enough for women and it will not be easily increased unless economic development is achieved in this district. At present, it is recommended to give iron tablets for the pregnant women during late stages of pregnancy and this is thought to be the only way that can be attained for the prophylaxis and treatment of anemias in adult females in this district.

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