Union of Burma

NUTRITION SURVEY

October – December 1961

A Report by the
Interdepartmental Committee on
Nutrition for National Defense

May 1963

OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE
WASHINGTON 25, D.C.

MANPOWER

17 May 1963

Dear Colonel Hla Han:

It is my pleasure to transmit, on behalf of the Interdepartmental Committee on Nutrition for National Defense (ICNND), the report of the nutrition survey of the Union of Burma. This survey was conducted by a joint Burmese-United States team during the period October-December 1961.

The United States team members and our Committee are indeed grateful for the extreme degree of cooperation and cordiality that prevailed during the survey. The conduct, planning and support of the survey, and the review and interpretation of the results, have been shared jointly by the team members of our countries. In this study an attempt has been made to identify the major opportunities for nutritional improvement and to identify those problem areas that will require further study in order to implement practical and effective measures. Three such problem areas are those of infantile beriberi, goiter, and anemia.

Dr. J. F. Mueller and Dr. O. C. Johnson, United States team members who presented the preliminary report, were greatly impressed by the expansion of the nutrition laboratory facilities and the follow-up research projects that had been initiated. The recent signing of the Memorandum of Understanding between your Government and the United States National Institutes of Health regarding the establishment of cooperative research project agreements, and the preliminary negotiations to establish research projects on infantile beriberi, anemia, and goiter, clearly indicate that nutritional considerations are being given a significant place in public health and educational programs in the Union of Burma.

We have a continuing interest in the nutrition and health of your people and will welcome requests for assistance at any time.

Respectfully,

Frank B. Berry

Frank B. Berry, M.D.
Deputy Assistant Secretary
(Health and Medical)

Colonel Hla Han
Minister for Health and Education
Union of Burma
Rangoon, Burma

NATIONAL INSTITUTE OF ARTHRITIS AND METABOLIC DISEASES

INTERDEPARTMENTAL COMMITTEE ON NUTRITION FOR NATIONAL DEFENSE

Department of Defense:
Dr. Frank B. Berry, Deputy Assistant Secretary of Defense (Manpower-Health and Medical), Chairman
Capt. William N. New, USN, MC

Army:
Lt. Col. Jacques L. Sherman, MC

Navy:
Rear Admiral Calvin B. Galloway, MC
Dr. Robert Van Reen

Air Force:
Lt. Col. Franklin L. Bowling, MC
Maj. Myron J. Woltjen, MC

Department of State:
Mr. Walter M. Rudolph

Department of Agriculture:
Dr. Sam R. Hoover
Mr. David L. Hume

Department of Health, Education, and Welfare:
Dr. G. Donald Whedon (Acting)
Dr. Charles Williams (Acting)

Agency for International Development:
Dr. Philip R. Lee
Dr. Frank W. Parker

Atomic Energy Commission:
Dr. James L. Liverman

Committee Secretariat

Dr. Arnold E. Schaefer, Executive Director
Dr. Ernest M. Parrott, Assistant Director for Logistics
Dr. Allan L. Forbes, Assistant Director for Medical Programs
Dr. John M. Kalbfleisch, Senior Assistant Surgeon, PHS
Dr. Irwin H. Rosenberg, Senior Assistant Surgeon, PHS
Mrs. Harriet R. Martin, Program Officer
Miss Christine S. Wilson, Publications Editor

Consultant Panel

Dr. William F. Ashe
Dr. S. Bayne-Jones
Dr. George H. Berryman
Mr. Edwin B. Bridgforth
Dr. C. O. Chichester
Dr. Gerald F. Combs
Dr. William J. Darby
Dr. Charles S. Davidson
Dr. Floyd S. Daft
Dr. R. W. Engel
Dr. Karl E. Gardner
Dr. Wendell H. Griffith
Dr. David B. Hand
Dr. R. Gaurth Hansen
Dr. D. Mark Hegsted
Dr. L. A. Maynard
Dr. William J. McGanity
Dr. William N. Pearson
Lt. Col. Irvin C. Plough, MC
Dr. Herbert Pollack
Dr. W. H. Sebrell, Jr.
Dr. Fredrick J. Stare
Dr. Lester J. Teply
Dr. Philip L. White
Dr. John B. Youmans

CONTENTS

		Page
	List of Tables	VI
	List of Figures	XIII
	Team Member List	XIV
	Acknowledgments	XV
I	Introduction	1
	Recommendations	3
II	Background	15
III	Procedures	18
IV	Agriculture and Food Processing in Burma	28
V	The Military Survey	45
VI	The Military Dependents	77
VII	The Civilian Survey	107
VIII	Correlation of Results	134
IX	Special Studies	153
X	Appendix	181

LIST OF TABLES

Table No.		Page
	Introduction	
1	Abbreviations Used in the Report	2
	Background	
2	Birth and Death Rates per 1,000	16
	Procedures	
3	Summary of Number Examined, Burma	18
4	Number Examined in Each Group, Burma	18
5	Description of Clinical Criteria Used	20
6	Military Population Studied in Dietary Survey, Burma	22
7	Methods of Analysis Used to Determine Nutrient Content of Foods	23
8	Composition of Military Dependent and Civilian Families, Dietary Survey Sample, Burma	24
9	Composition of Military Dependent Dietary Sample, Burma, Interviewed by Questionnaire	25
10	Composition of Civilian Dietary Sample, Burma, Interviewed by Questionnaire	25
11	Distribution of Military Dental Sample, Burma	26
12	Distribution of Persons Given Dental Examinations, Burma	26
	Agriculture and Food Processing in Burma	
13	Production of Goods and Services, Burma, 1959-1960	29
14	Burma Food Balance, 1958	30
15	Production of Major Crops, Burma, 1959-1960	31
16	Number of Plants, Persons Employed, Wages and Salaries and Value of Products in Food Industries and Tobacco, Burma, 1956-57	34
17	Summary of Exports, Burma, 1959-60	40
18	Summary of Foods Imported, Burma, 1959-60	41
	The Military Survey	
19	Characterization of the Military Sample, Burma	45
20	Medical History of the Military Sample, Burma	47
21	Height, Weight and Age of the Military Sample, Burma	47
22	Skinfold Measurements of the Military Sample, Burma	47
23	Clinical Signs of Thiamine Deficiency, Military Sample, Burma	49
24	Clinical Signs of Riboflavin Deficiency, Military Sample, Burma	49
25	Clinical Signs of Possible Vitamin A Deficiency, Military Sample, Burma	50
26	Percent Prevalence of Filiform Papillary Atrophy of the Tongue, Military Sample, Burma	51
27	Percent Prevalence of Goiter, Military Sample, Burma	51
28	Percent Prevalence of Nasolabial Seborrhea, Military Sample, Burma	51
29	Percent Prevalence of Thickened Bulbar Conjunctivae, Military Sample, Burma	52
30	Percent Prevalence of Pterygium, Military Sample, Burma	52
31	Blood Pressures, Military Sample, Burma	52
32	Total Serum Protein Levels, Military Sample, Burma	53
33	Serum Albumin Levels, Military Sample, Burma	53
34	Serum Globulin Levels, Military Sample, Burma	54
35	Thiamine Excretion, Military Sample, Burma	54
36	Percent Stimulation of Red Cell Transketolase Activity After Addition of Thiamine *in Vitro*, Military Sample, Burma	55
37	Riboflavin Excretion, Military Sample, Burma	55

LIST OF TABLES (Continued)

Table No.		Page
	The Military Survey (Continued)	
38	N'-Methylnicotinamide Excretion, Military Sample, Burma	56
39	Serum Vitamin A Levels, Military Sample, Burma	56
40	Serum Carotene Levels, Military Sample, Burma	56
41	Serum Vitamin C Levels, Military Sample, Burma	57
42	Hemoglobin Levels, Military Sample, Burma	57
43	Plasma Corpuscular Volume (Hematocrit), Military Sample, Burma	58
44	Mean Corpuscular Hemoglobin Concentration, Military Sample, Burma	58
45	Urinary Iodine Excretions, Military Sample, Burma	58
46	Serum Cholesterol Levels, Military Sample, Burma	59
47	Percentage Nutrients From Various Foods, Basic Army Food Ration, Military, Burma	60
48	Daily Nutrient Intake, Military Sample, Burma	62
49	Percentage Nutrients From Various Foods by Recipe Method, Military Sample, Burma	63
50	Daily Nutrient Intake, Defense Services Academy, Burma	68
51	Mean Numbers of Decayed, Missing and Filled (DMF) Permanent Teeth, Military Sample, Burma	71
52	Mean Scores For Periodontal Disease (PI) and Gingival Recession, Military Sample, Burma	72
53	Severity of Periodontal Disease, Military Sample, Burma	72
54	Status of Oral Hygiene (OHI), Military Sample, Burma	73
55	Mean Scores For Periodontal Diseases and Gingival Recession Related to Oral Hygiene, Military Sample 20-29 Years of Age, Burma	73
	The Military Dependents	
56	Age Groups by Sex and Location, Military Dependents, Burma	78
57	Medical History of the Military Dependents, Burma	77
58	Skinfold Measurements of the Military Dependents, Burma	85
59	Clinical Signs of Thiamine Deficiency, Military Dependents, Burma	85
60	Clinical Signs of Riboflavin Deficiency, Military Dependents, Burma	86
61	Percent Prevalence of Glossitis, Military Dependents, Burma	86
62	Percent Prevalence of Follicular Hyperkeratosis, Military Dependents, Burma	86
63	Percent Prevalence of Swollen Red Papillae, Military Dependents, Burma	87
64	Percent Prevalence of Filiform Papillary Atrophy of the Tongue, Military Dependents, Burma	87
65	Percent Prevalence of Goiter, Military Dependents, Burma	88
66	Percent Prevalence of Nasolabial Seborrhea, Military Dependents, Burma	88
67	Percent Prevalence of Thickened Bulbar Conjunctivae and Pterygium, Military Dependents, Burma	88
68	Blood Pressures, Military Dependents, Burma	89
69	Percent Prevalence of Hepatic and Splenic Enlargement, Military Dependents, Burma	89
70	Total Serum Protein Levels, Military Dependents, Burma	90
71	Serum Albumin Levels, Military Dependents, Burma	90
72	Serum Globulin Levels, Military Dependents, Burma	91
73	Thiamine Excretion, Military Dependents, Burma	91
74	Percent Stimulation of Red Cell Transketolase Activity After Addition of Thiamine *in Vitro*, Military Dependents, Burma	92
75	Riboflavin Excretion, Military Dependents, Burma	92

LIST OF TABLES (Continued)

Table No.		Page
	The Military Dependents (Continued)	
76	N'-Methylnicotinamide Excretion, Military Dependents, Burma	93
77	Serum Vitamin A Levels, Military Dependents, Burma	93
78	Serum Carotene Levels, Military Dependents, Burma	93
79	Serum Vitamin C Levels, Military Dependents, Burma	94
80	Hemoglobin Levels, Military Dependents, Burma	94
81	Plasma Corpuscular Volume (Hematocrit), Military Dependents, Burma	95
82	Mean Corpuscular Hemoglobin Concentration, Military Dependents, Burma	95
83	Urinary Iodine Excretions, Military Dependents, Burma	95
84	Serum Cholesterol Levels, Military Dependents, Burma	96
85	Food Intake by Food Groups, Military Dependents, Burma, Grams per Standard Man per Day, Questionnaire	98
86	Nutrient Intakes, Military Dependents, Burma, per Standard Man per Day, Recipe Method	100
87	Nutrient Intakes, Military Dependents, Burma, per Standard Man per Day, Food Composite Analysis	100
88	Nutrient Intakes, Military Dependents, Burma, per Standard Man per Day, Questionnaire Method	102
89	Nutrient Intakes, Military Dependents, Burma, per Standard Man per Day	102
90	Dental Caries, Periodontal Disease and Gingival Recession, Military Dependents, Burma	104
91	Severity of Periodontal Disease, Military Dependents, Males and Females, Burma	104
92	Mean Oral Hygiene Index Scores, Military Dependents, Burma	105
	The Civilian Survey	
93	Activity by Location, Civilian Sample, Burma	108
94	Age Groups by Sex and Location, Civilian Sample, Burma	108
95	Medical History of the Civilian Sample, Burma	107
96	Skinfold Measurements of the Civilian Sample, Burma	113
97	Clinical Signs of Thiamine Deficiency, Civilian Sample, Burma	113
98	Clinical Signs of Riboflavin Deficiency, Civilian Sample, Burma	114
99	Clinical Signs of Possible Vitamin A Deficiency, Civilian Sample, Burma	114
100	Percent Prevalence of Swollen Red Papillae, Civilian Sample, Burma	114
101	Percent Prevalence of Filiform Papillary Atrophy of the Tongue, Civilian Sample, Burma	115
102	Percent Prevalence of Goiter, Civilian Sample, Burma	115
103	Percent Prevalence of Nasolabial Seborrhea, Civilian Sample, Burma	116
104	Percent Prevalence of Thickened Bulbar Conjunctivae and Pterygium, Civilian Sample, Burma	116
105	Blood Pressures, Civilian Sample, Burma	116
106	Percent Prevalence of Hepatic and Splenic Enlargement, Civilian Sample, Burma	117
107	Total Serum Protein Levels, Civilians, Burma	117
108	Serum Albumin Levels, Civilians, Burma	118
109	Serum Globulin Levels, Civilians, Burma	118
110	Thiamine Excretion, Civilians, Burma	119
111	Percent Stimulation of Red Cell Transketolase Activity After Addition of Thiamine *in Vitro*, Civilians, Burma	119
112	Riboflavin Excretion, Civilians, Burma	119

LIST OF TABLES (Continued)

Table No.		Page
	The Civilian Survey (Continued)	
113	N'-Methylnicotinamide Excretion, Civilians, Burma	120
114	Serum Vitamin A Levels, Civilians, Burma	120
115	Serum Carotene Levels, Civilians, Burma	121
116	Serum Vitamin C Levels, Civilians, Burma	121
117	Hemoglobin Levels, Civilians, Burma	122
118	Plasma Corpuscular Volume (Hematocrit), Civilians, Burma	122
119	Mean Corpuscular Hemoglobin Concentration, Civilians, Burma	122
120	Urinary Iodine Excretions, Civilians, Burma	123
121	Serum Cholesterol Levels, Civilians, Burma	123
122	Nutrient Intakes, Civilians, Burma, per Standard Man per Day, Food Composite Analysis	126
123	Nutrient Intakes, Civilians, Burma, per Standard Man per Day, Recipe Method	126
124	Nutrient Intakes, Civilians, Burma, per Standard Man per Day, Questionnaire Method	128
125	Nutrient Intakes, Civilians, Burma, by Three Methods	128
126	Dental Caries, Periodontal Disease and Gingival Recession, Civilians, Burma	130
127	Severity of Periodontal Disease, Civilian Males and Females, Burma	131
128	Mean Oral Hygiene Index Scores, Civilians, Burma	132
	Correlation of Results	
129	Correlation of Iodine Excretion With Enlarged Thyroid, Burma	150
130	Correlation of Thiamine Excretion With Loss of Ankle Jerks, Burma	150
131	Correlation of Riboflavin Excretion With Angular Lesions, Burma	151
132	Correlation of Mean Corpuscular Hemoglobin Concentration With Filiform Papillary Atrophy of the Tongue, Burma	151
	Special Studies	
133	Distribution of Mean Corpuscular Hemoglobin Concentration, Field Laboratory Studies, Burma	154
134	Distribution of Hematocrit Values, Field Laboratory Studies, Burma	154
135	Distribution of White Blood Cell Counts, Burma	154
136	Distribution of Eosinophil Counts, Burma	154
137	Hemoglobin Levels of Individuals With and Without Intestinal Parasites, Burma	156
138	Percent Prevalence of Nasolabial Seborrhea, Burma	157
139	Urinary Excretion of Vitamin B_6, Burma	158
140	Distribution of High Xanthurenic Acid Excretion Following Tryptophan Loading, Burma	158
141	Urinary Excretion of Oxalate, Burma	159
142	Prevalence of Nasolabial Seborrhea Associated With Biochemical Criteria of Vitamin B_6 Deficiency, Burma	159
143	Prevalence of Deficient Excretion of Vitamin B_6 Associated With Abnormal Oxalate or Xanthurenic Acid Values, Burma	161
144	Abnormal Distribution of Serum Proteins, Burma	162
145	Normal Distribution of Serum Proteins Following Separation by Paper Electrophoresis, Burma	162
146	Electrophoretic Versus Chemical Fractionation of the Serum Proteins, Burma	163

LIST OF TABLES (Continued)

Table No.		Page
	Special Studies (Continued)	
147	Distribution of Transketolase Values According to Urinary Thiamine Excretion Levels, Burma	166
148	Urinary Magnesium Excretion by USAMRNL Personnel	168
149	Distribution of Urinary Magnesium Excretion Levels by Population Group, Burma	168
150	Distribution of Urinary Magnesium Excretion Levels by Location, Burma	169
151	Dietary Content of Magnesium, Burma	169
152	Fatty Acid Composition of Lipids in Burmese Diets	172
153	Fatty Acid Composition of Serum Lipids of Selected Burmese Subjects	173
154	Assays of Red Cell Hemolysis in Burmese Subjects	174
155	Folacin and Vitamin B_{12} in the Serum of Randomly Selected Burmese Subjects	176
156	Essential Amino Acid Composition of Proteins in Burmese Diets	178

APPENDIX TABLES AND SECTIONS

Table No.		Page
	Procedures	
1A	Clinical Examinations, Burma Population Sample, by Location and Examiner	182
1B	Food Composition Values Used in Burma Survey	188
1C	Questionnaire Form, Nutrition Project, Burma	196
1D	Standard Man Value	198
1E	Methods and Criteria Used in the Dental Examinations, Burma	199
	Agriculture and Food Processing in Burma	
2A	Basic Reference Library	201
2B	Edible Burmese Plants	203
	The Military Survey	
3A	Height, Weight, Percent "Standard Weight" and Age by Rank, Burma, Military	210
3B	Clinical Findings by Location and Service, Burma, Military, Abbreviated Examinations	212
3C	Clinical Findings by Percent "Standard Weight," Burma, Military	214
3D	Clinical Findings and Messing Practice by Rank, Burma, Military	216
3E	Clinical Findings by Location and Service, Burma, Military, Detailed Examinations	218
3F	Clinical Findings by Time in Service, Burma, Military	220
3G	Suggested Guide to Interpretation of Biochemical Data	221
3H	Biochemical Findings by Location, Burma, Military	222
3I	Biochemical Findings by Time in Service and Percent "Standard Weight," Burma, Military	230
3J	Biochemical Findings by Age, Rural-Urban Origin and Activity, Burma, Military	236
3K	Burma Army Ration Scales (Ordinary)	242
3L	Vegetables Commonly Purchased by Burma Military	243
3M	Burma Army Operational Ration Scales	244
3N	Burma Army Hospital Diet	245
3 O	Salt Intake by Food Composite Analysis, Burma Military	247
3P	Nutrient Intake by Unit, Burma, Military	248
3Q	Suggested Guide to Interpretation of Nutrient Intake Data	250
3R	Water Analysis for Minerals, Burma	251
3S	Minor Vitamins and Minerals in Military Diet, Burma	251
3T	Intake of Minor Nutrients by Location per Man per Day, Burma Military	252
3U	Dental Caries and Periodontal Disease Findings for Populations Examined in Burma, Thailand, Vietnam and Baltimore, Maryland, USA	254
3V	Dental Findings Related to Results of Biochemical Determinations, Military Males, Burma	255
	The Military Dependents	
4A	Age, Height, Weight and Percent "Standard Weight" by Location, Burma, Dependents	256
4B	Clinical Findings by Sex, Age and Location, Burma, Dependents	257
4C	Biochemical Findings by Sex and Age, Burma, Military Dependents	260
4D	Biochemical Findings by Location, Burma, Military Dependents	263
4E	Nutritional Requirements in Burma	266
4F	Percent of Calories from Protein, Fat and Carbohydrate, Burma, Military Dependents	267
4G	Dental Findings Related to Results of Biochemical Determinations, Military Dependents, Males and Females, Burma	268

APPENDIX TABLES AND SECTIONS (Continued)

Table No.		Page
	The Civilian Survey	
5A	Age, Height, Weight and Percent "Standard Weight" by Location, Burma, Civilians	269
5B	Clinical Findings by Sex, Age and Location, Burma, Civilians	270
5C	Biochemical Findings by Sex and Age, Burma, Civilians	275
5D	Biochemical Findings by Location, Burma, Civilians	278
5E	Food Intake by Food Groups, Civilians, Burma, Grams per Standard Man per Day, Questionnaire	281
5F	Dental Caries, Periodontal Disease and Gingival Recession, Military, Military Dependent and Civilian Males, Burma	282
5G	Dental Caries, Periodontal Disease and Gingival Recession, Military Dependent and Civilian Females, Burma	283
5H	Dental Findings Related to Results of Biochemical Determinations, Civilian Males and Females, Burma	284
	Correlation of Results	
6A	Nutritional Status of Burmese Population as Determined by Clinical, Biochemical and Dietary Studies	285

LIST OF FIGURES

Figure No.		Page
	Background	
1	Map of Burma	14
	The Military Survey	
2	Height, Weight and Percent of "Standard Weight" by Age, Military, Burma	48
	The Military Dependents	
3	Military Dependents, Burma, Individual Height and Weight Measures for Infant Girls, 3-12 Months	79
4	Military Dependents, Burma, Individual Height and Weight Measures for Infant Boys, 4-12 Months	80
5	Military Dependents, Burma, Growth of Girls, 0-5 Years	81
6	Military Dependents, Burma, Growth of Boys, 0-5 Years	82
7	Military Dependents, Burma, Growth of Girls, 5-18 Years	83
8	Military Dependents, Burma, Growth of Boys, 5-14 Years	84
	The Civilian Survey	
9	Civilians, Burma, Individual Height and Weight Measures for Girls, 1-5 Years	109
10	Civilians, Burma, Individual Height and Weight Measures for Boys, 1-5 Years	110
11	Civilians, Burma, Growth of Girls, 5-17 Years	111
12	Civilians, Burma, Growth of Boys, 5-17 Years	112
	Correlation of Results	
13	Key to Locations	135
14	The Anemia Problem, Burma	136
15	The Goiter Problem, Burma	140
16	Correlation of Goiter and Urine Iodine Excretion	143
17	Thiamine Nutriture, Burma	144
18	Riboflavin Nutriture, Burma	147
	Special Studies	
19	Comparison of Various Criteria of Vitamin B_6 Deficiency by Location	160

APPENDIX FIGURES

Figure No.		Page
1A	Clinical Examination Card — Abbreviated Form	185
1B	Clinical Examination Card — Detailed Form, Front	186
1C	Clinical Examination Card — Detailed Form, Back	187
3A	Comparison of Average Heights and Weights of Burmese Adults with Averages from Other Countries	209

BURMA NUTRITION SURVEY TEAM

Administration:	Major Hla Kyaw Pe - Co-Director Capt. Hla Pe Capt. Thar Tun
Clinicians:	John F. Mueller - Co-Director Major Ko Ko Gyi - Deputy Director Major Tin U Capt. Tin Maung Aye Capt. Mya Oo Willard A. Krehl Charles S. Davidson
Dentists:	Norman W. Littleton Capt. Than Khin Maung
Nutritionists:	John A. Clague - Deputy Director Ogden C. Johnson U Kywe Thein U Pe Win Lieut. J. Khin Maung and Staff Cpl. Sein Maung
Food Technologists:	Keith H. Steinkraus Capt. Khin Maung
Biochemists:	Howerde E. Sauberlich George E. Bunce Major Kyaw Sein Tun Capt. Maung Maung Capt. Tun Khin Capt. Khin Hlaing Lieut. Aung Hlaing Lieut. Hla Tun U Hla Pe WO I D'Souza Sgt. Tin Maung Sgt. Lun Kyi Sgt. Pya Gyi Cpl. Khin Maung Nyunt Pte. Tin Tun Pte. Ma Nu Yin Pte. Ma Kyin Hlaing
Field Laboratory:	Sgt. Ohn Shwe Cpl. Tun Myint Cpl. Ba Htay U Than Tin
Clerical and General Duties:	WO I J. A. King Sgt. Aye Maung Sgt. Thein Dan Sgt. Hla Shwe Sgt. Thein Myint Sgt. Kyaw Aung
Motor Transport:	Capt. Thein Tun Sgt. Maung Maung Myint

ACKNOWLEDGMENTS

The survey team wishes to thank the following, without whose help and cooperation the completion of the survey work and report would have been impossible:

Col. Hla Han, Minister of Health
Nutrition Project, Directorate of Health Services
Directorate of Health Services
Ministry of Defense
United Nations Children's Fund (UNICEF)
Central Statistical and Economic Department
State Agricultural Marketing Board
Agricultural and Rural Development Corporation
Industrial Development Corporation
Union of Burma Applied Research Institute
United States Embassy

I.

INTRODUCTION

Upon an invitation by the Union of Burma, a nutritional survey under the auspices of the Interdepartmental Committee on Nutrition for National Defense (ICNND) of the United States of America was performed from October 9, 1961, to December 14, 1961. It was a joint cooperative effort between the Union of Burma and its Armed Forces serving as hosts and a nine-man U.S. team of investigators as guests. It was undertaken in an attempt to assess the nutritional status of the Armed Forces, better define problems if they existed, and form a basis for continued research and development in nutrition within the country. In addition the Army was kind enough to allow the team to survey large numbers of Army dependents as well as scattered groups of civilians. These latter opportunities added much of importance to the results of the survey.

The team, whose roster is given on page XIV, was divided into two major groups, the field team and the laboratory team. The field team was composed of clinicians, dentists, nutritionists, food technologists, field laboratory workers, transportation corps and clerks. Its itinerary took it to:

Military and Dependents		Civilians
Mingaladon		
Seik Kyi	(Rangoon Area)	Zigon
Ratanabon		
Indaing		Indagaw
Toungoo		Kyee Taw
Meiktila		Shwe Daung
Ba Htoo Myo		Lauk Sauk
Chauk		Sé Bauk
		Ngayan Chaung
Maymyo		Wet Wun
Moulmein		

The biochemical laboratory team was stationed at Mingaladon Army Base in the excellent quarters of the Biochemical Laboratory of the Burma Army Medical Corps Headquarters and Depot. The laboratory was completely set up by the team and a large majority of the biochemical analyses were performed there. A few of the special analyses were performed by laboratories in the United States. The Army provided all transportation for the personnel, equipment and samples, as well as housing throughout our stay. Without the careful preliminary planning, continuing care for details throughout the survey and thoughtful recognition of the needs of their American guests by the Army, the survey could not have been so successfully accomplished.

As has been commented before in many of the ICNND reports, the timing of the survey is often critical and its results judged appropriately. In the case in point, this survey was begun just at the end of the monsoon rains and extended into the rice harvesting period. It was also during the period when many fruits and vegetables were available and could well have influenced some of our observations on dietary intake. On the other hand, the clinical and biochemical data might well reflect a period of inadequacy which occurred during the rains. These comments are purely speculative, but deserve at least some mention.

687462 O - 63 - 2

The following table defines abbreviations used in the text and tables:

TABLE 1. ABBREVIATIONS USED IN THE REPORT

kg	kilogram(s)	mm	millimeter(s)
gm	gram(s)	mm Hg	millimeters of mercury
mg	milligram(s)	oz	ounce
mcg	microgram(s)	>	greater than
I.U.	International Units	<	less than
ml	milliliter(s)	S.D.	standard deviation
cm	centimeter(s)	S.E.	standard error of the mean
cc	cubic centimeter(s)	rpm	revolutions per minute

Burma has been well surveyed in many areas of interest during the post-World War II period, including nutritional surveys. Some of the latter have been carried out by the Nutrition Department of the Ministry of Health of Burma and are included in their quarterly reports. A more comprehensive report was made by Pranger and Ross for the FAO (Food and Agriculture Organization) in 1958 (1). Much valuable information can be gleaned from these reports. However, none of them has been of the multidisciplined variety or of the scope attempted by the present survey.

References

1. Pranger, W., and Mary S. Ross. Report on Nutrition and Home Economics in Burma. Report No. 828, FAO/58/3/1849, Rome, 1958.

RECOMMENDATIONS

I. Introduction

The "heart and soul" of a nutritional survey are contained in its recommendations. The latter result from a serious and intensive evaluation of all the data that could be accumulated during the survey. However, it is not enough merely to make routine suggestions, but rather individually to fit each recommendation to its problem. These recommendations are what we believe to be practical and efficient remedies for some of the problems. No pretense is meant to suggest that they are Utopian. Some of them if implemented will produce immediate rewards; others will take time. All of them will cost money; some a little, others more. The initial outlay, however, will be repaid many fold in greater individual efficiency, gain in man-hours of work, better morale, etc. The group is aware of the financial limitations of the Government and its people as well as other social, religious and political factors which are involved in the picture. We are not suggesting that nutrition be given A-1 priority in the nation. We are suggesting that it be given serious consideration as a basic, fundamental aspect of the welfare of a country that as such demands attention.

Justification for each recommendation will be found in the text. When possible and desirable, some estimation of cost has been included. This is based on experience in other countries with similar problems.

II. Recommendations Specifically for the Military

A. Changes in basic ration

1. Adopt a standard enrichment program for the following:

a. Enriched rice. As rapidly as possible the military should set up specifications for and purchase only enriched rice. Enriched rice is produced for export by the State Agriculture and Marketing Board (SAMB) in its Neikban Rice Mill Ltd., Rangoon. It is recommended that the rice be enriched by adding at minimum the following (per kilogram polished rice):

Riboflavin	2.4 mg
Thiamine	4.4 mg
Niacin	35.25 mg
Iron	28.69 mg

At the time of the survey, Neikban Rice Mill imported the highly enriched rice grains (premix) from the Philippine Islands and added them to the regular polished rice in the proportion of 1 kilogram premix per 199 kilograms of polished rice to yield an enriched rice to meet the above specifications. It is recommended that at the start of this program the above procedure be continued. Details of the process are presented in Section IV on Agriculture and Food Processing in Burma.

As part of any rice enrichment program, it is essential that present cooking procedures be modified. Rice enriched by the "premix" method will withstand vigorous washing without loss of vitamins. However, during cooking the protective coating given the vitamins in the rice is dissolved. If excess cooking water is discarded, the vitamins are lost (see B3 immediately below).

As a corollary of the above, it is recommended that the military discontinue purchase of vitamin tablets and use the money presently spent on the vitamin tablets to support the enriched rice program. Current stocks of vitamin tablets should be distributed to military, military dependents, pregnant and lactating women, and children.

b. Enriched canned sweetened condensed milk. Specifications should be established that all sweetened condensed milk imported or canned locally be enriched with the following vitamins (per 100 grams of milk):

Vitamin A	700 I.U.
Vitamin D	400 I.U.
Thiamine	2 mg
Riboflavin	2 mg

At current prices for synthetic thiamine and riboflavin, $0.036 (U.S.) per gram, cost of this program would be negligible. Vitamin B_6 should probably also be added to the milk. However, cost precludes its addition at this time. Further study is necessary to demonstrate whether vitamin B_6 should be added to milk.

c. Iodization of salt. All salt for the military should be purchased on specification requiring that it contain one gram added iodine in the form of 1.686 grams of potassium iodate per 10,000 grams salt. Details of the iodization procedure are presented in the agriculture and food processing section (IV) of this report.

It is recommended that, as rapidly as is practical, all salt be iodized to the above level.

2. Increase the allotment of pulses by 20 grams per man per day to a total of 100 grams per man per day.

3. Set rigid standards for quality of meat. The Army at the present time has facilities for food control. These should be expanded and energetically enforced in all areas, but especially in regard to meats. Such standards should include, for example, amounts of allowable fat, fiber ratios, source of supply, etc.

4. Diversify diets to include more vegetables, fruits, nuts and milk products. The immediate limitations of this proposal are appreciated. However, with expansion of the canning and dairy industries, and the institution of refrigeration facilities, these goals are well within the reach of the Burma military.

B. Improvement in cooking procedures

1. Consolidation of mess halls and kitchens should be accomplished within major military facilities where at all possible.

2. All consolidated facilities should be equipped with steam-jacketed cooking vessels such as already exist in Mingaladon, Maymyo and Ratanabon. The elimination of the loss of burned or charred rice which is presently incurred would more than compensate for the expense.

3. All efforts should be made to eliminate the use of excess water in the cooking of rice. It has been calculated that from 1/2 to 1/3 of the thiamine content of rice is discarded in the excess water which is poured off during the presently contrived cooking process.

C. Improved operational ration

1. Efforts should be directed toward the development of suitable and acceptable food products for this important ration. This should be done on an individual as well as a unit basis. Such items as precooked, dehydrated rice and curries are immediate possibilities. Organizations such as the ICNND would be available for technological help in such a development program.

D. Improvement in Army hospital diets

1. The present Army hospital diets are totally inadequate, from both a nutritional and a patient acceptance point of view. It is imperative that steps be instituted to correct this situation.

2. The training of competent dietitians is essential to this recommendation. This could be accomplished first in a foreign country, such as the United States, and later by a home-based program.

3. The success of such a program is also dependent upon the appreciation of nutrition by Army physicians. A course in nutrition should be made available to every physician in the military.

4. At the present time, diets should be designed by some nutritional expert, either inside or outside of the Army, and be installed routinely in every Army hospital.

E. Sanitation problems

1. The presently constituted Sanitary Corps should be greatly expanded within the military. Its functions should be:

a. Set and enforce rigid standards for items mentioned below as well as all others relating to sanitation.

b. Design and build adequate facilities.

c. Be empowered to inspect and enforce the same regulations in the dependent housing areas.

d. Train personnel.

2. Areas badly in need of attention are:

a. Development of a safe water supply in each major military base.

b. Construction of latrines which are functional, yet safe. Such work is going on in Burma at the Rural Health Center Research Unit in Insein District.

c. Adequate screening of the kitchen and mess hall.

d. Adequate garbage disposal.

F. Food storage

1. The development of refrigeration facilities for fresh foods at each supply depot would be of great help. Again, the savings on food spoilage would soon pay for the initial financial outlay.

2. Standardization of storage facilities at each base should be enforced by the Commanding Officer. Such standards would be directed toward rodent and pest control. The use of rat poisons should be considered.

3. Regular and routine inventory controls should be developed for canned and packaged food so that excessive supplies do not deteriorate "on the shelf."

G. Training of personnel

1. It would be advisable that a training school or course be devised for all military cooks and kitchen aides. Principles of nutrition, sanitation and hygiene could be incorporated in such a program. Simple items, like the use of hot water for sterilization purposes, could be taught.

2. Throughout these recommendations we will mention time and again the importance of education in the entire program. The military has an opportunity to promulgate nutritional information to its men in many and diverse ways. These methods should be used wherever and whenever possible in a repetitive manner. Simple audio or visual aids could be devised as well as routine indoctrinational courses in nutrition, sanitation and hygiene.

3. Finally, training of personnel at the technical level is a "must" for Burma. The need is evident at all levels from the most advanced to the most simple. Here again, our country stands willing to help in this regard. Once a few well trained individuals are available then Burma itself should become self-sufficient and develop its own training programs.

III. Recommendations for the Military Dependents

A. Modification of the present ration system for married military men

For reasons given elsewhere in the text it is urged that the married military man's regular ration be eliminated and that a family ration be substituted composed only of basic staples in amounts according to the size of the family. On the basis of a family consisting of 3 standard men, it should consist of the following:

1. Enriched rice - 1 kilogram per day

2. Iodized salt - 25 grams per day

3. Sweetened condensed milk - 3 cans per week

Such a program would eliminate the tremendous waste of manpower and time now devoted to distributing the ration and would allow the soldier to gree money now spend on basic items for fresh foods to be purchased at a local commissary or market.

An additional item of great importance is that the family ration be continued while the father is away on active duty. It might well be reduced, but should not be withdrawn as is now the case.

An alternative solution to the present dilemna of the married soldier would be to provide a family pay allotment. If such a program were acceptable, the present practice of supplying a fresh ration should be eliminated for reasons given elsewhere. The amount of such an allotment would be determined by the economic situation of the country at any given time.

B. Military controlled commissaries, well stocked with a variety of fresh and packaged food items, should be established close to dependent housing areas. These military stores should be carefully inspected and checked by the Commanding Officer to assure their high standards. They should successfully compete with civilian markets in quality if not in price.

C. A strong nutrition educational program is a "must" for this group. Simple and repetitive courses in health, hygiene and nutrition should be standard for every year of schooling. Only through the education of the young can one hope to alter significantly and extensively the eating habits of the Burmese toward more diversified foods. Rice, particularly enriched as we are recommending, is a good food, but it is not a "complete food." Diversification to include milk products, more animal protein, greater varieties of vegetables, etc., will not only improve the health of the nation but will surely improve its productivity (see IV C below, Civilian Recommendations).

Educational programs for the wives of the military in proper infant feeding, sanitation principles and home economics could be sponsored by each post. The military has a large "captive population" and should exploit this fact as vigorously as possible. Signs and posters imparting nutritional facts could be erected at strategic points in the commissaries or around the area. The military would have to train personnel to develop such programs, but certainly this could be the duty of a group of nutritionally oriented physicians or dietitians, once the latter become a reality.

D. A school snack should be instituted in all military schools. It could consist of some nutritious item such as dried milk powder or perhaps a specially prepared highly "enriched" biscuit. Whatever is chosen, it should contain a good source of B-vitamins.

E. All sanitary facilities for the military dependents should be subject to the same rules and regulations as apply to the military.

IV. Civilian Recommendations

A. The nutrition problems of civilian populations are, of course, not only more prevalent but also more complicated to solve. Education remains the cornerstone of good nutrition. One can not expect the adult to deviate from customs and mannerisms which have been handed down from generations before him. The only way to achieve some of the principles which are generally accepted as worthy is through education of the young. This is not an immediate or dramatic remedy, but a most reliable one if properly implemented. With education so readily available to the great majority of Burmese children, the mechanisms are already present for beginning the program at any time. Of course, such a program is absolutely dependent upon the proper indoctrination of the teachers during their courses in teacher's college. This should not be a difficult problem to resolve.

The rural health center is another area from which good nutrition education should emanate. Some of this is being done at the present time in excellent fashion. More is needed.

Much better use of the radio and newspaper would be helpful in disseminating health and nutrition material. This could be in the form of "tips" or on a more elaborate scale. The potentials of a good nutrition educational program in Burma are enormous. All that is needed is someone in authority to "start the ball rolling."

B. Formation of a National Nutrition Council is recommended to develop an integrated program.

Knowledge of the Union of Burma's nutrition problems has rapidly increased in recent years by research and survey work including the survey reported here. It is believed that sufficient information is now available to warrant the development of a long-term nutrition program and the formation of a Nutrition Council for the benefit of the people.

Composition of such a Nutrition Council should include representatives from Government agencies responsible for health, defense, education, agriculture, economics, transportation, labor and others which are appropriate. Experts in nutrition from industry, universities and other institutions should be members of the Council. The Council membership should not be large, say 15 or 20 members. Representatives from other organizations or groups who are interested or could contribute should be included at stated meetings as observers or utilized in the preparation of specific reports and recommendations. A chairman should be elected or appointed. The Council should have a permanent secretary and staff to coordinate the work of the Council and make it continuous and effective.

The Council's activities should include:

1. Study of present knowledge of nutrition in the Union.

2. Initiation and support of further research, surveys, food analyses and technological experiments.

3. Design and submission to the appropriate legislative bodies of such regulations as are deemed necessary, including standards for processed foods, minimal daily allowances of nutrients, etc.

4. Preparation of statistical reports and dietary tables as well as serving as an advisory board on all matters of importance to the Union pertaining to nutrition.

5. Stimulation of nutrition education for all people through appropriate organizations and channels so that constructive changes in food production, distribution, eating habits and taboos can be made.

The Council should have adequate financial support so that it can carry out its program.

C. Diversification of the diet

Diversification of the diet should be encouraged for the military and military-dependents as well as for the civilian population through all possible educational means. Legumes and the green and yellow leafy vegetables are cheap and easily available in Burma. Their content of riboflavin would greatly help in balancing the riboflavin deficiency in the diet. Other foods rich in riboflavin include the following:

Food item	Riboflavin mcg/100 gm (1, 2)1/
Dried prawns	480
Roasted groundnut	274.6
Roasted peas	268.8
Boiled peas	153.6
Spinach	290
Drumstick leaves (dantdalun ywet)	254.0
Gooseberry	287.0
Soybeans	310.0
Tamarind	140.0
Duck	200
Lean pork	160
Eel	280

1/ Numbers in parentheses are for references listed on page 13.

The thiamine intake could be increased by eating larger quantities of the following foods:

Food item	Thiamine mcg/100 gm (1, 2)
Indian mulberry (yeyo-ywet)	210
Watercress (kazun-ywet)	117.6
Sensitive plant (yay-htikayon)	115.2
Tomato	115.2
Dried fish	120-158.4
Fish paste	100
Shrimp paste	110-136.8
Soybeans	1,070
Lean pork	690
Eel	210

To aid in this regard the following steps should be taken:

1. Expansion of the fishing industry. The Burmese should enjoy a plentiful supply of fish which could serve as an excellent source of animal protein and other essential nutrients in their diets. It is recommended that the Government do everything it can to expand the deep sea fishing industry, expand facilities for preservation of fish through canning, salting and drying, and facilitate distribution of salt water fish both to the military and to the civilian population. It would be desirable for the Defense Services Canning Plant to set up a subsidiary for canning fish and fish curries on the coast at a location favorable for landing catches of deep sea fish. A drier presently at the Kalaw plant should be transferred to such a plant and used to dry both fish and shrimp first for military use and secondly as an example for dehydration of fish and shrimp on a larger scale for civilian use. Such a subsidiary located on the coast would also be in a strategic location to procure salt for salt preservation of fish at a reasonable price and in quantity.

Dried fish and shrimp as received by the Army would have improved keeping quality if the initial moisture was reduced to below 12 percent and the products were packaged in moisture-proof plastic bags.

The construction and use of ponds for culture of fresh water fish should be encouraged by the Government. Use of paddy fields and ponds for raising of fish should be encouraged by sale of young fish fry of varieties recommended for the purpose by the Directorate of Fisheries directly to the farmers at cost.

2. Expansion of the canning industry. The Defense Services Canning Plant at Kalaw should be kept as modern and progressive as possible to serve as an example and model for private industry. The quality of the product should be maintained at a high enough level to permit sale of excess production on the civilian and export market.

3. Expansion of the livestock industry. If all the nonworking cattle in Burma were systematically replaced by high-producing dairy types, the people of Burma would benefit greatly through a vastly increased supply of fresh milk and other dairy products. It would also supply the base for a sweetened condensed milk industry.

Production of more poultry, swine, sheep and goats should be encouraged. Burma has an excellent supply of ingredients for the scientific formulation of animal feeds which are essential for the efficient production of animals in large numbers. Among these

reasonably priced ingredients are broken rice grains, rice bran, gram, sesamum and groundnut presscakes, fish and prawn residues, brewers yeast from the State Brewery and Distillery at Mandalay, and molasses from the sugar mills.

D. Enrichment program

The enrichment programs recommended for the military should be expanded to include the civilian population as rapidly as possible.

V. General Recommendations

A. Dental health

Since oral diseases are widespread and severe in the population of Burma, measures to alleviate this situation could contribute to the health and well being of the people.

1. Encouragement and support should be given to:

a. The development and utilization of preventive dental procedures.

b. The development of appropriate methods of treatment at costs within the economic capacity of the people.

2. Emphasis should be given to measures to help control periodontal diseases.

a. Educational programs aimed toward stimulating interest in personal oral hygiene would be valuable for all segments of the population. Local health clinics could participate.

b. Consideration could be given to training auxiliary personnel, including dental hygienists, to provide prophylactic dental services under dental supervision, particularly in military establishments.

B. Population, natural resources and nutrition

Inherent in any long-range plan for nutrition are two other matters: population increase and conservation of soil, water and other natural resources.

Many countries with a rapidly expanding population, including several of Burma's neighbors, have found that population growth proceeds as fast as or faster than food production, thus nullifying improvement in nutrition or even leading to starvation. Fortunately, excessive population is not presently one of Burma's problems, but every indication suggests that it soon may be. The present time is not too early to begin careful continuous study of:

1. Population growth resulting from increased birth rate, diminished mortality and immigration.

2. Methods for controlling excessive population growth.

3. Methods of educating all concerned with regard to the facts relating to this problem.

Food production for Burma's consumption and for export depends upon sufficient fertile land and ample water, among other factors. As with population expansion, land and water are not presently major deficiencies in Burma. Land waste from erosion, overfarming and misuse over many generations is evident, however, in many areas of the country. Floods continue to be unpredictable and sometimes devastating. As with population, now is the time for planning and executing a major program of soil conservation and water control. It is evident that much is already being done and planned in flood control, soil rehabilitation and conservation. It is our purpose here only to reemphasize the close relation between nutrition, population and natural resources.

C. Training of personnel

This item, although touched upon several times, is well worth repeating for emphasis. Burma realizes it must expand its technological forces at all levels of competence from the plumber's helper to the electronic engineer or from the orderly to the physician. This again is a slow process, but the U.S. through such agencies as the ICNND or several hundred other agencies or institutions always stands ready to offer help in training programs in any area desired. This is by far the most valuable thing America can offer — her technical know-how. How much better it is for Burma to do for herself!

D. Research projects

Although this document is quite imposing in size, it should be clear that in 2 1/2 months the problems can be only superficially explored. It is hoped that one of the major by-products of this survey would be stimulation of further interest and exploration of the nutritional status of the country by those interested. Many problems have been raised, few answers given, by our studies. Therefore, along these lines we would like to recommend several possible areas of further investigation.

1. The vitamin B_6 problem. From the data presented in the chapter on special studies, it is quite clear that a subclinical, if not a real, vitamin B_6 deficiency exists in a large section of the Burmese population. However, so little is known concerning the early manifestations of human vitamin B_6 deficiency that a definitive statement as to corrective suggestions seems unreasonable. Therefore, some of the answers that would be valuable in this area are:

a. The relationship between urinary vitamin B_6 activity, xanthurenic acid excretion after tryptophan administration, dietary intake and performance capacity.

b. The relationship of naturally occurring nasolabial seborrhea and vitamin B_6 status as measured by the above parameters.

c. Vitamin B_6 nutriture in Burmese with complicating infectious diseases.

d. Vitamin B_6 nutriture in Burmese pregnant women.

e. The relationship between vitamin B_6, oxaluria and urinary calculi.

2. Anemias. It seems wise to attempt a detailed study of the anemias which are so prevalent in Burma. This should be done carefully and systematically and should include complete blood counts; bone marrow examinations; measurement of serum iron, vitamin B_{12}, folic acid and ascorbic acid levels; careful search for occult loss of blood from the gastrointestinal tract; ferrokinetics; hemoglobin electrophoresis. Any study which does

not include most of these items will prove inconclusive. On the other hand, all of these things could be done by an interested team and would be a really worthy project that would receive support from many sources.

3. Cirrhosis. Liver disease, especially cirrhosis and probably kwashiorkor, became evident to the clinical team members as important medical problems. This was learned from conversation with physicians and from ward rounds in which we were privileged to take part at several hospitals.

There seems to be little doubt that kwashiorkor in young children results in a major degree from insufficient intake of protein and perhaps of certain other nutrients, although acute infections often seem to precipitate the disease. Careful study of infant feeding practices followed by an education campaign should eventually eliminate this disease.

The causes of cirrhosis are not well known. Alcoholism, a factor in some countries, does not appear to be important in Burma. How often viral hepatitis leads to cirrhosis is unknown, but it may be important. In experimental animals malnutrition of certain kinds may be an important contributing factor. Retrospective study of these and other possible factors in patients with cirrhosis would be an important contribution to knowledge. Likewise, a prospective study of population groups known to have suffered malnutrition would be valuable, although more difficult to do.

Finally, a few studies in animals indicate that certain molds and fungi growing on feeds may be hepatotoxic. Whether these organisms growing on human foods, or substances produced by them, are hepatotoxic to man would be a difficult but important field to study.

4. Urinary calculi problem. The problem of urinary calculi in Burma, as in other areas of Southeast Asia, is one of serious proportions. The etiology of such calculi is unknown and it would appear that their occurrence is common enough to offer a fertile field for clinical investigation of this problem. It is suggested that a research wing or ward, or a number of beds, possibly in the Rangoon General Hospital, be set aside where patients with urinary calculi might be sent for study. Such studies should include renal function tests, careful evaluation of urine for the presence or absence of bacteria, including qualitative and quantitative bacterial counts. The possibility that urea-splitting organisms may be common in patients with urinary calculi is to be suspected. Under these circumstances an alkaline urinary pH might be prevalent which would favor the deposition of magnesium, calcium, ammonium phosphate-type calculi. Furthermore, the nutritional status of these individuals should be carefully evaluated, particularly with regard to magnesium, pyridoxine and possibly vitamin A. It would also be important to evaluate the dietary history of such individuals, with particular emphasis directed toward the calcium and phosphorus intake.

5. Research into possible nutritional deficiencies in hospital populations. In addition to the nutrition survey conducted in Burma which dealt with ambulatory, reasonably healthy people, it would be valuable to extend the survey to include the nutritional status of certain hospitalized groups. This would be particularly applicable to pediatric hospitals where children are admitted with acute fulminating disease which may have nutritional components. It is strongly suspected, for example, that a good number of children with kwashiorkor come through the Children's Hospital in Rangoon. Two team physicians working in this hospital very briefly saw several children who presented symptoms strongly suggestive of kwashiorkor.

Another area of investigation which would be most rewarding is that of beriberi, in both infants and in pregnant and lactating females. While it would appear that the hospitals see this clinical problem onoy rarely, it is possible that in the rural communities infantile beriberi is more common that is supposed. It would be of great interest to have an investigative team try to unearth more information about this most elusive problem in rural areas. It would be of particular interest to evaluate thiamine nutritional status of children by more modern techniques such as the transketolase method, in addition to the usual urinary excretion studies. Such a program would encompass a nutritional status evaluation of mothers of these infants, including a dietary evaluation.

6. Nutritional evaluation of patients with preeclampsia. Preeclampsia is not an uncommon finding in obstetric departments in hospitals in Burma and here again it would be valuable to evaluate the nutritional status of these patients with respect to salt intake, protein malnutrition and vitamin intake.

7. Goiter appears to be a significant problem in Burma. Further investigation into the role of dietary iodine versus possible dietary goitrogens would be pertinent. Use could be made of more refined techniques, such as serum protein-bound iodine, and radioactive iodine uptake by the thyroid gland with and without thyrotropic hormone.

References

1. Food Composition Tables. Nutrition Laboratory, Department of Health, Union of Burma, 15 September 1959.

2. U.S. Department of Agriculture. Composition of Foods Used in Far Eastern Countries. Agriculture Handbook No. 34, Washington, D.C., 1952.

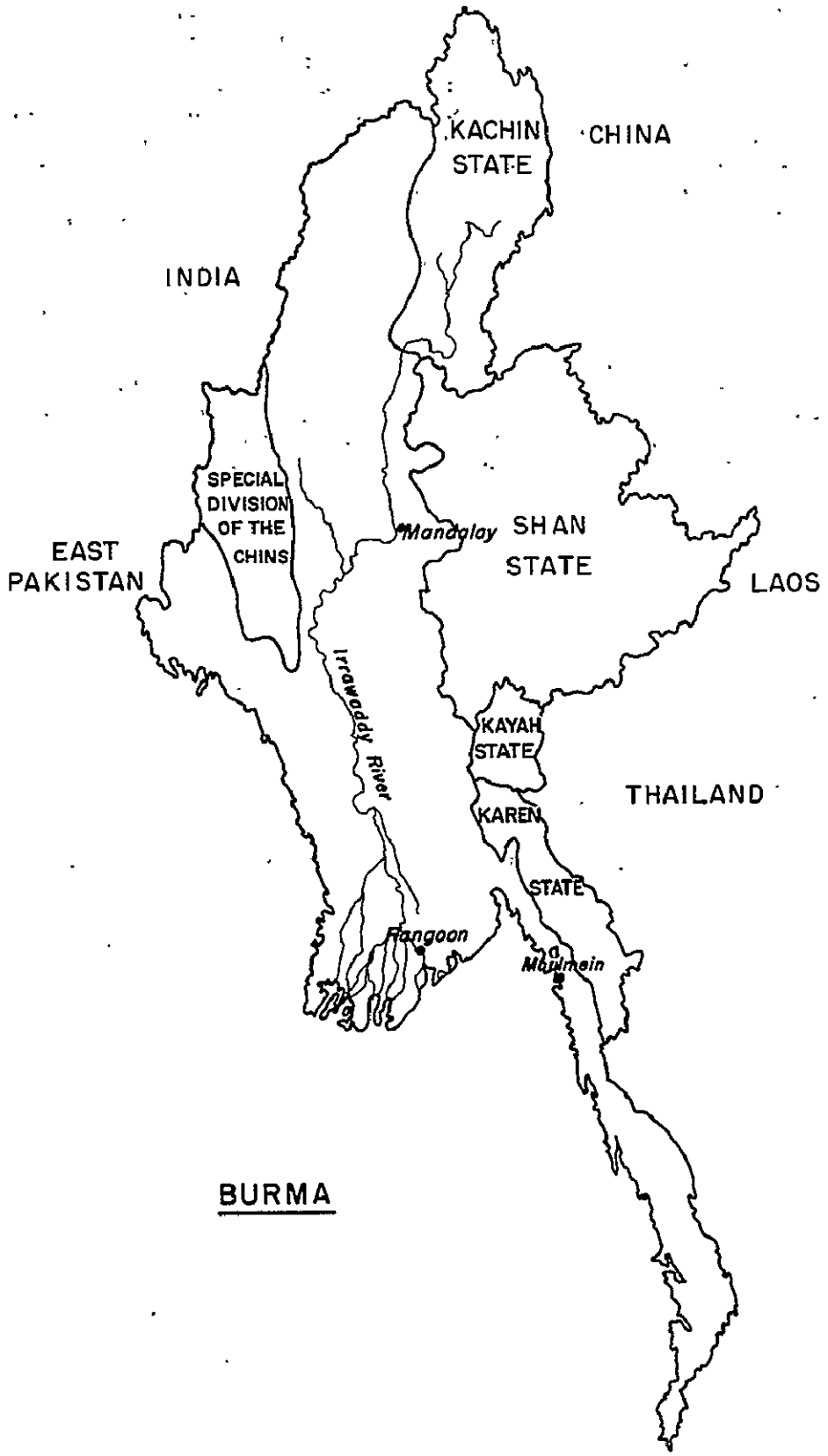

KACHIN
STATE
CHINA
INDIA
SPECIAL
DIVISION
OF THE
CHINS
EAST
PAKISTAN
Mandalay
SHAN
STATE
LAOS
Irrawaddy River
KAYAH
STATE
THAILAND
KAREN
STATE
Rangoon
Moulmein
BURMA

FIGURE I

II

BACKGROUND

Burma is many things to many people. She is home to some 20,000,000 people, of mixed origins but bound together by ancient culture and mutual goals. She is the acknowledged center of classic Buddhism, some 90 percent of her people being Buddhist. She is a land of beauty, yet scarred from not-forgotten wars; she is rich in resources, yet poverty exists. She produces abundant food from her soil, yet malnutrition is present. In this land of peace-loving people internal strife and insurrection have taken their toll. The courage and determination of her people have been frustrated but not dimmed by her adversities.

Burma gained her independence in 1948 after some 63 years of British rule. Unfortunately what progress she had made during her colonialism was destroyed by the devastation first of the Japanese invasion in 1942 and then the subsequent re-invasion by the Allies during World War II. No sooner had liberty been achieved than civil strife appeared, some of it Communist inspired, which continues even to the present time. Although most of the organized insurrection is gone, and the present difficulties are primarily banditry, the Union of Burma has found it necessary to expend what strength and vitality she had left in controlling such strife instead of using it to rebuild the country and better her people. It is important that this fact be fully appreciated.

The people of Burma are an ethnically mixed group. The country was populated by three major migration waves coming down from central Asia, first the Mons, then the Tibeto-Burmans and finally the T'ai Chinese. Each of these groups was pushed out of the area where they first settled by succeeding migrations or isolated in areas which has given rise to the various states as follows: (population given in thousands)

Burma proper (8 administrative divisions)	16,271
Shan	1,987
Karen	578
Kachin	501
Chin Special Division	257
Kayah	83

Add to these the million or so Indians, Pakistanis and other local immigrants and one can see the complexities of culture, eating patterns and religious customs which play a role in nutritional status. The understandable desire for autonomy among the states, many of which have their own customs and language, has been responsible for much of the insurrection and instability which has plagued the Government. However, the development of a truly democratic political system, the expansion of educational systems adopting a common language and the stability afforded by a strong military and civil organization have been responsible for the growth of intense nationalism which is everywhere evident in Burma.

Being a tropical country, Burma is both blessed and cursed with heavy rainfall. Agriculture flourishes in most areas and is by far the leading enterprise with rice as the major product, accounting for about 75 percent of the value of exports. However, much more could be cultivated, since only one eighth of the land is devoted to agriculture and at least that much more is potentially productive. Unfortunately a great deal of land in central Burma is badly eroded due to the enthusiasm of former rulers who leveled large forests for firing the bricks to build pagodas. Although the rain and sun are excellent friends of agriculture, they also favor the propagation of various parasites and microorganisms which flourish in and infest much of the population, taking their toll in vitality and strength.

Industry is only beginning in Burma. Rice milling, of course, is the major one at the moment. However, as will be pointed out later, other food processing industries are being begun by both the military and civilians. Most other industry is on a small, individual basis, often housed in the family's domain. Mechanization is minimal although it is becoming more of a reality as time goes on, but ingenuity is present everywhere. However, the average workday of a Burmese is long and arduous which further compounds his need for adequate and healthful nutrition. Everywhere he goes in Burma, the visitor cannot help but be impressed with the industriousness of the people -- men, women and children.

The gross national product of Burma has been gradually increasing, with several exceptions due either to internal problems or catastrophes of nature. However, the annual income of the average Burmese family amounts to the equivalent of 87 U.S. dollars. Thus, much of what the family consumes must be grown or bartered for, rather than purchased. In the case of the farmer, this may mean giving up fruits and vegetables for utensils or clothes, thus restricting his diet to rice and little else. Thus again the nutrition of the country is influenced by many and varied factors.

Education, a bulwark to health and good nutrition, is widely available in Burma. Literacy is the rule, rather than the exception. Much of it was formerly due to the Buddhist monks, but more recently the Government has provided free education from the primary level through college to those willing to accept it. Although the rural areas still suffer from inadequacies, attempts are being made to expand educational facilities as rapidly as possible. It is estimated that some 2,000,000 children are enrolled in some type of school. This obvious opportunity must be realized in furthering nutrition education.

Health care is primarily provided by the Government, although a few private health facilities do exist, both professional and institutional. Health centers are scattered over the country, administering to the people as best they can. For the most part they are understaffed and poorly equipped, capable of promulgating preventive medicine in the form of vaccinations and instructions to expectant mothers and performing first-aid type of care. Individuals with more serious problems are sent to a regional hospital which is generally overcrowded and again understaffed. Burma needs competently trained health personnel in all areas. Most critical, however, is its need for more physicians. With the recent opening of the new Medical College in the University of Mandalay to augment the existing one at the University of Rangoon, hopes are alive for bettering this situation.

Vital statistics are usually quoted in such a report as this even though their gross limitations and inaccuracies are well appreciated. Burma's records are no exception. Attempts are under way to develop a more accurate and comprehensive system within the country but fruits of these efforts will not be available to the reader at this time. Some information is recorded in the table below comparing Burma to its neighbor, Thailand.

TABLE 2. BIRTH AND DEATH RATES PER 1,000

	Burma, 1959	Thailand, 1957
Birth rate	38.2	33.7
Death rate	19.9	9.5
Infant mortality (per 1,000 live births)	136.9	62.2
Maternal mortality (per 1,000 live births)	4.7	5.0

Thus it can be seen that although Burma's birth rate is high (and is still increasing), the very high infant mortality and crude death rates are stifling her growth. These figures, inaccurate as they must be, reflect, however, the importance of the need for improved health facilities. It is true that nature has effected homeostasis and has prevented overpopulation of the country, but Burma is in a position now to feed and care for more of her people and efforts must be directed toward this goal.

The leading causes of death according to the 1961 report of the Vital and Health Statistics Division of the Directorate of Health Services are (per 100,000 population):

Ill-defined and unknown causes of morbidity and mortality	282.3
Diseases peculiar to infancy	255.2
Influenza and pneumonia (except newborns)	248.6
Anemias	129.5
Diseases of the heart	115.1
Senility without mention of psychosis	99.4
Tuberculosis (all forms)	95.7
Avitaminosis and other deficiency states	72.6
Accidents	47.7
Dysentery (all forms)	24.9
Malaria	20.6

Again it is difficult to evaluate the significance of such data, but certainly they verify the suspicion that infectious disease is a major public health hazard as well as pointing up the importance of sanitation and good nutrition to the populace at large.

Finally a word must be said about the impact of Buddhism on the people and its role in the nutritional status of the country. Over 90 percent of the Burmese are devout Buddhists, an extraordinary majority for such a mixed population. The teachings of Buddha which extol pacifism, kindness and humility are evident throughout Burma in the everyday actions of her people. The distaste for aggressiveness has hampered her international activities in trade. The Buddhist law which forbids killing of any living thing has influenced the intake of animal protein. Only the Army is allowed to slaughter beef and most of the other slaughtering is usually done by non-Buddhists. Undoubtedly this has to some degree affected the eating habits of the people, although at the present time the new Revolutionary Government has legalized slaughtering of beef.

Thus, while this report will concern itself with the clinical, biochemical, dietary, dental and food technology aspects of nutrition in Burma, it is obvious that many facets of the economic, social, religious and cultural complexities of the country are interwoven into the problem and cannot easily be separated one from the other. It is important that the reader fully appreciate this fact and realize the gross limitations that are automatically placed upon the authors. The scope and abilities of the team were limited in many of these areas, nor would it be anything but presumptuous for us to pretend to understand all of the complexities in the short period during which the survey was conducted. Therefore this report will deal with facts as we saw and accumulated them, but should be interpreted in the light of the comments made above.

687462 O - 63 - 3

III

PROCEDURES

The procedures utilized in this survey were comparable to those used in previous studies by the ICNND and are detailed for an interested reader in the revised edition of the Manual for Nutrition Surveys (1).

1. The Clinical sample derived from the survey and its breakdown into groups, ages and sex are given in the following two tables.

TABLE 3. SUMMARY OF NUMBER EXAMINED, BURMA

	Examinations			
	Abbreviated	Detailed	Biochemical	Dental
Military, total group	4,963	1,375	367	2,411
Civilians, total group	2,003	548	168	929
Dependents, total group	2,104	596	174	990
Boys' boarding school	86	21	6	44
Defense Services Academy	156	39	10	56
Grand total	9,312	2,579	725	4,430

TABLE 4. NUMBER EXAMINED IN EACH GROUP, BURMA

		Examinations			
		Abbreviated	Detailed	Biochemical	Dental
Military (all male)		4,963	1,375	367	2,411
Civilian male children	<15 years	346	91	26	124
Dependent male children	<15 years	303	74	18	74
Civilian female children	<15 years	241	75	21	122
Dependent female children	<15 years	285	65	22	94
Civilian male adults	15+ years	758	210	63	342
Dependent male adults	15+ years	3	1	1	--
Civilian female adults	15+ years 1/	658	172	58	341
Dependent female adults	15+ years 1/	1,513	456	133	822
Total		9,070 2/	2,519 2/	709 2/	4,330 2/

1/ Of the 658 females (civilians) 15+ years, 50 were pregnant and 156 were lactating. Of the 1,513 females (dependents) 15+ years, 260 were pregnant and 679 were lactating.
2/ These figures exclude the Defense Services Academy and the boys' boarding school.

The examinations were performed by the clinical team consisting of four Burmese and three American physicians. The abbreviated examinations were done primarily by the latter with help from the former, while most of the detailed examinations were performed by the

Burmese because of the language problem in obtaining the historical information. A breakdown of the examinations according to examiner is given in Table 1A of the Appendix.

Each of the 9,312 individuals was examined briefly (abbreviated examination) for obvious clinical signs of malnutrition. This included measurement of height and weight and a rapid but careful examination of the eyes, mouth, skin, thyroid gland, extremities and Achilles' reflex. Depending upon the load of patients for the day, one of every 3 or 4 of the subjects was then given a more detailed examination which included measurement of skinfold thickness, blood pressure and pulse, and examination of the heart, chest and abdomen and a dental evaluation. Again depending upon the load, one of every 3 or 4 so examined was then sent to the field laboratory where blood, urine and stool specimens were obtained for biochemical, hematologic and parasitologic studies. A special note of thanks should be offered here to the faithful clerks of the team, who obtained all of the necessary biographical data on the subjects and who were so meticulously careful, yet rapidly efficient in their chores.

The examination card forms are shown in Appendix Figures 1A-1C.

A description of the clinical criteria used in the examinations is given in Table 5.

2. The Biochemical sample

Samples of blood and urine were obtained by random selection from those individuals given detailed physical examinations (see Tables 3 and 4). The sampling ratio varied from location to location in order to insure a laboratory work load of approximately 20-25 samples per day.

Hematocrits were performed at the examination site on blood samples obtained by fingertip puncture. In addition, a portion of this blood was introduced by means of a Sahli pipette into previously prepared tubes of cyanmethemoglobin reagent. These tubes were then capped and returned to the base laboratory where the contents were transferred to colorimeter tubes for determination of hemoglobin concentration.

About 20 milliliters of blood was collected by venipuncture into vacutainers where it was allowed to clot. It was sometimes necessary to obtain lesser volumes when the subjects were women or children. An additional 10-12 milliliters of blood was drawn into heparinized tubes from 12 subjects for use in the determination of red cell transketolase activity and to provide additional serum for special studies (amino acids, fatty acids, folic acid, etc.). Urine was collected in individual plastic bottles containing 2-5 milliliters of toluene and sufficient 1.0 N hydrochloric acid (HCl) to achieve a pH of about 3.

All samples were stored in ice coolers and returned to the base laboratory, usually arriving within 24 hours after collection. The serum was removed from the clotted blood samples following centrifugation and divided into suitable aliquots for the determination of total protein, albumin, globulin, vitamin A, carotene, cholesterol and vitamin C. The urine was filtered through Whatman No. 1 filter paper and portions were allocated for the determination of creatinine, thiamine, riboflavin and N^1-methylnicotinamide. All of these except cholesterol were performed essentially as described in the ICNND Manual for Nutrition Surveys (1). Serum cholesterol (free and total) was estimated by the method of Searcy and Bergquist (2). The transketolase activity of the red cells from the heparinized blood was determined by a method similar to the procedure described by Brin et al. (3). A detailed description of this method and a summary of the results are included in the Special Studies section (page 163).

TABLE 5. DESCRIPTION OF CLINICAL CRITERIA USED

Clinical Entity	Requirements for Positive Recording
Nasolabial seborrhea	Marked accentuation by scraping with finger or tongue blade
Angular lesions	Definite loss of continuity of the mucous membrane
Swollen red interdental papillae -	
localized	More than one papilla involved, but not all
diffuse	Both maxillary and mandibular sides
Gingival marginal swelling, redness, atrophy, and recession	Gingiva of more than one tooth involved
Gingival bleeding	Spontaneous bleeding and distinctly friable tissue
Filiform papillary atrophy - slight	Less than one third of visible surface involved
Filiform papillary atrophy - moderate	Between one third and two thirds of visible surface involved
Filiform papillary atrophy - severe	More than two thirds of visible surface involved
Goiter, Grades 0 - III	WHO criteria (see below)1/
Follicular hyperkeratosis	Distinctly not tinea versicolor
Loss of ankle jerk	Absent with manual reinforcement, and in two positions (kneeling on chair, and with feet resting on floor while sitting)
Loss of knee jerk	Absent with manual reinforcement, and in two positions (freely swinging, and with feet resting on floor while sitting)
Calf tenderness	Pain of a degree obvious to all

1/ The World Health Organization (WHO) criteria for grading goiter are: (4)

Grade 0: persons without goiter. By definition these are persons whose thyroid glands are less than four to five times enlarged.

Grade I: persons with palpable goiters. The thyroid is considered to be more than four to five times enlarged although not visible with the head in normal position. Most of these will be readily visible with the head thrown back and the neck fully extended.

Grade II: persons with visible goiters. Persons with goiters which are easily visible with the head in normal position but which are smaller than those in Grade III. Palpation may be helpful in determining the mass of the gland, but is not needed for diagnosis.

Grade III: persons with very large goiters. The goiters of persons in this category can be recognized at a considerable distance. They are grossly disfiguring and may be of such size as to cause mechanical difficulties with respiration and in the wearing of clothes.

In the detailed examinations, examination was routinely made for absence of knee jerks and malleolar vibratory sense. Skinfold thicknesses were determined at two sites: (a) a longitudinal fold midway between the olecranon and the head of the humerus on the dorsal surface of the brachium, with the arm flexed across the chest, and (b) a horizontal-to-oblique fold just below the tip of the scapula, with the arms relaxed at the sides. The caliper described by Best (5) was utilized.

Excess serum was transferred to ampules which were sealed and frozen after the addition of toluene as a preservative and ascorbic acid as an antioxidant. At the conclusion of the survey, these samples were packed in dry ice and shipped by air to the U.S. Army Medical Research and Nutrition Laboratory (USAMRNL) in Denver, Colorado. They were subsequently analyzed for folic acid and vitamin B_{12} using microbiologic procedures, for serum proteins by paper electrophoresis and for fatty acids by gas chromatography. When additional serum was available, it was treated with 10 percent trichloroacetic acid and the free amino acid pattern was determined at the Denver laboratory with a Beckman amino acid analyzer. The results of these determinations are included in the Special Studies section of the report (p. 153 ff).

Surplus urine was stored in plastic bottles under a layer of toluene and returned to the United States at the end of the survey. One aliquot was sent to the Boston Medical Laboratory for the determination of the iodine content using a modification of the method of Zak (6). A second portion was shipped to the USAMRNL for estimation of oxalate by the method of Archer et al. (7) and of magnesium by the ethylene diamine tetraacetic acid titration method of Robinson and Rathbun (8).

An additional 200 blood samples was drawn at the laboratory in Mingaladon from local military personnel and their dependents for determination of red cell fragility in the presence of peroxide, an indirect measure of the blood levels of vitamin E. This test could only be performed in the Mingaladon area since it must be begun within 2 hours after collection of the sample. These results and an account of the method are summarized in the Special Studies section of the report (page 171).

Approximately 130 urines were analyzed for free vitamin B_6 at the base laboratory using the Saccharomyces carlsbergensis microbiologic assay, and xanthurenic acid was measured in the urine of 60 subjects before and 6 hours after administration of a test load of DL-tryptophan. Details and results will be found under the Special Studies section on page 156.

3. The Dietary sample

a. Military

The military sample for the dietary survey was selected from groups that composed a certain portion of the clinical and biochemical sample. The sample included 2 Naval units, 1 Air Force unit, the Defense Services Academy and 12 Army units (Table 6).

(1) Methods

(a) Recipe method. The standard recipe procedure utilized in previous ICNND surveys (1) was employed. The quantity of food eaten by the individual soldier was calculated from the amount of raw food used in the preparation of each individual food item. The nutrients in the food consumed were calculated using the Burmese Food Tables prepared by the Nutrition Project (Appendix 1B; 9) and U.S. Department of Agriculture Handbook No.34 (10).

With one exception, food records were not available in the individual military units. One of the Naval units had such data, which were converted to food intakes, using inventory procedures outlined in the ICNND manual (loc. cit.).

(b) Food composites. Food composites equal to an individual daily intake were prepared by calculating the total amount of food prepared and consumed and the

TABLE 6. MILITARY POPULATION STUDIED IN DIETARY SURVEY, BURMA

Location	Unit	Average No. Men Eating Per Day 1/	Type of Activity 2/
Mingaladon	BAMC	70	Sedentary
Mingaladon	BATD #1	343	Very Active
Ratanabon 3/	Navy	100	Sedentary
Ratanabon 4/	Navy	300	Active
Indaing	COD	50	Sedentary
Indaing 3/	107th Regt.	100	Moderately Active
Toungoo	22nd Buregt.	48	Sedentary
Meiktila	Art. Depot	147	Active
Meiktila 3/	Air Force	600	Sedentary to Active
Ba Htoo Myo	BACFS	142	Active
Ba Htoo Myo 3/	BANCOS	350	Very Active
Chauk 3/	104th Regt.	63	Moderately Active
Maymyo	BATD #2	177	Very Active
Maymyo	Defense Services Academy	186	Very Active
Moulmein	1st Chin Rifles	90	Moderately Active

1/ Average for total meals served.
2/ Sedentary: Headquarters Units; Nonfield Units.
Moderately Active: Operational Units at rest camp.
Active: Operational Units; Training Units (not Basic).
Very Active: Basic Training.
3/ These units were studied only by the food composite method. All others were studied by recipe and food composite methods.
4/ This unit was studied by the food inventory method only.

number of persons eating at a given meal. These composites were made by homogenizing samples and then preserving 2 aliquots, one with 5 percent oxalic acid and the second with the addition of 50 milliliters of 1 percent alcoholic potassium hydroxide solution to 200 grams of homogenate and 10 grams of chloroform. Samples taken for analysis were equivalent to one tenth of the food consumed by an individual per day. Food composites were analyzed in the United States by the Wisconsin Alumni Research Foundation laboratories by the methods shown in Table 7.

TABLE 7. METHODS OF ANALYSIS USED TO DETERMINE NUTRIENT CONTENT OF FOODS

Nutrient	Method
Protein	A.O.A.C., Official Methods, 9th ed., p. 12, 1960
Fat (Ether Extract)	A.O.A.C., Official Methods, 9th ed., p. 287, 1960
Thiamine	A.O.A.C., Official Methods, 9th ed., p. 655, 1960
Riboflavin	A.O.A.C., Official Methods, 9th ed., p. 669, 1960
Ascorbic Acid	Roe and Kuether, J. Biol. Chem. 147, 399, 1943
Beta-Carotene	A.O.A.C., Official Methods, 9th ed., p. 652, 1960
Niacin	A.O.A.C., Official Methods, 9th ed., p. 667, 1960
Vitamin B_{12}	U.S.P., XVI, p. 888, 1960
Vitamin B_6 (S. carlsbergensis)	Atkins, Schultz, Williams and Frey, Ind. Eng. Chem., Anal. Ed. 15, 141, 1943
Folic Acid	A.O.A.C., 8th ed., p. 830, 1955
Ash	A.O.A.C., Official Methods, 9th ed., p. 284, 1960
Iodine	Binnerts, Analytica Chimica Acta 10, 78, 1954
Moisture	A.O.A.C., Official Methods, 9th ed., p. 283, 1960
Calories (Bomb Calorimetry)	Gleland and Harding, Rev. Sci. Instr. 28, 696, 1957
Fiber	A.O.A.C., Official Methods, 9th ed., p. 288, 1960
Carbohydrate	By difference

b. Dependents and civilians

Families of military dependents and of the civilian population were surveyed in order to estimate the kinds and amounts of food eaten and to calculate nutrient intakes. Information was also obtained on the food attitudes of the population. Attempts were made to select a representative sample from within each group studied by the clinical and biochemical members of the survey team. In the case of small villages and small dependent units, all housewives were included in the dietary sample. In all, 776 dependent families (3,249 persons) and 386 civilian families (1,848 persons) were studied (Tables 8-10).

(1) Methods

Three methods were used to calculate food intakes in the military dependent and civilian populations.

(a) Questionnaire method. Three trained interviewers from the (Burma) Nutrition Project carried out a questionnaire study (Appendix 1C). The questionnaire was designed to obtain information on the amount of rice eaten by the family on the previous or a normal day and on the amount of other foods usually eaten per week. This procedure has been generally used by the Nutrition Project and was followed in order to have information for comparison with their many previous surveys. Surveys were always carried out in the home, where the housewife was more readily able to recall foods available or to show the interviewer specific specimens of foods or servings.

TABLE 8. COMPOSITION OF MILITARY DEPENDENT AND CIVILIAN FAMILIES, DIETARY SURVEY SAMPLE, BURMA

Age (years)	Males	Females
0-1	150	160
1-3	330	343
4-6	312	287
7-9	225	213
10-12	153	158
13-15	95	79
16-19	92	177 (Including Pregnant 13, Lactating 16)
20-59	1,241	1,194 (Including Pregnant 74, Lactating 143)
60+	76	110

MILITARY DEPENDENTS

	Food Composite Method	Food Weighing (Recipe) Method	Questionnaire Method
Families	18	116	776
People	91	497	3,249

CIVILIANS

Families	7	117	386
People	49	643	1,848

(b) Recipe method. In approximately 10 percent of the homes in which questionnaires were used, one- or two-day sampling was completed in which all of the food prepared and eaten on a given day was weighed. The amount of food consumed per individual or per standard unit was then calculated using food tables.

(c) Food composites. In 25 homes food composites were collected, representing the actual foods consumed by the family. Analysis of these samples was carried out in the manner described for analysis of the military food composites and the intake per standard unit was determined. All food intakes for the military dependent and civilian populations have been converted to a standard man value, using a requirement scale that gives a standard man value of one (see Appendix Table 1D).

TABLE 9. COMPOSITION OF MILITARY DEPENDENT DIETARY SAMPLE, BURMA, INTERVIEWED BY QUESTIONNAIRE

Location and Unit	Number of Families	Number of Persons	Standard Man Value	Total Income per Family per Month Kyats
Mingaladon, BAMC	77	345	241.0	72
Mingaladon, Air Force	55	255	172.4	165
Rangoon, Navy	56	253	178.85	137
Toungoo, 22nd Buregt.	71	297	214.75	85
Indaing, COD	51	222	155.25	98
Meiktila, Air Force	84	357	249.65	128
Meiktila, Artillery	87	365	262.35	94
Ba Htoo Myo, All Units	107	400	277.6	76
Maymyo, Engineer	60	308	217.25	100
Chauk, 104th Regt.	58	220	106.9	80
Moulmein, 1st Chin Rfl.	70	227	171.5	81

TABLE 10. COMPOSITION OF CIVILIAN DIETARY SAMPLE, BURMA, INTERVIEWED BY QUESTIONNAIRE

Location	Number of Families	Number of Persons	Standard Man Value	Total Income per Family per Month Kyats
Indagaw	57	266	200.5	83
Kyee Taw	40	168	130.35	74
Shwe Daung	44	225	174.65	117
Lauk Sauk	45	241	185.95	109
Sé Bauk	31	125	97.7	55
Ngayan Chaung	79	452	327.05	96
Wet Wun	46	180	139.95	70
Myaing-Gyi	44	191	142.45	89

4. The Dental sample

All dental examinations were performed by the two team dentists. Standard dental mirrors and explorers were used and examinations were conducted in areas of good natural light. Emphasis was placed on obtaining information about the occurrence of dental caries and periodontal diseases in the Burma population sampled. Criteria employed in the clinical assessment of oral health are presented in Appendix 1E. After an initial period of standardization uniformity between the two examiners in applying the selected indices to evaluate clinical findings appeared satisfactory. This is indicated by the fact that dental findings returned by each examiner for major components of the Burma population sample were in good agreement.

A total of 4,430 persons was given a dental examination. All had received a medical evaluation and one or more biochemical determinations were carried out for 708 of these individuals. The dental sample included 2,467 military males, 1,034 military dependents and 929 civilians. Distribution of the military sample by branch of service is presented in Table 11. Distribution of the total dental sample by age and sex is outlined in Tables 3, 4 and 12.

TABLE 11. DISTRIBUTION OF MILITARY DENTAL SAMPLE, BURMA

Age (years)	Army	Navy	Air Force	Defense Services Academy	Total
15-19	136	40	16	47	239
20-29	1,217	110	209	9	1,545
30-39	559	7	29	--	595
40-49	80	1	--	--	81
50+	7	--	--	--	7
Totals	1,999	158	254	56	2,467

TABLE 12. DISTRIBUTION OF PERSONS GIVEN DENTAL EXAMINATIONS, BURMA

Age (years)	Military Males 1/	Military Males 2/	Dependents Females	Civilians Males	Civilians Females	Total
0-4	--	9	8	1	1	19
5-9	--	44	58	44	41	187
10-14	--	37	28	79	80	224
15-19	239	28	81	48	28	424
20-29	1,545	--	522	89	91	2,247
30-39	595	--	180	76	87	938
40-49	81	--	34	62	64	241
50+	7	--	5	67	71	150
Total	2,467	118	916	466	463	4,430

1/ Includes men of the Defense Services Academy.
2/ Includes those attending boys' boarding school.

References

1. Interdepartmental Committee on Nutrition for National Defense. Manual for Nutrition Surveys, revised edition (in press, 1963).

2. Searcy, R.L., and L.M. Bergquist. A New Color Reaction for the Quantitation of Serum Cholesterol. Clin. Chim. Acta 5, 192, 1960.

3. Brin, M., M. Tai, A.S. Ostashever and H. Kalinsky. The Effect of Thiamine Deficiency On the Activity of Erythrocyte Hemolysate Transketolase. J. Nutrition 71, 273, 1960.

4. Pérez, C., N.S. Scrimshaw and J.A. Muñoz. Technique of Endemic Goitre Surveys. Endemic Goitre, p. 369, see esp. p. 376, World Health Organization Monograph Series No. 44, Geneva, 1960.

5. Best, W.R. An Improved Caliper for Measurement of Skinfold Thickness. J. Lab. Clin. Med. 43, 967, 1954.

6. Zak, B., H.H. Willard, G.B. Myers and D.J. Boyle. Chloric Acid Method for Determination of Protein-Bound Iodine. Anal. Chem. 24, 1345, 1952.

7. Archer, H.E., A.E. Dormer, E.F. Scowen and R.W.E. Watts. Studies On the Urinary Excretion of Oxalate by Normal Subjects. Clin. Sci. 16, 405, 1957.

8. Robinson, H.M.C., and J.C. Rathbun. The Determination of Calcium and Magnesium in Blood Using One Indicator. Canad. J. Biochem. Physiol. 37, 225, 1959.

9. Food Composition Tables. Nutrition Laboratory, Department of Health, Union of Burma, 15 September 1959.

10. U.S. Department of Agriculture. Composition of Foods Used in Far Eastern Countries. Agriculture Handbook No. 34, Washington, D.C., 1952.

IV

AGRICULTURE AND FOOD PROCESSING IN BURMA

A survey was made of agriculture and food processing methods. The primary purpose was to obtain basic information regarding existing practices which might be modified in order to correct any nutritional deficiencies observed by the clinical, dietary and other sections of the survey team.

1. Survey period

Harvest of rice began about November 15. Therefore, the survey covered the end of the rice year and the period of harvest. This is a period during which acute beriberi may appear in the population.

2. Summary of agriculture

Over-all land area is 261,610 square miles with an estimated population of 20,255,000.

Lower Burma, the rice granary of the country, has over 52 million acres of cultivable land of which an estimated one-third is in actual use. Rainfall in this area is from 80 to 200 inches per year. Central Burma is a dry zone with less than 40 inches of rainfall per year. North Burma has over 4,000,000 acres of cultivable land of which only 371,000 acres are used. Rainfall is intermediate between that in the wet zone of the South and the dry zone of Central Burma. Paddy covers 68 percent of all cultivated land.

Eighty percent of the Burmese live on farms and produce (fishing included) roughly 35 percent of the gross national product. Gross national product in 1959-60 was $1,254,120,000 of which agriculture and fishing contributed $447,930,000 (Table 13).

As a rice surplus-producing country and the largest rice exporter in the world, Burma depends upon this cereal as the backbone of the economy and the major food supply. The consumption of polished rice as the major food staple (almost a pound is available per person per day; Table 14) is responsible for the prevailing inadequacy of thiamine and riboflavin nutriture. This problem is further compounded by the practice of discarding the water in which rice is cooked and insufficient diversification of the diet.

There are an estimated 1,000 tractors in Burma and mechanization is being pushed in an effort to modernize farming and get ready for the day when there may be a shortage of labor. While Shan State and the region around Mandalay are adapted to large-scale farming, the delta probably will never be, although research is being directed toward mechanization of rice cultivation and harvest. FAO has supplied Burma with a complete machine shop for repairing tractors and other farm machinery. Nine hundred young men are trained every year to drive, repair and maintain tractors.

The State Agriculture and Marketing Board (SAMB) is encouraging farmers to grow fewer varieties of rice, as it is difficult to mill and market a great number. However, efforts have failed so far due, at least in part, to the fact that they are not paid any premium for using pure seed.

The Agriculture and Rural Development Corporation (ARDC) is deeply involved in sugar cane production. It teaches farmers how to grow the cane, helps them with tractors for expanding acreage, provides cuttings for planting, distributes fertilizer (ammonium sulfate) not available on the market except through its program, distributes chemicals for

TABLE 13. PRODUCTION OF GOODS AND SERVICES, BURMA, 1959-1960[1/]

	Millions Dollars (U.S.)	Millions Kyats
Gross national product	1,254	5,972
Gross domestic product	1,257	5,985
Agriculture and fisheries	448	2,133
Forestry	91	434
Mining and quarrying	21	100
Rice processing	43	203
State marketing	63	299
State transport	26	124
State banking	4	18
Other public utilities	14	65
General government	130	620
Rental value of housing	46	220
Other industries and services	377	1,798
a. Salt and ngapi	10	46
b. Construction	39	186
c. Agricultural marketing	101	480
d. Residual	228	1,086

Gross output per capita per year	$55 U.S.	263 kyats
Consumption per capita per year	$35 U.S.	169 kyats

1 kyat = $0.21 (U.S.)

1/ Economic Survey of the Union of Burma, 1961.

TABLE 14. BURMA FOOD BALANCE, 1958[1/]
(POPULATION 20,255,000)

Product	Supply: Production	Supply: Imports	Supply: Exports	Supply: Change in Stock	Supply: Total Supply	Utilization: Non food use[2/] Total	Utilization: Supply for food: Total Gross	Utilization: Supply for food: Extraction rate	Utilization: Supply for food: Net: Total	Utilization: Supply for food: Net: Per Year	Utilization: Supply for food: Net: Per Day
	in 1,000 metric tons							Percent	10,000 metric tons	kg.	Calories
Rice[3/]	5,226	--	1,494	233	3,499	244	3,255	--	3,255	160.7	1,585
Wheat	10	29	--	--	39	5	34	83	28	1.4	15
Corn	44	--	27	--	17	3	14	--	14	0.7	5
Millet	81	--	--	--	81	7	74	90	67	3.3	30
Total Grain	5,361	29	1,521	233	3,636	259	3,377	--	3,364	166.1	1,635
Sugar											
Centrifugal[4/]	41	33	--	18	56		56	--	56	2.8	30
Other[5/]	144	--	--	--	144	--	144	--	144	7.1	70
Potatoes	50	--	--	-3	53	5 [7/]	48	--	48	2.4	5
Peanuts [6/]	157	--	--	17	140	119	21	--	21	1.0	15
Other pulses[8/]	300	--	88	9	203	20	183	--	183	9.0	80
Other vegetables	1,200	--	--	--	1,200	120	1,080	--	1,080	53.3	30
Fruits[9/]	814	10	--	21	803	80	723	--	723	35.7	60
Meat[10/]	87	--	--	--	87	--	87	--	87	4.2	25
Fish[11/]	500	25	--	--	525	--	525	--	525	25.9	45
Slaughter fats	15	1	--	1	15	--	15	--	15	0.7	15
Peanut oil	45	8	--	1	54	--	54	--	54	2.7	65
Sesame oil[12/]	17	--	--	1	16	--	16	--	16	0.8	20
Coconut oil	--	10	--	--	10	5	5	--	5	0.2	5
Total fats											
As product	77	19	--	1	95	5	90	--	90	4.4	105
Fat content	75	19	--	1	93	5	88	--	88	4.3	--
Whole milk[13/]	359	24	--	19	364	--	364	--	364	18.0	30
Eggs	92	--	--	-5	97	--	97	--	97	4.8	20
Total Consumption											2,150

1/ Food Balance in Foreign Countries. PAS-H 101 (Oct. 1960). Part II. Estimate for 12 countries in the Far East. Foreign Agriculture Service, U.S. Dept. of Agriculture.
2/ Breakdown of nonfood use was not available. 3/ 1958 harvest production - utilization (Crops of 1957). Adjustment made in change in stocks. 4/ Raw. 5/ Noncentrifugal. 6/ Shelled basis. 7/ Peanuts used in manufacture of peanut oil. 8/ Edible only. 9/ In terms of fresh. Includes tree nuts. 10/ Carcass weight. Includes beef, pork, poultry, mutton. Production includes most from animals slaughtered within country. 11/ Landed weight. 12/ Includes the sesame oil equivalent of sesame seed consumed as seed. 13/ Trade and consumption include the whole milk equivalent of canned and dried milk, if any. Partly based on official sources, partly estimated. Excludes alcoholic beverages.

rat and insect control, arranges for advances in payments to farmers so they do not have to borrow, markets the product systematically, surveys new areas, and estimates sugar cane yield. This program is stimulating increased sugar production.

The Department of Agriculture distributes seed for special crops such as soybeans, rents tractors, furnishes fertilizers, and guarantees the market price. This will eventually help diversification of the diet.

Although Burma is using a great amount of ingenuity in fostering mechanized and modern farming methods, much of Burmese agriculture remains primitive. Low yields per acre are the result of extensive farming, which occurs whenever land is relatively abundant in relation to population. Improved cultural practices, improved seed, soil classification, use of fertilizers, water control and intensive farming could increase food production markedly. This, coupled with greater diversification of the diet, could do much to alleviate nutritional problems in Burma.

Production of major crops in 1959-1960 is shown in Table 15. In 1960-1961, acreage under all crops except sesamum increased. Production of pulses, sugar cane and wheat increased by only small percentages. Groundnut production increased 27 percent over the previous year. This is very desirable since fat consumption is below recommended standards. About 12 grams of fat are available per person per day (Table 14). The World Health Organization has indicated that the diet of the average Burmese is more deficient in fats than any other item. Total import of fats averages 30,000 tons per year.

TABLE 15. PRODUCTION OF MAJOR CROPS, BURMA, 1959-1960[1/]

Crop	Sown Acreage	Tons Produced
Paddy	10,667,000	6,916,000
Groundnut	1,086,000	275,000
Sesamum	1,547,000	66,000
Cotton	357,000	12,000
Pulses	1,337,000	332,000
Sugar cane	67,000	1,005,000
Millet and wheat	492,000	68,000
All other crops	2,153,000	
TOTAL	17,720,000	

1/ Economic Survey of the Union of Burma, 1961.

Sheep production has been increasing at a rate of about 14,000 per year, while pigs have increased by about 3,000 per year. Goats increased by 12,000, while cows remained relatively constant in numbers from 1959 to 1960. Mortality rates in all herds of domestic animals are high. Animals available for slaughter are limited. This, coupled with relatively high price, makes widespread increased use of animal proteins impossible at this time. Approximately 11.5 grams of meat are available per person per day (Table 14).

3. Summary of fish production

Fish and fish products are the most important sources of animal protein in the Burmese diet and, as such, they consume about 30 percent of the average Burmese family's food budget. About 70 grams of fish are available per person per day (Table 14).

Although Burma has 1,200 miles of coastline, deep sea fishing has not as yet been developed. The fishermen still use old-fashioned equipment and methods. Modernization of the deep sea fishing industry could vastly increase the supply of fish.

The best shrimp collecting areas are in the hands of the insurgents at present. Once security is established in these areas, Burma can become self-sufficient in shrimp production.

The Directorate of Fisheries is doing all it can to expand the culture of fish in ponds and to increase the supply of fresh water fish which the Burmese seem to prefer. European carp reared in ponds reach marketable size in 1-1/2 years. Surplus rice bran can be used as feed. The European carp breeds in impounded water. Other varieties require running water for laying eggs. There is excellent demand for carp and they are good, either in a curry or fried. However, they cost approximately $0.33 to $0.44 per pound, making them relatively expensive. Tilapia from Thailand is a prolific breeder and easily raised in ponds and paddy fields. Tilapia are fine fried but do not make a good curry. They cost about half the price of carp.

The Army has 80 acres in ponds and is raising carp. Its success will increase the supply of fish for Army use and can serve as an example for the civilian population.

The shortage of cold storage facilities makes it difficult to distribute fresh fish very far inland. Even Rangoon does not have enough fish to supply the demand.

Licenses are sold for fishing inland areas commercially. This has led to exploitation. Conservation laws and enforcement are necessary to control the catching of fish during the breeding season.

During the season when hilsa are caught fish are often a glut on the market. During this period there is also often a shortage of salt which is essential for drying larger fish. It is difficult to transport salt from the salt collection areas to the fishing areas. Furthermore, the fishermen do not have the funds to purchase the quantities of salt needed for salting surplus fish.

4. Summary of food processing

The general pattern of food consumption in Burma is to consume fruits, vegetables and meats, particularly fish, purchased fresh the year round. Little need exists for the consumption of canned foods which are beyond the means of the average consumer. However, for the military and for use during emergencies as well as to conserve the supplies of those fruits and vegetables available only at certain times of the year, it is desirable to have a basic canning industry.

a. Food industries

In 1960, there were 5 canning factories in Burma. Since then, two factories, one at Kyaukse and one in Rangoon (B.C.C.), have gone out of business. Failure was due to poor quality of product and to heavy losses from spoilage through use of defective tin cans. At present, three canning factories are operating:

Defense Services Canning Factory (Kalaw - now moved to Mandalay) — capacity 10,000 to 15,000 cans per day.
Producers Canning Cooperative (Taunggyi) — capacity 1,000 cans per day.
P.A.T.C. (Rangoon) — capacity 1,000 cans per day.

The Defense Services cannery at Kalaw dominates the canned food production of Burma. The manager is a food technologist trained in London and progressive in outlook. The Taunggyi plant also is progressive and does some experimentation in the field of new canned products. All three plants can fish and meat curries, vegetables, including beans, and fruits, principally pineapple and mango.

All tin plate used for cans is imported. The cost of a one-pound can ranges from 17 pyas (3.6 cents U.S.) up.

The canning factory at Kalaw supplies the Army, but the capacity of the plant is greater than is needed for Army use. Therefore, it is essential that the plant produce a product of high enough quality to compete on the civilian and the export market as well. The cannery at Kalaw should be modernized and made as efficient as possible. It should serve as a model for private canning companies.

The location at Kalaw is so far removed from the source of low priced fish that a subsidiary for canning fish should probably be established on the coast close to the center of the Burmese fishing industry. Such a plant could also be equipped for the drying of fish, shrimp and prawns under controlled conditions. The Kalaw plant already has a commercial size hot-air tray drier that could be transferred and used for this purpose.

The Burmese Army also operates a fish and shrimp paste factory which is attempting to improve and modernize the traditional processing methods.

Burma has other interesting modern food industries.

The State Agriculture and Marketing Board is building 12 ultramodern rice mills. Two have already been completed and are fully equipped to produce rice enriched with vitamins. They can also produce rice undermilled to controlled degrees.

Parboiled and full boiled rice are produced by the Shwe Thein Rice Mill (Rangoon) for export to India and for local consumption by Indian people.

In addition to the new rice mills, there are 882 mills (1957 count; Table 16), many of which have small capacity and relatively old equipment.

The Pwint Gaung Bros. shrimp paste (ngapi) factory not only builds its own fishing boats, but produces its own tin cans. Its employees are furnished clean uniforms and the plant has an atmosphere of cleanliness, sanitation and efficiency. The plant, which produces 60,000 pounds of shrimp and fish paste daily, operates its own quality control laboratory.

Groundnut and sesamum oil are produced by many plants ranging from small ones, where wooden machinery is turned by oxen to press out the oil, to modern plants having the most modern presses operated by electricity.

The new Burma Vegetable Oil and Ghee Plant is equipped with fine West German machinery (and has a German advisor) to produce decolorized, deodorized, refined peanut oil and vegetable ghee. This coming year it expects to have its own presses and solvent extraction machinery for removing the oil from seeds, particularly groundnut. At present, it buys the crude groundnut oil and refines it. The company generates its own hydrogen by electrolysis of water and pumps it into tanks under pressure for use in hydrogenating the oil to make ghee. It also manufactures its own tin cans and enamels labels on the cans. It can refine 12 tons of oil per day.

687462 O - 63 - 4

TABLE 16. NUMBER OF PLANTS, PERSONS EMPLOYED, WAGES AND SALARIES AND VALUE OF PRODUCTS IN FOOD INDUSTRIES AND TOBACCO, BURMA, 1956-57

Industry	No. Plants	Persons Employed	Wages and Salaries (kyats) 1/	Value of Products (kyats)
Food manufacturing and beverages	1,104	62,787	37,352,812	357,256,982
Dairy products	3	122	117,821	1,756,715
Grain mills (except rice)	21	664	627,532	21,184,130
Canning and preservation of fruits and vegetables	6	205	113,929	967,705
Canning and preservation of fish and seafood	5	230	313,550	5,883,920
Rice mills	882	50,122	24,192,072	207,624,891
Bakery products	65	2,172	2,023,294	23,338,649
Sugar refineries	4	4,582	5,584,907	54,478,472
Cocoa, chocolate, candy	33	1,474	702,353	9,098,733
Macaroni, spaghetti, noodles	30	992	784,115	9,169,182
Distilleries	5	252	398,312	2,642,265
Soft drinks and carbonated water	20	665	1,059,955	6,514,871
Crystallized boiled sugar (jaggery)	5	95	20,706	107,600
Ice manufacturing	12	585	515,843	2,451,108
Tobacco	271	10,764	5,453,100	34,695,806

1/ 1 kyat = $0.21 (U.S.).

SAMB has also built 5 rice bran oil mills (solvent extraction) with capacities of 50 tons of rice bran per day. Three other plants refine the oil for human consumption. Rice bran oil has qualities for deep fat frying superior to groundnut oil.

The State Brewery at Mandalay produces 728,000 gallons of beer per year. The yeast is discarded. A distillery operated in conjunction with the brewery also discards its spent liquors. Both of these products could be useful in animal feed programs if they were dried.

There are 6 wheat flour mills in the vicinity of Rangoon. Five are modern. The largest has a capacity of 60 tons of wheat per day. Flour is of 70-72 percent extraction. There is no enrichment.

There are an additional 15 grain mills (not including rice) in other parts of Burma.

Inasmuch as bread is not an important food in the Burmese diet, bakeries are generally small. Even the larger bakeries rely upon hand labor rather than extensive mechanization.

There are 4 sugar refineries. The one at Pyinmana was built in 1956 with modern Japanese equipment and has a capacity of 1,500 tons of cane per day. A Japanese expert is helping to run the plant. The other sugar refineries are older, but produce a fair quality coarse sugar. The molasses is a surplus raw material in all the plants. This is partly due to an artificially high price maintained by the Government for molasses used within Burma — 80 kyats ($16.80) per ton versus an export price of 30 kyats ($6.30) per ton. Molasses can be used as a nutrient medium for the production of food yeast, alcohol, rum and various chemicals through fermentation with microorganisms.

There are many cane jaggery manufacturers, some of whom still use oxen to operate the crushing (juicing) machines. Palm jaggery is also a popular confection (30,000 tons per year). Use of wood to boil the palm juice has been partially responsible for loss of ground cover and much erosion in some sections of Burma. Groundnut husks are now being burned to heat the palm juice. The bagasse is burned in some of the jaggery plants to concentrate cane juice.

At the present time, there are not enough good dairy cattle to supply creameries and milk pasteurizing plants or a condensed milk factory. Burma imports relatively large quantities of condensed and dried milk. If it could become self-sufficient in these products, it could save 53,000,000 kyats or over $10,000,000 (U.S.) per year in foreign exchange. Gradual replacement of present nonworking cattle with high-producing dairy cows would achieve this end. It would be necessary to adopt better handling and feeding practices than those used currently. Burma has all the raw materials necessary for formulating good animal feeds. Groundnut and sesamum presscakes are exported in large quantities. Yeast from the State Brewery at Mandalay is discarded (see above), but could be dried and incorporated into animal and poultry feeds as a source of B-vitamins as well as protein.

A factory to produce canned, sweetened condensed milk is being built which will prepare its product from imported dried milk. The Agriculture and Rural Development Corporation has maintained a small bottled milk factory in Rangoon. The plant bottles the fresh milk in sealed soft-drink bottles and subjects it to a sterilizing heat process. This milk will keep for months in the unopened bottles without refrigeration. The plant has satisfactory equipment, but the capacity is too great for the amount of fresh milk available.

Slaughterhouses are small, unsanitary and very poorly equipped. It is against the law to slaughter beef except for military use. Much of the slaughter of beef, pork, sheep, or goat, therefore, is on a very small scale. Pork is prized for its fat rather than the lean meat. There is very little refrigeration available, so meat is sold the day of slaughter.

The Defense Services Canning Plant at Kalaw is planning a new slaughterhouse in conjunction with its present factory. The purpose is to insure a supply of fresh beef when it is needed. This new slaughterhouse, if modern in design, equipment and methods, could set an excellent example for other slaughterhouses within Burma.

The Army Resettlement Farm is doing a remarkable job of introducing new and better strains of chickens to Burma. Using a 39,000-egg capacity incubator, the Army has developed some good foundation stock and is releasing chicks to the civilian market at approximately 30 cents (U.S.) each.

Burma Pharmaceutical Industries (BPI) produces 4 to 5 million fortified yeast tablets per year. Cost is $0.42 U.S. per 1,000 tablets or 0.042 cents U.S. per tablet -- roughly 25 tablets for 1 cent U.S. These were highly accepted when passed out free by the Government to pregnant or lactating women and children. They are reasonably priced and should be used more widely among the civilian population.

Burma Pharmaceutical Industries produced 27,000,000 vitamin tablets for the military last year. The cost is $0.42 per 100 tablets or 0.42 cents each, about 2 for a penny (U.S.). The Army has found it difficult to get the men to consume these tablets daily. It may be desirable to eliminate the vitamin tablets and use this money for the manufacture of enriched rice for the military and military dependents.

It is difficult to apply modern technology to food processing in Burma because of the lack of satisfactory methods for harvesting crops at optimum maturity and the inability to collect and market produce in sufficient quantities to supply a cannery such as that at Kalaw. Burma would like to be self-sufficient in its sugar requirements. Sugar cane production is fostered by ARDC. The Government virtually controls production. Harvest is accomplished not on the basis of optimum sugar content which would yield the most sugar, but on the basis of having each farmer cut a portion of his crop at a time, supplying the sugar mill with required amounts of cane and permitting all the farmers to sell portions of their crop at the same time. Sugar cane planting should, if possible, be on the basis of supplying the mill with cane harvested at its optimum maturity. This admittedly is not easy but attention should be given to this possibility.

The new food processing plants discussed above show that Burma is progressing in the field of food processing, and profound changes can be expected as these new plants influence the production and consumption of foods in Burma and raise the quality of Burmese exported foods. The quality of food produced by the modern plants is much higher than that of those produced by traditional methods, yet the price is often no higher. Thus, the consumer may become more particular.

b. Food quality control

The Army has established not only the leading canning factory in Burma, but also has pioneered in the field of quality control of the food products it buys. Specifications have been set up for every major food product purchased. The Supply and Transport Directorate Laboratory (Quartermaster Corps) analyzes each shipment for deleterious substances, particularly toxins, according to the British Pharmacopoeia (1958) and Bells Sale of Food and Drugs (13th ed.). Pwint Gaung Bros., the leading producer of shrimp paste (ngapi) in Burma, also maintains a laboratory controlling shrimp and fish paste manufacture. The Nutrition Laboratory of the Department of Health is equipped to analyze all foods of importance to Burma for nutrient content. The Food and Drug Act (1928) places a penalty on selling articles of food or drugs not of proper nature, substance, or quality. As yet, there is no enforcement agency and standards have not been established.

c. Food processing research

The Union of Burma Applied Research Institute (UBARI) is well equipped for research in the fields of food technology and food processing. The Unit Operations Laboratory has three hot-air tray driers, a drum drier and a spray drier located in the Chemistry Section. It has two hammer mills, two Fitz mills, one ball mill, and a microcollector for particles smaller than 100 mesh. It has a homogenizer, a basket centrifuge (5 gallons capacity per hour), three plate filters (ranging up to 14 inches square), 1 double-effect vacuum evaporator, two vacuum thin-film single effect evaporators, a canning line for vegetables, can formers and sealers, 6 steam kettles, 6 reaction vessels, one oil expeller, a peanut dehusker, a fruit pulper, diaphragm, rotary and centrifugal pumps, liquid-liquid extractors, distillation equipment, and additional specialized and general equipment. In short, it is well equipped to undertake very nearly any food processing research that Burma may need for some time. It is short of refrigerated storage and cold rooms for processing, and needs packaging equipment as well. It is also lacking in essential food research references and journals. A list of suggested publications is appended to this report (Appendix 2A). Another difficulty lies in the fact that it does not have enough professional personnel to undertake and complete study of the many problems which confront the food processing industry today. There are a number of professional staff members who could profit from advanced study in the United States.

It is expected that the laboratories of the Supply and Transport Directorate will be placed under the Director of Defense Industries. They will have more space in their new quarters and there is some hope that some equipment for food processing research will be included to permit this group to pursue problems of particular interest to the Army, such as development of a precooked dehydrated rice and field ration.

d. Salt production in Burma

Salt is produced by approximately 190 small producers in the Bassein, Amherst, Kyaukphyu and Pyapon areas primarily by boiling sea water. Sometimes solar evaporation is used prior to boiling. The two "model" salt refineries at Bassein and Amherst are modifications of the traditional methods, but are not modern.

Total salt production in Burma for 1959-60 was 144,230 long tons. Chemical analysis by the Chemical Examiner to the Government of the Union of Burma reveals the following composition for salt:

Details of Composition	Sample A	Sample B
Color	white	light brown
Moisture	2.44%	0.07%
Insoluble matter	0.04%	0.08%
Calcium sulfate	0.60%	1.94%
Calcium chloride	nil	0.01%
Sodium sulfate	1.23%	nil
Magnesium chloride	1.35%	0.05%
Sodium chloride	94.34%	97.85%
mg iodine/100 gm salt	1.16	0.64

The iodine content of the above salt ranged from 6 to 11 parts per million (ppm) iodine in the salt. Present iodization schedules in most countries today call for 50 to 100 ppm iodine in the salt. Therefore, the level of iodine naturally present in Burmese salt is far too low to prevent goiter where salt is the only food contributing iodine to the diet.

Salt costs 2.3 cents U.S. per pound in upper Burma versus 2.0 cents U.S. per pound in Rangoon. Average salt available for consumption is 14.4 pounds per person per year, or approximately 18 grams per person per day. Actual consumption as shown by food analysis appears to be closer to 12 grams per day. Salt intakes vary from 6.9 to 18.3 grams per person per day in various parts of the military.

(1) Iodization of salt

In view of the prevalence of goiter in Burma, it is highly desirable that as much of the salt as possible under present methods of production and distribution be iodized. The Economic Development Corporation (EDC) should be notified of the desirability of adding potassium iodate to the salt. Its subsidiary, the General Trading Corporation, Rangoon, is the leading handler of salt in Rangoon. It would be desirable to start commercial iodization of salt at its distributing center.

From the technologic point of view, iodization of salt is simple. The salt is ground to the desired degree of fineness and potassium iodate diluted with calcium carbonate is added by a simple worm screw conveyor. A machine to add iodate to crude salt can be purchased from one of the following companies:

Novadel Ltd., 10 Buckingham Palace Gardens, London, S.W. 1, England
Alite Machines Ltd., Letchworth, Herts, England
Wm. Gardner Ltd., Gloucester, England
Escher Wyss, Zurich, Switzerland

Cost would be approximately $1,200 to $1,500 (U.S.) for a machine with a capacity of 10 tons of salt per day.

Potassium iodate and calcium carbonate diluent can be purchased from one of the following:

Malinckrodt Chemical Works, St. Louis, Missouri, U.S.A.
Charles Pfizer and Co., Brooklyn, New York
May and Baker Ltd., Dagenham, Essex, England
Fisons Chemical Ltd., London, N.W. 1, England

(2) Levels of iodization

Assuming a salt intake of 10 grams per day and an iodine requirement of 400 micrograms per day, 40 micrograms of iodine should be added per gram of salt. This amounts to 40 grams of iodine per ton of salt. One gram of iodine is contained in 1.686 grams of potassium iodate so 67.44 grams of potassium iodate diluted with 606.96 grams of calcium carbonate should be mixed with each ton of salt. Based on a cost of $9.98 (U.S.) per kilogram of potassium iodate and $0.53 (U.S.) per kilogram of calcium carbonate, the cost of iodating one ton of salt would be $1.00 (U.S.).

Burma Pharmaceutical Industries has indicated a willingness to participate in a program of iodization of salt. BPI could obtain the potassium iodate and mix it with calcium carbonate. It could also check the iodized salt to determine that iodization is accomplished at the desired levels. The Supply and Transport Laboratories of the Quartermaster Corps should set up specifications for iodization of all salt for military use and routinely determine iodization level on all salt delivered to the military.

e. Food storage problems

It is conservatively estimated that 10 to 15 percent of the rice paddy and 20 percent of the wheat flour is destroyed by insects and rodents. These pests undoubtedly cause serious losses in other foods also. A modern program of insect and rodent control coupled with construction of better storage facilities would result in a valuable saving in food. More rice could be exported and less wheat imported with a resulting improvement in the balance of trade for Burma.

f. Enrichment of rice

The Neikban Rice Mill, Rangoon (State Agriculture and Marketing Board), is currently enriching rice for export. It imports a "premix" from the Philippines. The "premix" consists of polished rice grains which have been impregnated with 880 milligrams of thiamine, 7,050 milligrams of niacin and 5,738 milligrams of iron per kilogram of rice. The rice grains are coated with a protective colorless solution which prevents loss of the vitamins in the rice grains even during the vigorous washing used in much of Southeast Asia. Each kilogram of enriched premix rice is carefully mixed with 199 kilograms of regular polished rice in a special machine already installed and used in the Neikban Rice Mill. A glazing drum for preparing the heavily vitamin-enriched premix is available in the Ahlone Rice Mill (SAMB).

The protective coating on the premix grains dissolves and releases the vitamins during cooking. Therefore, it is essential to cook the rice without an excess of water. If enriched rice is cooked in an excess of water and the latter is poured off as is traditional in Burma, the added vitamins will be largely lost.

Riboflavin can be added to the premix, but colors it bright yellow. If the rice is carefully stirred during cooking the riboflavin, and therefore the yellow color, becomes distributed throughout the rice. Otherwise the enriched grains stand out and may be discarded by the consumer, unless distribution of the rice is accompanied by careful education in its use and value.

By a more recent development (E.J. Lease, South Carolina Agricultural Experiment Station, Clemson, South Carolina) riboflavin, as riboflavin-5'-phosphate sodium, is applied in a solution containing polyethylene glycols or methyl cellulose which promotes

rapid dispersion of the yellow vitamin. Ferric pyrophosphate is used as a masking agent to cover the yellow color of the riboflavin in the raw premix grains. The thiamine, niacin and iron are added to the premix grains by the regular process described above and covered with a protective coating of zein and confectioners shellac. Then the riboflavin and ferric pyrophosphate are added. The thiamine, niacin and iron are wash-resistant, whereas the riboflavin is not. Therefore, by the Lease process the rice should be neither washed nor cooked in an excess of water. It is doubtful that even the Burma military is prepared to accept both of these restrictions in cooking rice at this time without extensive education and supervision of its cooks.

At the start of the enriched rice program, it would seem desirable for the Supply and Transport Laboratories to set up specifications for the degree of enrichment desired in rice for military use and to procure it entirely through SAMB. It may be desirable temporarily to continue importing the premix from the Philippines. Premix is also available from Thai Rice Co., 691 Sathorn Road, River Bank, Bangkok, Thailand. The premix can be purchased with or without the addition of riboflavin. By the standard enrichment formulas 480 milligrams of riboflavin are added per kilogram of premix. Premix containing thiamine, riboflavin, niacin and iron costs about $432 (U.S.) per ton. This will enrich 199 tons of regular polished rice to yield a total of 200 tons of enriched rice. Cost of enrichment is about $0.0013 (U.S.) per man per day assuming a 600 gram intake of rice. Total cost would be about $48,000 (U.S.) per 100,000 men per year. Without riboflavin in the enriched premix the cost would be somewhat less.

Quality control tests should be run on enriched rice by the Supply and Transport Laboratory to determine that the rice meets the standards established for procurement.

5. Economic factors bearing on nutritional status

Burma is one of the few surplus food producing countries in Asia. Her exports (Table 17) consist almost entirely of rice, oil cake, some pulses and a little corn. Out of 6,916,000 tons of rice produced, 2,080,000 tons (30 percent) were exported to Indonesia, India, Pakistan, Ceylon and Singapore, China, United Kingdom, Russia, and other countries. Principal imports (Table 18) are canned and dried milk, vegetable oils, fish and fish products, coffee and tea. In the year 1959-60 exports of $190,470,000 exceeded imports of $183,960,000 by $6,510,000 in a very narrow favorable balance of trade.

TABLE 17. SUMMARY OF EXPORTS, BURMA, 1959-60

Commodity	Value 1/ (in million kyats)	Value 1/ (in million dollars, U.S.)	Volume (in thousand tons)
Rice	835	$175.35	2,080
Other agricultural produce	179	37.59	311
Cotton	33	6.93	15
Pulses	42	8.82	98
Oil cake 2/	55	11.55	163
Rubber	37	7.77	9
Metals and ores	40	8.4	44
Timber	88	18.48	97
All others	29	6.09	
TOTAL	1,338	$280.98	

1/ Based on 1 kyat = $0.21 U.S.
2/ The export price for oilseed presscakes was $70.77 (U.S.) per ton in 1959-60.

TABLE 18. SUMMARY OF FOODS IMPORTED, BURMA, 1959-60

Commodity	Value (in million kyats)	Value (in million dollars, U.S.)
Milk, canned and dried	53	$11.13
Fish and fish products	20	4.2
Vegetable oils	42	8.82
Coffee and tea	1	.21

a. Wages[1/]

Male farm laborers receive about 63 cents (U.S.) per day and their food. Women workers are paid 42 cents per day. Sometimes farm laborers are hired by the season for eight months, April through November. Wages in this case may be 80 baskets (approximately 1,670 kilograms) of rice paddy valued roughly at $48. Young people hired to look after cows and bullocks during the growing season are paid 25 baskets of rice (522 kilograms) or $15 to $16 for the entire season. When the pay is in the form of rice paddy, which must be consumed during the remainder of the year, it leaves very little if any cash to spend for other foods or other material goods.

At the Government Seed Farm (Haphan) male field laborers are paid $0.68 whereas women receive $0.37 per day. Workers are also provided with housing. Salaries within the Department of Agriculture range from $20 per month for Field Assistants to $320 per month for the Director.

In oil mills men workers can earn as high as $2.00 per day during the processing season. Women are paid about $0.60 per day in these same factories.

The average family receives an income of $87 (U.S.) per year.

b. Retail food prices[2/]

Rice, the backbone of the diet, costs from 2.8 to 5.7 cents (U.S.) per pound. Certain vegetables are relatively cheap, for example, fresh green beans cost 2 cents per pound. Prices of other desired foods such as dried prawns are very high - $0.94 to $1.16 per pound. Even fresh fish which costs 25 to 50 cents per pound (Rangoon) is beyond the means of many Burmese families except in small quantities. Dried and salted fish costs up to 84 cents per pound. Duck eggs are 26 to 50 cents per dozen. Fat pork can be purchased for 20 to 32 cents per pound. Mutton costs 29 to 35 cents per pound. Chicken is 29 to 36 cents per pound. Meat is beyond the means of the average Burmese except in small quantities. Ngapi (medium quality fish or shrimp paste), a favorite condiment eaten with rice, costs 75 to 84 cents per pound. The cost partially explains why consumption per day is limited to about 0.23 ounces fish paste and 0.2 ounces of fish sauce per person. Onions cost 7 cents,

1/ Unit of pay in U.S. dollars and cents.
2/ All prices in U.S. dollars and cents.

gram 8 cents, noodles 11 to 15 cents, vermicelli 28 to 33 cents, salt 2 to 2.3 cents, and wheat 9 to 13 cents per pound. A single papaya costs 17 cents. Sweetened condensed milk costs 24 to 38 cents per can. This explains why it is diluted and extended as much as possible. Sugar is 11 to 14 cents per pound. Vegetable cooking oils (sesamum or groundnut) sell for 19 to 26 cents per pound. On limited incomes these foods have to compete with rice as part of the diet and, being more expensive, they are used in smaller quantities. The Burmese use considerable ingenuity in choosing and eating a wide variety of plant leaves that are available for the picking (see Appendix 2B), and catch some fish which add to their diets without cost.

Canned goods are expensive: Tin cans themselves cost from 3.6 to 8 cents (U.S.) each. A 14 ounce can of beans in tomato sauce costs 37 cents. A 16 ounce can of mangoes costs 62 cents. A 20 ounce tin of beef curry costs 74 cents. Chicken and mutton curries are still more expensive. A 20 ounce can of pineapple in syrup or bamboo shoots in brine costs 35 cents. A 6 ounce can of baked beans is 21 cents.

Oxen cost $42 to $100 each. Water buffalo cost about $60. A milk cow costs about $80.

The Defense Services Canning Plant sells its canned goods to the military and military dependents at the following prices, in U.S. cents:

Beef, mutton, or pork, 1 lb. tins	30
Hilsa (fish), 1 lb. tin	56
Beans in tomato sauce, 1 lb. tin	23
Mangoes or pineapple, 1 lb. tins	30

A comparison of wages versus prices shows that the average consumer is not able to afford to add much meat, shrimp, or canned goods to his basic food, rice.

The basic diet of a farmer's family is 1,000 kilograms of rice saved during harvest and 20 to 30 salted fish per year. The farmer who is able to obtain this food every year for his family is considered fortunate. Home gardens are almost impossible to raise on the delta except where floating gardens are present. Peas and beans which are Indian foods are not highly acceptable to the Burmese.

Money lenders still finance 75 percent of farming. No money may change hands in these transactions; the money lender lends seed at higher than market prices and then takes payment in crops at below market prices. Under these conditions it is difficult to determine the true rate of interest, but it is very high.

The average sugar cane holding, except in the delta, is 3 acres. The average holding in the delta is 7 acres. A farmer can make $8.40 per acre profit growing paddy versus $42 per acre profit growing sugar cane per year. There are no middle men between sugar cane grower and processer, while there are many middle men in rice marketing.

c. Effect of inflation on food prices

The retail price rise of domestic food items was most pronounced in the spices group which advanced 74 percent (1959-60 to 1960-61) with prominent rises in onions and chillies. The onion price more than doubled and the chillies advanced 56 percent. Fresh fish prices rose 45 percent while vegetable prices advanced 13 percent. Meat and eggs increased 14 percent in price. Wheat increased by 10 percent. The price of oil and fat rose only slightly. Rice declined in price 2.5 percent.

d. Government revenue

In 1959-60, actual Government receipts were $301,980,000, with disbursements of $279,930,000, resulting in a surplus of $22,050,000. Of Government receipts, $62,790,000 came from income taxes, $27,090,000 from customs revenue and $11,340,000 from sales taxes.

6. Education and agriculture

a. Agricultural schools and colleges

Ultimately the hope of improved agriculture and food production lies in education.

There is one College of Agriculture in Burma, located at the University of Mandalay. It offers instruction in the major fields of agriculture leading to a Bachelor of Science degree. Laboratory facilities for research are very limited. Graduates of the College go into responsible positions in the Department of Agriculture. Graduates of the State Agricultural Institute at Pyinmana, 125 students, go out as teachers of vocational agriculture in the high schools and extension workers for the Department of Agriculture. Emphasis is on practical agriculture.

UNICEF plans to teach vocational agriculture in the schools using land attached to each school. UNICEF will furnish implements to farm the land, teach the boys how to farm, and teach some nutrition at the same time.

b. Agricultural research and extension

There are two Agricultural Research Institutes in Burma. The one at Gyogon is very well equipped and concerned mainly with fundamental research in the fields of agronomy, soil physics and chemistry, mycology, entomology and botany. The Institute at Mandalay is concerned with applied problems.

There are nine Agricultural Experiment Stations in Burma. Five of them work predominantly with rice, two with cotton, one with groundnut and sesamum, and one with sugar cane and pulses. Every station has attached farms studying plant breeding, cultural practices, fertilizer and soils. The results of these studies are made available to the farmers.

c. Union of Burma Department of Agriculture

The Union of Burma Department of Agriculture is well organized and includes District Agricultural Officers (equivalent to U.S. county agricultural agents), Township Agricultural Officers, Field Inspectors and Field Assistants. Graduates of Pyinmana are qualified for Township Officer while graduates of the College of Agriculture (Mandalay) are eligible for appointment as District Officers. All of these trained agriculturists are involved in extension of agricultural knowledge to the cultivators.

Shan State has its own Department of Agriculture and an Agricultural Research Station at Taunggyi. It also has a central farm at Heho for demonstration and seed multiplication purposes.

The Agriculture and Rural Development Corporation has one extension man for approximately every 500 acres growing sugar cane or cotton. The Department of Agriculture has approximately one extension man for every 50,000 acres of other products. More extension workers are needed.

Burma is placing much emphasis on education and research in the field of agriculture. With time this will revolutionize agriculture and food production.

d. Army retirement and resettlement program

A rather unique retirement system has been organized in the Army which is coupled with a resettlement plan for Burma. Under this system a soldier can retire after ten years service. If he choses to do so, he receives a 15 acre plot of land, two bullocks, and a house in the northern areas of Burma in addition to his pension.

After 5 years, he must pay the Government about $1,200 (U.S.) in installments. In order to prepare these men for their new careers, the Burma Army School of Agriculture teaches them the fundamentals of farming.

References

Lockwood, Agnese N., The Burma Road to Pythidawtha. International Conciliation-Carnegie Endowment for International Peace.

Ministry of National Planning. Second Four-Year Plan. Govt. Printing and Stationery. Rangoon, Burma, 1961.

Pranger, W. and Ross, M.S., Report on Nutrition and Home Economics in Burma. FAO Report 828 BUR/NU. Rome, 1958.

Davidson, R.P., Report to the Government of Burma on The Union of Burma Land and Agricultural Plan. FAO Report No. 588. Proj. BUR/Agl. Rome, 1957.

Economic Survey of the Union of Burma, 1961. Presented in Parliament by the Honorable Minister of Finance and Revenue. August 15, 1961. Supt. of Documents and Stationery, Rangoon.

Wittfogel, H., Report to the Government of Burma on The Development of Food Research and Food Industry in Burma. FAO Report No. 1378, Rome, 1961.

McKee, H.S., Report to the Government of Burma on The Development of Food Research. ETAP (FAO) Report No. 1051, Rome, 1959.

Government of the Union of Burma. Bulletin of Import Trade Sept. 1960 and Progressive Totals for Oct. 1959 to Sept. 1960. Central Statistical and Economics Department. New Secretariat. Rangoon.

Government of the Union of Burma. Bulletin of Export Trade. Sept. 1960 and Progressive Totals for Oct. 1959 to Sept. 1960. Central Statistical and Economics Department. New Secretariat, Rangoon.

May, J.M., The Ecology of Malnutrition in the Far and Near East. Hafner Publishing Company, New York, 1961.

Government of the Union of Burma. Quarterly Bulletin of Statistics. First and Second Quarters, 1961.

V

THE MILITARY SURVEY

1. Clinical survey

a. Historical data

A total of 4,963 men of the Army, Navy and Air Force, excepting the 156 men in the Defense Services Academy, was examined at their installations of assignment through the cooperation of their local commanding officers. Their distribution in percentages according to time in service, activity, rural or urban origin and place of messing is given in Table 19.

TABLE 19. CHARACTERIZATION OF THE MILITARY SAMPLE, BURMA

	ARMY									
Location	Mingaladon	Indaing	Toungoo	Meiktila	Ba Htoo Myo	Chauk	Maymyo	Moulmein	Boarding School	Total
Total Number	812	297	366	357	769	213	899	370	50	4,133
	Percent Distribution									
Time in Service										
<1 month										
1-3 months	6.0									1.2
3-5 "	6.3		2.7				32.4			8.5
6 months-5 years	27.8	41.8	26.5	34.7	37.2	23.5	31.5	32.4	100.0	32.9
6-10 years	26.2	45.4	32.8	35.0	30.9	49.3	20.6	32.7		30.0
11-15 "	25.6	9.4	35.0	28.3	27.0	23.0	13.1	22.2		22.3
16+ "	8.0	3.4	3.0	2.0	4.8	4.2	2.4	12.7		5.0
Activity										
Active training	13.0				33.0		18.6			12.8
Operational duty	2.2			0.6			0.1			0.5
Garrison duty	78.7	67.3	97.8	98.6	65.4	100.0	80.8	99.2		81.2
Clerical duty	6.0	32.6	2.2	0.8	1.6		0.6	0.8		4.3
School students									100.0	1.2
Origin										
Rural	46.0	42.1	54.4	29.4	36.4	54.0	37.2	73.5	40.0	44.1
Urban	53.9	57.9	45.6	70.6	63.6	46.0	62.8	26.5	60.0	55.9
Messing Practice										
Mess on base	24.9	39.7	42.6	38.4	61.5	33.8	67.0	38.6	100.0	47.2
Mess at home	44.4	60.3	57.4	61.6	38.5	66.2	33.0	61.4		46.7
Unknown	30.7									6.0

TABLE 19. CHARACTERIZATION OF THE MILITARY SAMPLE, BURMA (Continued)

	NAVY			AIR FORCE			
Location	Seik Kyi	Ratanabon	Total	Mingaladon	Meiktila	Total	Combined Services
Total Number	126	102	228	130	472	602	4,963
				Percent Distribution			
Time in Service							
<1 month		22.5	10.1				0.5
1-3 months					7.8	6.1	1.7
3-5 "	92.1		50.9		3.8	3.0	9.8
6 months-5 years		52.9	23.7	66.2	48.1	52.0	34.8
6-10 years	6.3	17.6	11.4	27.7	30.5	30.0	29.2
11-15 "	1.6	5.9	3.5	6.2	9.7	9.0	19.8
16+ "		1.0	0.4				4.2
Activity							
Active training	100.0	22.5	65.4		38.8	30.4	17.3
Operational duty							0.4
Garrison duty		77.4	34.6	100.0	61.2	69.6	77.7
Clerical duty							3.6
School students							1.0
Origin							
Rural	46.0	51.0	48.2	19.2	15.2	16.1	40.9
Urban	54.0	49.0	51.8	80.8	84.7	83.9	59.1
Messing Practice							
Mess on base	100.0	62.7	83.3	56.2	58.3	57.8	50.2
Mess at home		37.2	16.7	43.8	41.7	42.2	44.8
Unknown							5.0

As a general principle the Burmese military mixes its units with men from various regions of the country. The one exception to this rule is the Chin Rifles, the unit examined in Moulmein.

Each individual receiving a detailed examination was asked concerning previous knowledge of malaria, trachoma, tuberculosis, diarrhea and vitamin ingestion. The results in percentages of total examinees for the three groups are shown in Table 20.

TABLE 20. MEDICAL HISTORY OF THE MILITARY SAMPLE, BURMA[1/]

	Army	Navy	Air Force	Defense Services Academy
			Percent Prevalence	
Malaria	14.4	5.3	3.2	2.6
Trachoma	1.1	0	1.9	0
Tuberculosis	0.4	0	0	0
Diarrhea	1.8	1.3	1.3	0
Vitamin supplementation	7.4	0	2.5	15.4

b. Anthropometric data

As would be expected, the average height and weight of the Burmese military man are low according to U.S. standards (see Appendix Figure 3A). Since no good standard height and weight charts are available for Burmese, percents of "standard weight" have little meaning when they are calculated with U.S. figures. Table 21 gives the actual mean values for the four groups.

TABLE 21. HEIGHT, WEIGHT AND AGE OF THE MILITARY SAMPLE, BURMA

	Army	Navy	Air Force	Defense Services Academy
Mean height (cm)	162.8	164.3	163.2	163.2
Mean weight (kg)	53.1	52.6	51.6	52.4
Mean age (years)	27.0	22.5	24.2	18.7

Graphs depicting the changes in height and weight according to age for the three services are shown in Figure 2.

Average skinfold thicknesses for the groups are given in Table 22.

TABLE 22. SKINFOLD MEASUREMENTS OF THE MILITARY SAMPLE, BURMA

	Army	Navy	Air Force	Defense Services Academy
Arm (mm)	5.6	5.5	6.0	6.7
Scapula (mm)	8.8	8.1	8.5	7.6

1/ Detailed data upon which tables throughout the text are based may be found in the Appendix tables.

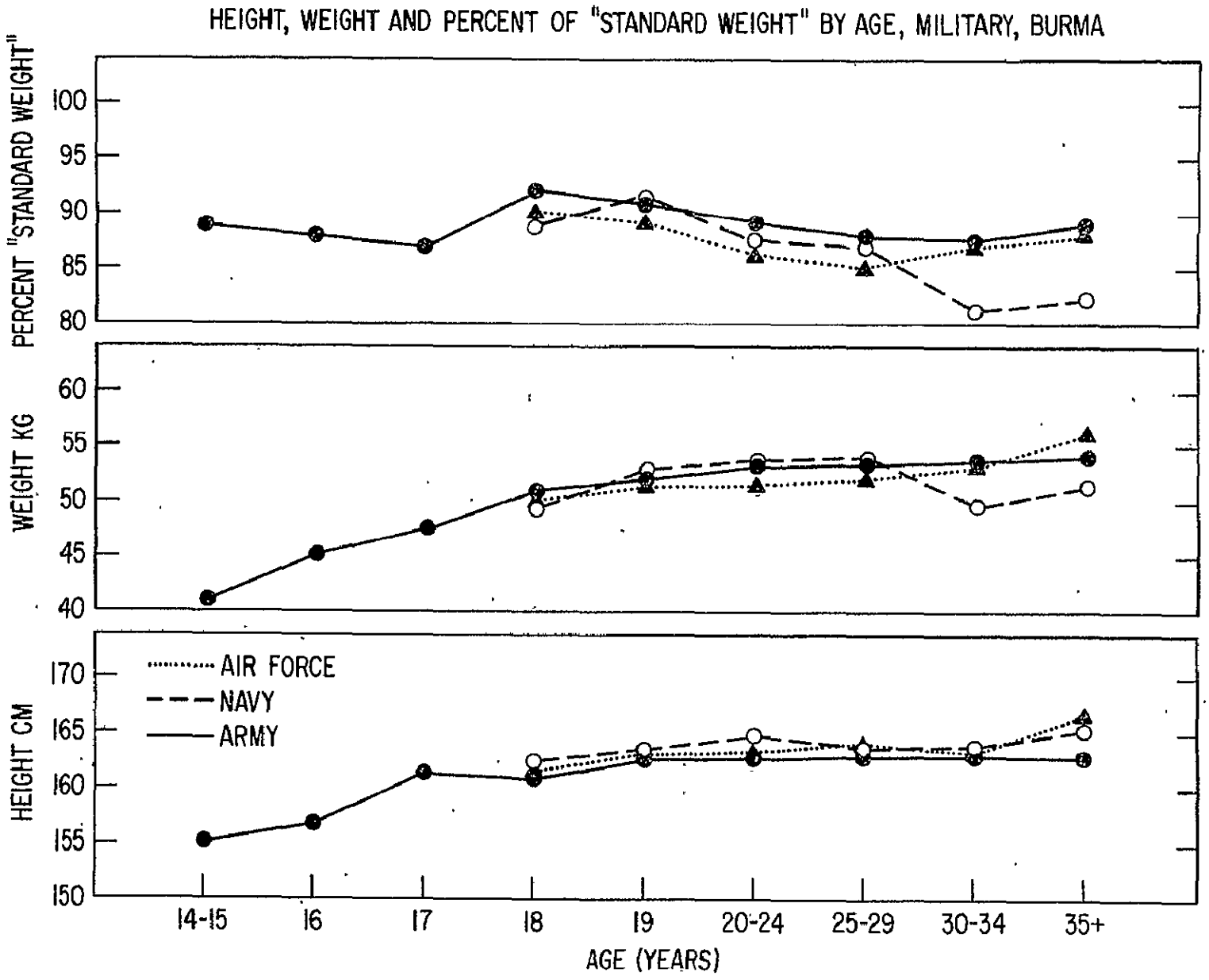

HEIGHT, WEIGHT AND PERCENT OF "STANDARD WEIGHT" BY AGE, MILITARY, BURMA
PERCENT "STANDARD WEIGHT"
100
95
90
85
80
WEIGHT KG
60
55
50
45
40
HEIGHT CM
170
165
160
155
150
AIR FORCE
NAVY
ARMY
14-15
16
17
18
19
20-24
25-29
30-34
35+
AGE (YEARS)

FIGURE 2

These figures compare rather favorably with those found for the Thai military. If one accepts these results along with the weights as evidence of caloric balance (a large assumption) then one might suggest that on clinical grounds there is little reason to expect caloric undernutrition in the Armed Forces.

In attempting to define obesity, the use of percent of "standard weight" is perhaps the fairest parameter to use. The combined services have a prevalence of slightly above 2 percent obesity, as calculated from those above 100 percent of "standard weight." Using such figures obviously prejudices the results toward the low side but does indicate that the problem exists, albeit minimally so as compared to Western figures.

c. Protein status

There was no clinical evidence of protein malnutrition in any subject examined.

d. Vitamin status

(1) Vitamin B-complex

(a) Thiamine. The average prevalence of bilateral loss of ankle jerk in the combined services was 1.4 percent. Bilateral edema was seen in only 4 individuals (0.1 percent) and calf tenderness in but 2 soldiers. No obvious case of beriberi was observed. Table 23 shows the comparative values.

TABLE 23. CLINICAL SIGNS OF THIAMINE DEFICIENCY, MILITARY SAMPLE, BURMA

	Army	Navy	Air Force	Defense Services Academy
	Percent Prevalence			
Bilateral loss of ankle jerk	1.6	1.3	0	0.6
Bilateral ankle edema	0.1	0	0	0
Bilateral calf tenderness	0.05	0	0	0

(b) Riboflavin. Angular lesions and angular scars, generally thought to be a manifestation of riboflavin deficiency, were seen in 4.6 and 2.2 percent of all military men respectively. Cheilosis was observed in 2 examinees. No instance of magenta tongue was seen. Scrotal dermatitis, present in only 0.1 percent of the subjects, was probably due to fungal disease rather than riboflavin deficiency. The breakdown according to service was:

TABLE 24. CLINICAL SIGNS OF RIBOFLAVIN DEFICIENCY, MILITARY SAMPLE, BURMA

	Army	Navy	Air Force	Defense Services Academy
	Percent Prevalence			
Angular lesions	4.8	5.3	2.8	0
Angular scars	2.2	1.3	1.8	1.3
Cheilosis	0.05	0	0	0

687462 O - 63 - 5

(c) Niacin. There was no clinical evidence of pellagra seen in any of the military personnel examined. Glossitis, characterized by redness of the tongue with some papillary engorgement, was seen in only 0.3 percent of the subjects. One might very well question the significance of such findings as having anything whatsoever to do with niacin deficiency.

(2) Vitamin A

Bitot's spots, the classic yet questionable eye sign of vitamin A deficiency, was present in only 0.1 percent of the military. Xerophthalmia was not observed. Follicular hyperkeratosis of the skin, another sign difficult to interpret, was present in 3.3 percent of those examined, the great majority being seen on the back. These signs occurred as follows:

TABLE 25. CLINICAL SIGNS OF POSSIBLE VITAMIN A DEFICIENCY, MILITARY SAMPLE, BURMA

		Army	Navy	Air Force	Defense Services Academy
		Percent Prevalence			
Bitot's spots		0.1	0	0.2	0
Follicular hyperkeratosis	arms	0.2	2.6	0.2	0.6
	back	2.3	14.5	4.0	0.6
	thighs	0.2	0.9	0.5	0

(3) Vitamin C

No overt signs of scurvy were seen in any person examined. Swollen red papillae, whether localized to two or more interdental papillae on one alveolar ridge or diffuse on both ridges, were seen in 2.3 percent of all subjects. As will be commented upon in the dental section, it was the consensus of all examiners that these findings were in all likelihood due to poor oral hygiene rather than to vitamin C deficiency.

(4) Vitamin D

No recent or past evidence of rickets was seen in any individual examined.

e. Mineral status

(1) Iron

Although pallor was not officially recorded because of its subjectiveness, it was certainly seen. Filiform papillary atrophy of the tongue, a clinical sign of protean origin, was present in 1.4 percent of all military personnel. If one third of the papillae were atrophied it was classified as slight. If one-third to two-thirds were gone, it was considered moderate and over two-thirds atrophy was called severe. Using these criteria, a breakdown according to various services showed the following:

TABLE 26. PERCENT PREVALENCE OF FILIFORM PAPILLARY ATROPHY OF THE TONGUE, MILITARY SAMPLE, BURMA

		Army	Navy	Air Force	Defense Services Academy
Filiform papillary atrophy	slight	0.9	1.8	0.7	0
	moderate	0.5	0.4	0.3	0
	severe	0	0	0	0

(2) Iodine

Thyroid enlargement was graded according to the WHO standards (1) as Grade I (palpably enlarged), Grade II (visibly enlarged), Grade III (grossly enlarged) and Grade IV (huge goiter, disfiguring). The over-all prevalence of goiter was found to be 1.9 percent for Grade I and only one soldier out of the entire group had a Grade II goiter. The prevalence broke down according to services as follows:

TABLE 27. PERCENT PREVALENCE OF GOITER, MILITARY SAMPLE, BURMA

		Army	Navy	Air Force	Defense Services Academy
Goiter	Grade I	2.0	2.2	1.2	1.9
	Grade II	<0.005	0	0	0

f. Findings of dubious or unknown nutritional significance

(1) Nasolabial seborrhea

Although nasolabial seborrhea is a common finding in vitamin B_6 deficiency experimentally induced in humans by metabolic antagonists, its value as a reliable sign of naturally occurring vitamin B_6 deficiency is only speculative. It was observed in 6.3 percent of the combined services and could be broken down as follows in Table 28:

TABLE 28. PERCENT PREVALENCE OF NASOLABIAL SEBORRHEA, MILITARY SAMPLE, BURMA

	Army	Navy	Air Force	Defense Services Academy
Nasolabial seborrhea	6.6	3.1	6.1	3.2

(2) Thickened bulbar conjunctivae

This interesting and frequent abnormality of the bulbar conjunctivae was far and away the most common finding in the survey. It occurred in 52.1 percent of the military personnel examined. Of interest is the fact that it was seen in 55.2 percent of the people of rural origin as compared to 49.9 percent in those from the cities. Prevalence according to service distribution was as follows:

TABLE 29. PERCENT PREVALENCE OF THICKENED BULBAR CONJUNCTIVAE, MILITARY SAMPLE, BURMA

	Army	Navy	Air Force	Defense Services Academy
Thickened bulbar conjunctivae	52.8	35.5	53.2	5.8

(3) Pterygium

Another frequent pathological finding in the eye occurred in 2.6 percent of the military. It frequently accompanied thickening of the bulbar conjunctivae. Its percent prevalence in the various groups was:

TABLE 30. PERCENT PREVALENCE OF PTERYGIUM, MILITARY SAMPLE, BURMA

	Army	Navy	Air Force	Defense Services Academy
Pterygium	3.0	0.9	0.7	0

(4) Blood pressure

The prevalence of hypertension, at least by Western standards, appears to be quite low in the military. Only 12 of the total 1,290 readings recorded had systolic pressures above 150 mm Hg and 100 mm Hg diastolic. The mean reading for the entire group was 114/72. Broken down according to services it was:

TABLE 31. BLOOD PRESSURES, MILITARY SAMPLE, BURMA

	Army	Navy	Air Force	Defense Services Academy
Mean systolic, mm Hg	114	110	116	106
Mean diastolic, mm Hg	72	71	74	68

(5) Other

Because of the intense interest in serum cholesterol, fat metabolism and atherosclerosis in various world population groups, a particular effort was directed toward looking for arcus senilis and xanthelasma. The former was present in 1.9 percent of the entire military population examined while the latter was not recorded in a single instance. Hepatomegaly and splenomegaly was thought to be present in 0.9 and 0.4 percent, respectively, in the combined services.

2. Biochemical survey

a. Introduction

Samples of blood and urine were collected from approximately every fourth subject given a detailed physical examination. These samples were stored in ice and transported to the clinical laboratory at Mingaladon, usually arriving within 24 hours after collection. Various determinations were performed on the samples in an effort to obtain biochemical data on the relatively recent nutritive status of the subjects. The procedure for collection and a description of the methods employed are included in Section III 2 on biochemical procedures.

b. Protein status

There was no evidence of an insufficiency of protein according to the serum albumin values of the combined military services. No "deficient" albumin levels were found among the 349 samples analyzed (see Appendix Table 3G for ICNND suggested levels). However, serum globulin levels were above 3.5 grams per 100 milliliters in 42.7 percent of these individuals. These results are consistent with findings in other Asian nations (Thailand, Vietnam; 2, 3).

TABLE 32. TOTAL SERUM PROTEIN LEVELS, MILITARY SAMPLE, BURMA

Service	Army	Navy	Air Force	Total
No. of subjects	277	33	39	349
Mean	7.5	7.5	8.0	7.6
		Percent Distribution		
gm protein per 100 ml serum				
<6.00 ("Deficient")	0.7	0.0	0.0	0.6
6.00-6.39 ("Low")	1.4	0.0	2.6	1.4
6.40-6.99 ("Acceptable")	19.8	12.1	2.6	17.2
≥7.0 ("High")	78.0	87.9	94.9	80.8

TABLE 33. SERUM ALBUMIN LEVELS, MILITARY SAMPLE, BURMA

Service	Army	Navy	Air Force	Total
No. of subjects	277	33	39	349
Mean	4.1	4.1	4.1	4.1
		Percent Distribution		
gm albumin per 100 ml serum				
<2.5 ("Deficient")	0.0	0.0	0.0	0.0
2.5-3.4 ("Low")	1.4	3.0	0.0	1.4
3.5-4.9 ("Acceptable")	97.1	93.9	97.4	96.8
≥5.0 ("High")	1.4	3.0	2.5	1.7

TABLE 34. SERUM GLOBULIN LEVELS, MILITARY SAMPLE, BURMA

Service	Army	Navy	Air Force	Total
No. of subjects	277	33	39	349
Mean	3.4	3.5	3.9	3.5
		Percent Distribution		
gm globulin per 100 ml serum				
1.0-1.9 ("Deficient")	0.4	3.0	0.0	0.6
2.0-2.9 ("Low")	26.0	24.2	5.1	23.5
3.0-3.5 ("Acceptable")	34.3	27.3	30.8	33.2
≥3.6 ("High")	39.4	45.4	64.1	42.7

c. Vitamin status

(1) Vitamin B-complex

(a) Thiamine. The thiamine excretion data show that some 43 percent of personnel of the combined services examined were excreting a median of less than 27 micrograms of thiamine per gram of creatinine. This level of excretion is considered to indicate an intake of the vitamin which would result in clinical deficiency if continued for sufficient time. In three areas, the median excretions fell in the "deficient" range, while in no area was the median excretion "acceptable" or "high." The finding that 11 and 8 percent, respectively, of the personnel of the combined services were excreting either "acceptable" or ample amounts of thiamine is evidence that an adequate supply was being obtained by a portion of the troops, possibly through consumption of vitamin tablets in the military mess.

Assay of the percent stimulation of activity of red blood cell transketolase following addition of thiamine pyrophosphate *in vitro* supported the evidence from urinary analysis that thiamine intake was less than satisfactory in the total military population. Stimulation of enzyme activity was in excess of 20 percent in 29.2 percent of the 147 personnel so tested.

TABLE 35. THIAMINE EXCRETION, MILITARY SAMPLE, BURMA

Service	Army	Navy	Air Force	Total
No. of subjects	274	31	40	345
Median excretion	30	45	46	34
		Percent Distribution		
mcg thiamine per gm creatinine				
< 27 ("Deficient")	46.7	25.8	27.5	42.6
27-65 ("Low")	35.0	51.6	45.0	37.7
66-129 ("Acceptable")	10.9	9.7	15.0	11.3
≥130 ("High")	7.3	12.9	12.5	8.4

TABLE 36. PERCENT STIMULATION OF RED CELL TRANSKETOLASE ACTIVITY AFTER ADDITION OF THIAMINE IN VITRO, MILITARY SAMPLE, BURMA

Service	Combined military
No. of subjects	147
	Percent Distribution
Percent stimulation of enzyme activity	
>20 ("Deficient")	29.2
16-20 ("Low")	10.2
<15 ("Satisfactory")	60.5

(b) Riboflavin. The excretion of riboflavin in Armed Forces personnel was generally low. Almost 11 percent of those examined fell in the "deficient" range. A notable exception to this trend was the "acceptable" median excretions detected in Army and Air Force units at Meiktila (90 and 96 micrograms per gram of creatinine, respectively).

TABLE 37. RIBOFLAVIN EXCRETION, MILITARY SAMPLE, BURMA

Service	Army	Navy	Air Force	Total
No. of subjects	275	34	40	349
Median excretion	60	46	90	61
		Percent Distribution		
mcg riboflavin per gm creatinine				
< 27 ("Deficient")	10.9	14.7	7.5	10.9
27-79 ("Low")	54.9	61.8	35.0	53.3
80-269 ("Acceptable")	27.6	20.6	47.5	29.2
≥270 ("High")	6.5	2.9	10.0	6.6

(c) N'-methylnicotinamide. None of the 157 urine samples analyzed from combined services personnel was in the "deficient" excretion range. The median excretion falls well within the "acceptable" range. These data would seem to indicate an adequate intake of niacin or its precursors. The highest rates of excretion again were found in the troops stationed at Meiktila.

TABLE 38. N^1-METHYLNICOTINAMIDE EXCRETION, MILITARY SAMPLE, BURMA

Service	Army	Navy	Air Force	Total
No. of subjects	130	12	15	157
Median excretion	2.80	3.20	4.50	3.00
		Percent Distribution		
mg N^1-methylnicotinamide per gm creatinine				
<0.5 ("Deficient")	0.0	0.0	0.0	0.0
0.5-1.59 ("Low")	16.2	16.7	13.3	15.9
1.6-4.29 ("Acceptable")	61.5	75.0	33.3	59.9
≥4.3 ("High")	22.3	8.3	53.3	24.2

(2) Vitamin A

There was no biochemical evidence of avitaminosis A at the time of the survey. Only one "deficient" value was detected among the 349 samples analyzed. In addition, better than 95 percent of the mean serum carotene values were in either the "acceptable" or the "high" range.

TABLE 39. SERUM VITAMIN A LEVELS, MILITARY SAMPLE, BURMA

Service	Army	Navy	Air Force	Total
No. of subjects	276	35	38	349
Mean	38.4	37.4	36.8	38.1
		Percent Distribution		
mcg vitamin A per 100 ml serum				
<10 ("Deficient")	0.4	0.0	0.0	0.3
10-19 ("Low")	3.6	0.0	0.0	2.9
20-49 ("Acceptable")	81.9	91.4	89.5	83.7
≥50 ("High")	14.1	8.6	10.5	13.2

TABLE 40. SERUM CAROTENE LEVELS, MILITARY SAMPLE, BURMA

Service	Army	Navy	Air Force	Total
No. of subjects	287	36	40	363
Mean	89	73	88	87
		Percent Distribution		
mcg carotene per 100 ml serum				
< 20 ("Deficient")	0.0	0.0	0.0	0.0
20-39 ("Low")	3.5	8.3	0.0	3.6
40-99 ("Acceptable")	65.8	80.6	77.5	68.6
≥100 ("High")	30.7	11.1	22.5	27.8

(3) Vitamin C

The mean serum vitamin C level for the combined services (0.46 milligrams per 100 milliliters) was indicative of a sufficient supply of this vitamin. In no area did the mean figure fall below the lower limit of acceptability. A "deficient" value was found in only one instance among 339 determinations.

TABLE 41. SERUM VITAMIN C LEVELS, MILITARY SAMPLE, BURMA

Service	Army	Navy	Air Force	Total
No. of subjects	284	35	20	339
Mean	0.46	0.45	0.42	0.46
		Percent Distribution		
mg vitamin C per 100 ml serum				
<0.10 ("Deficient")	0.4	0.0	0.0	0.3
0.10-0.19 ("Low")	2.1	0.0	20.0	2.9
0.20-0.39 ("Acceptable")	40.8	54.3	35.0	41.9
≥0.40 ("High")	56.7	45.7	45.0	54.9

d. Mineral status

(1) Anemia

Approximately 5 percent of the 350 personnel examined were found to have hemoglobin levels below 12 grams per 100 milliliters. The prevalence of a "deficient" level of mean corpuscular hemoglobin concentration was even greater, falling just below 20 percent. It would seem from these data that anemia is a problem for further consideration although more work will be required before the relative importance of the various causative factors can be ascertained.

TABLE 42. HEMOGLOBIN LEVELS, MILITARY SAMPLE, BURMA

Service	Army	Navy	Air Force	Total
No. of subjects	284	26	40	350
Mean	14.0	14.0	14.1	14.0
		Percent Distribution		
gm hemoglobin per 100 ml blood				
<12.0 ("Deficient")	4.9	0.0	7.5	4.8
12.0-13.9 ("Low")	43.0	50.0	32.5	42.3
14.0-14.9 ("Acceptable")	27.8	30.8	32.5	28.6
≥15.0 ("High")	24.3	19.2	27.5	24.3

TABLE 43. PLASMA CORPUSCULAR VOLUME (HEMATOCRIT), MILITARY SAMPLE, BURMA

Service	Army	Navy	Air Force	Total
No. of subjects	290	36	40	366
Mean	46.6	44.0	46.3	46.3
		Percent Distribution		
percent				
<36 ("Deficient")	0.3	2.8	0.0	0.5
36-41 ("Low")	5.5	22.2	7.5	7.4
42-44 ("Acceptable")	21.4	27.8	27.5	22.7
≥45 ("High")	72.8	47.2	65.0	69.4

TABLE 44. MEAN CORPUSCULAR HEMOGLOBIN CONCENTRATION, MILITARY SAMPLE, BURMA

Service	Army	Navy	Air Force	Total
No. of subjects	284	25	40	349
Mean	30.2	32.6	30.4	30.4
		Percent Distribution		
percent				
<28.0	19.4	4.0	17.5	18.0
28.0-29.9	25.0	16.0	15.0	23.2
30.0-31.9	30.6	44.0	40.0	32.7
≥32.0	25.0	36.0	27.5	26.1

(2) Iodine

Only 46 of the 220 combined military personnel examined were found to be excreting greater than 50 micrograms of iodine per gram of creatinine. Thus, 79.1 percent were excreting an amount considered to be less than desirable. These data are in good agreement with the dietary findings of a low intake of iodine, and suggest the need for an increased intake of this nutrient.

TABLE 45. URINARY IODINE EXCRETIONS, MILITARY SAMPLE, BURMA

Service	Army	Navy	Air Force	Total
No. of subjects	177	16	29	222
Mean	40	35	96	47
mcg iodine per gm creatinine		Percent Distribution		
<50	87.0	87.5	20.7	78.4
50-99	9.0	12.5	55.2	15.3
≥100	4.0	--	24.1	6.3

e. Cholesterol

Since serum cholesterol levels are affected by various dietary and environmental factors and are believed to be important in coronary heart disease, measurements of this compound were performed. The mean of 16 milligrams per 100 milliliters falls in the low segment of the usual range found in Western nations. It is worth noting that 2.5 percent of the individuals tested had values below 100 milligrams per 100 milliliters of serum, a situation rarely encountered in the United States. Analysis for free serum cholesterol revealed that 36.5 percent of the total cholesterol existed in the free state (average value for 106 subjects).

TABLE 46. SERUM CHOLESTEROL LEVELS, MILITARY SAMPLE, BURMA

Service	Army	Navy	Air Force	Defense Services Academy	Total
No. of subjects	288	36	40	10	374
Mean	163	153	156	173	162
mg cholesterol per 100 ml serum					
50-99 (Very low)	2.4	2.8	2.5	0.0	2.4
100-149 (Low)	32.6	38.9	40.0	30.0	34.0
150-199 (Average)	51.7	55.6	40.0	60.0	51.1
≥200 (High)	13.2	2.8	17.5	10.0	12.6

3. Dietary survey

a. Population studied

Dietary surveys were carried out in 14 military units using the recipe method, food composite analysis method, or a combination of both. Included in the sample were 1 Navy unit, 1 Air Force unit, the Defense Services Academy and 11 Army units. The composition of this sample corresponds very closely to the population studied by the clinical team.

The food intake data can be applied only to that part of the military population which eats its meals at the military unit. A large portion of the military population is married and consumes the majority of its meals in a family unit. Data for this part of the population can best be estimated from the food intake data obtained on the "dependent" population.

b. Military ration

The military ration for the Burmese Armed Forces is based on food items in amounts to be served to each man each day (Appendix 3K). The nutritive value of this basic diet is given in Table 47.

TABLE 47. PERCENTAGE NUTRIENTS FROM VARIOUS FOODS, BASIC ARMY FOOD RATION, MILITARY, BURMA

	Calories	Protein	Fat	Calcium	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Vitamin C
Rice	62.5	46.0	4.4	10.0	34.0	--	49.0	21.5	56.0	--
Oil, peanut	11.2	--	66.7	--	--	--	--	--	--	--
Meat 1/	6.0	24.0	19.8	7.9	20.0	6.0	7.8	25.4	25.0	--
Sugar	3.8	--	--	--	--	--	--	--	--	--
Ngapi	0.2	1.4	--	2.7	9.2	--	--	--	--	--
Vegetables 2/	3.4	4.9	2.5	23.5	12.0	39.5	13.8	9.9	12.5	80
Pulses	6.8	19.1	1.5	17.5	21.9	6.0	26.1	19.6	6.0	--
Fruits	1.7	--	--	5.4	2.9	30.0	3.3	2.0	--	20
Milk, sweetened condensed	4.4	4.6	5.1	33.0	--	19.5	--	21.6	0.5	--

1/ Meat, fresh fish, dried fish and eggs.
2/ Including potatoes.

The diet is composed of two parts. The dry ration is purchased on a contract basis and is stored at two major supply points, one at Mingaladon and the other at Mandalay. From these supply points the dry ration is shipped monthly or in some cases bimonthly to local supply points that serve Army units in specific areas from whence they are then shipped to the nearby camps. Food procurement is made in such a manner as to have adequate food supplies for a period of six months in the main supply point.

The fresh ration is purchased by the local supply center, or in some cases — vegetables particularly — by the unit at a local market. A list of vegetable items commonly purchased is given in Appendix 3L. Fresh meat is usually purchased on a contract basis through a local slaughterhouse. At the Defense Services Academy chickens were being used to produce eggs and at one of the individual bases visited, attempts were being made to produce a portion of the pork that would be used. Small amounts of vegetables were grown in local unit gardens, but these did not constitute a major portion of the fresh products consumed at any unit.

Some modifications of the standard ration are made with relation to troop training. Two ounces of rice per man per day are added to the basic ration in units where extremely active training is being carried out. In operational units, the Commanding Officer has some funds available to purchase extra items, principally fruits, above those normally obtained in order to improve the dietary status and the morale of the men.

The Burmese Army has two operational rations (Appendix 3M). One of these is based on a completely canned ration, and though it was claimed to be nutritionally adequate, acceptance was stated to be very poor. This is an eight-man ration, and does not need to be cooked.

A ten-man operational ration, based on rice and canned fish or meat, which must be cooked, is also available. It was stated, however, that the ration is not well accepted and is difficult to prepare and use. Canned ready-to-eat rice or rice and vegetable mixtures acceptable to the Burmese soldier have not been developed. An easily prepared ration for field operations should be one goal of a military food development program.

c. Hospital diets

The standard hospital diets are also included in the basic military ration and use the same basic issue as the operational military diets (see Appendix 3N). Three diets are available, all of which contain lesser amounts of rice than the basic ration. Hospitals have some special foods which would provide for a more nutritionally acceptable diet. However, use of these diets in relation to specific medical problems was stated by physicians associated with the survey group to present problems. Diets are designated as regular, soft and liquid. The soft and liquid diets do not appear to be nutritionally adequate. Development of hospital diets based on normal Burmese foods which meet both the medical and nutritional requirements of the patient should be undertaken at the earliest opportunity.

d. Food preparation and cooking equipment

In the majority of mess halls in the Burmese Army food is cooked in large metal pots over open wood fires. In some cases, elaborate fireplace cooking units have been built, but in many small company units the pans are simply placed on top of three strategically placed rocks. Wood obtained in the local area provides the fuel. A few exceptions were noted. The new kitchen facilities at both of the basic training units (Mingaladon and Maymyo) have jacketed steam kettles used with a separate steam production unit. Petroleum products are used in a few units and gas is used in the military unit at Chauk.

Food storage in individual units varies from very good to extremely poor. In the better units closed reinforced containers are used for dry products such as beans and rice. Fresh products are obtained daily and the only protection from flies is usually the container in which the product is shipped. No refrigeration equipment is currently in military units.

In most units storage of dry foods is accomplished simply by stacking in a large room with a locked door with no protection from infestation by insects or rodents. Food is carried from the storage to the kitchen area for each meal.

Food preparation is entirely by hand. Trained civilian cooks are frequently employed. In many camps cooks with years of experience prepare excellent and well accepted meals. These men have had no formal training in food preparation, but rely on experience.

Food preparation is usually an all-day matter, since in larger units great amounts of rice must be prepared. The cooking procedure for rice is as follows: The rice is initially washed three to four times, partially cooked in excess water and the excess water is then removed. Next the partially cooked rice is covered and allowed to steam until it is fully cooked.

Curries are prepared only a short while before serving, though a large amount of time is necessary to cut meat into small portions and to grind and mince condiments such as garlic, onion and red peppers. In most cases, food was prepared at a reasonable time and only in one or two instances was there an excessive period from food preparation to use.

Dining facilities were available in many camps, but a portion of the troops in most camps ate their meals in the surrounding area, rather than at a table. Each soldier is issued a dish, a cup and a spoon. The majority of the soldiers used this spoon only for eating soup and consumed the rest of the meal in the traditional manner with their fingers.

Food distribution to individual men was by companies in most units, except for those company units where direct service was made from the kitchen to the soldier seated at the table. This type of serving was also carried out at the Defense Services Academy. Salt, for addition to the food, was provided at the place where food was distributed to the individual soldier. A large bowl of coarse sea salt was available and it was apparent that most of the soldiers utilized a considerable amount of salt (see Appendix Table 3 O).

e. Food consumption

A comparison of the food provided for in the basic issue with that observed by the recipe and food composite studies is given in Table 48. The breakdown of the typical menus is given in Table 47. Food consumption in individual units is found in Appendix Table 3P. The differences between the figures for the basic ration menu and the food composite analysis reflect food losses during preparation and cooking.

TABLE 48. DAILY NUTRIENT INTAKE, MILITARY SAMPLE, BURMA

Nutrient	Recipe 1/ Method	Food Composite 2/ Analysis	Basic Ration	Soldiers Eating at Home 3/	"Acceptable" Levels, ICNND
Calories	3,547	3,028	4,242	2,654	2,800-3,200
Protein, gm	88.0	83.4	110	57.6	60-90
Fat, gm	70.8	51.5	84	65.4	--
Carbohydrate, gm	629	573	759	459	--
Calcium, mg	419	470	445	295	400-800
Iron, mg	14.3	34.0	19.8	11.2	9-12
Vitamin A, I.U.	2,194	2,610	1,527	2,857	3,500-5,000
Thiamine, mg	1.49	0.55	1.80	0.73	1.0-1.5
Riboflavin, mg	1.07	1.10	1.02	0.51	1.2-1.5
Niacin, mg	16.8	9.8	19.5	11.5	10-15
Vitamin C, mg	73	28.5	116	51	30-50

1/ 8 locations, 1,067 men.
2/ 13 locations, 2,480 men.
3/ From questionnaire data of dependent group. Calculated for standard man.

Comparisons of the basic ration and the results of this survey with the "acceptable" levels suggested by the ICNND (see Appendix Table 3Q) indicate that for the majority of nutrients the military ration is sufficient. However, in a number of instances there appear to be problems that in part are due to the composition of the basic ration. Food composite analysis indicated that amounts of calcium, vitamin A, thiamine and riboflavin were less than the "acceptable" values. Analysis of the data by recipe calculations placed calcium at the low end of the "acceptable" range and indicated that vitamin A and riboflavin were below the "acceptable" range. The basic Army ration is such that, without some type of fortification, intakes of both vitamin A and riboflavin are at less than "acceptable" levels. In the case of vitamin A, the level is lower because the basic ration has little vitamin A-containing foods. Since the local commander is able to purchase some foods such as fruits and vegetables, these can at least in part overcome this deficiency. In practice, however, units do not use this ration money to purchase foods with an adequate content of vitamin A, but instead utilize it for the more morale-building protein products, such as meat and fish.

(1) Calories

Caloric values by both the recipe method and the chemical analysis (see Appendix Table 3P) reflect very well the physical activities of the individual soldiers. Training units have the highest caloric intake, while units either resting or acting as headquarter units have the lowest intakes. Caloric intakes for all units are "acceptable."

The Calories in the diet are supplied to a great extent by rice. On the average 75 percent of the Calories in the military diet are supplied by rice. It is interesting to note that in training units where added Calories are needed, an extra rice allowance is made above that in the normal ration. A breakdown of the percentage of nutrients from the major foods is given in Table 49.

TABLE 49. PERCENTAGE NUTRIENTS FROM VARIOUS FOODS BY RECIPE METHOD, MILITARY SAMPLE, BURMA

AVERAGE OF ALL UNITS (8)

Food	Calories	Protein	Fat	Calcium	Iron	Vitamin A	Thiamin	Riboflavin	Niacin	Vitamin C
Rice	66.0	46.4	5.8	18.5	41.0	--	37.8	24.0	64.0	--
Oil, peanut	12.2	--	67.5	--	--	--	--	--	--	--
Meat 1/	4.3	24.0	18.3	4.6	9.3	3.5	8.6	13.5	14.0	--
Sugar	3.7	--	--	--	--	--	--	--	--	--
Ngapi	0.2	1.5	--	3.3	11.9	--	--	--	--	--
Vegetables 2/	1.1	3.1	1.8	21.2	10.9	60.8	10.3	10.6	6.9	74.5
Pulses	7.2	20.0	1.0	11.7	25.5	5.7	43.3	26.6	14.6	--
Fruits	0.8	--	--	2.9	1.4	14.4	1.0	1.3	--	25.5
Milk, sweetened condensed	4.5	4.2	6.4	38.8	--	15.6	1.0	24.0	0.5	--

1/ Meat, fresh fish, dried fish and eggs.
2/ Including potatoes.

(2) Protein

The protein level as determined by either chemical or recipe procedure was adequate. While rice supplied a considerable portion of the protein, adequate protein from animal sources and from certain legumes was also included.

(3) Fat

The difference in the caloric value of the diets by the recipe and chemical analysis is due to the difference in the fat content. Fat losses during cooking and serving are probably considerable. In addition, the pork used is in the main the most fatty portion and it is possible that sampling techniques used cannot adequately produce the best and most correct picture of the food that has been prepared.

(4) Vitamins

(a) Vitamin B-complex

(i) Thiamine. Thiamine intakes as determined by the recipe method were "acceptable," equaling 1.49 milligrams per man per day. However, chemical analysis indicated that the average individual intake was considerably less than 1 milligram per day. A major portion of the thiamine in the basic ration is supplied by rice and the quality of rice, particularly in thiamine content, varies considerably. If recipe calculations are made using the lowest values obtained by analysis of rice, values more in line with those obtained by chemical analysis are found.

(ii) Riboflavin. From the analysis of the food consumption data riboflavin appears to be the most critical nutrient. Intakes below the "acceptable" level were found in 9 of the 13 units surveyed. The basic Army rations provide for only 1.2 milligrams of riboflavin per day. It is apparent from the recipe calculations as well as the chemical analysis that the actual diet as prepared contains considerably more than this since after preparation the values for the recipe calculations and chemical analysis were 1.07 and 1.0 milligrams per day respectively. Wider use of vegetables would be useful and could help overcome the problems of vitamin A intakes as well as that of riboflavin. Greater use of the dry bean products will also overcome problems of riboflavin as well as thiamine deficiencies.

(iii) Niacin. Niacin intake is well above the minimum value by the recipe calculations. However, niacin appears to be on the low end of the "acceptable" range by chemical analysis. While the average value is almost within the "acceptable" range, 9 of the 13 units had values slightly less than 10 milligrams per day which is the lower end of the "acceptable" range.

(b) Vitamin A. The vitamin A content of the diet was not particularly high and infrequent use of vegetables would indicate that, unless more vegetable products high in vitamin A are used, the vitamin A intakes will not exceed 2,500 I.U. per day. Chemical analysis of the diets indicated that 10 of the 13 units studied had less than "acceptable" values for vitamin A as determined by this method. Recipe calculations indicated that 7 out of 8 units had less than "acceptable" intakes.

As discussed above, the vitamin A intake of the basic ration is low; an additional 1,500 I.U. of vitamin A needs to be supplied by purchase of vegetables and fruits at the local unit level.

(c) Vitamin C. Vitamin C intakes by recipe calculations were well above the "acceptable" range. However, chemical analysis indicated that 9 of the 13 units had values less than 30 milligrams per day. The lowest intake by chemical analysis was 17 milligrams per day and with variation in foods used, it is probable that the average intake of vitamin C over an extended period is within the "acceptable" range.

(5) Minerals

(a) Iron. The iron content of the diet, as measured by chemical analysis, is very high and probably reflects the extraction of iron from the pots during cooking. The iron content of the diet as calculated is well above the "acceptable" range and there appears to be no reason to believe that iron intake is less than adequate.

(b) Calcium. The calcium content of the ration is below the "acceptable" value in 7 of the 13 military units studied. Calcium in the diet is supplied principally by the small amount of sweetened condensed milk consumed each day in tea. Other calcium is supplied by beans and fish pastes and fish sauces. The added allowance given to the Defense Services Academy supplies them with a calcium intake in excess of 1 gram per day. The basic Army ration, as calculated, should supply approximately 400 milligrams of calcium per day. The chemical analysis did not indicate that this level was reached in the majority of units. The calcium content of water does not appear to play a major role, partly because of the small amount of water used by the troops above that used in food preparation (see Appendix Table 3R).

(6) Minor nutrients

(a) Iodine. Iodine intake was fairly uniform throughout the units studied. In only one unit was it less than 100 micrograms (see Appendix Tables 3S and 3T). There have been suggestions that intakes between 100 and 150 micrograms are sufficient, though exact data are not available.

(b) Fluorine. Fluorine intake data were obtained in only three areas, and were 1.91, 0.83 and 2.68 milligrams per man per day. From these meager data the concentration of fluoride in food does not appear to be low as related to prevention of dental caries.

(c) Vitamin B_6. Vitamin B_6 intakes were between 1.75 and 2.10 milligrams per man per day except in one unit which had an intake by analysis of 0.82 milligrams. While data to set requirements are not currently available, it would appear that the intakes may be somewhat on the low side, based on the chemical studies performed.

(d) Vitamin B_{12}. Vitamin B_{12} intakes were between 1.86 and 2.84 micrograms per person per day. Studies in other areas have indicated that this is a reasonable intake. Some problems in analysis developed due to inhibition of the test organism. It is possible that the results as reported were somewhat low.

(e) Folic acid. Folic acid intakes were low, averaging 0.103 milligrams per day with a high of 0.168 milligrams. Further studies should probably be done on this vitamin in order to determine if it was lost during storage or whether the values found represent a normal intake.

(f) Pantothenic acid. Pantothenic acid intakes as determined by analysis were extremely low and, based on the dietary observations, are assumed to be in error. A study should be made to determine whether pantothenic acid, under the conditions of preservation used, is stable, and whether the combination of foods mixed in the composite samples tended to have an adverse effect on pantothenic acid stability. The average intake of this vitamin by analysis was less than 1 milligram per day with no unit having as much as 1 milligram. Normal diets would be expected to contribute at least 4 to 8 milligrams per day.

f. Food waste

Calculations for food wastage were made in each of the units studied, but it was apparent that gross food waste was not a problem in the Burmese military. Plate waste was essentially zero in all of the units studied with the exception of the Defense Services

687462 O - 63 - 6

Academy which is discussed separately below. The major source of waste was related to the cooking procedure used for rice. During final cooking, the bottom of the cooking vessel became extremely hot and a rather thick layer of rice burned on the bottom of the pan. This burned rice was not fed to the troops.

A study of wastage due to burned rice was carried on in 7 units for a period of 14 days. During this time a total of 1,579.8 kilograms of rice was cooked. Analysis indicated that, with the cooking procedures employed, the weight of cooked rice is double that of the uncooked rice. The amount of burned rice discarded during the period was 177.9 kilograms, which is equivalent to 88.9 kilograms of uncooked rice. This is slightly over 6 percent of the total rice prepared in individual units. In some units losses frequently exceeded 10 percent of the rice prepared. Based on the current Army rations rice wastage due to burnt rice during the 14-day period was equivalent to a one-day ration for 120 soldiers. Improved cooking procedures, particularly the use of jacketed kettles, will markedly reduce this loss.

g. Foods consumed outside the mess

For soldiers living in Army barracks there is only limited opportunity to purchase foods outside of the mess hall. However, individuals living outside of the barracks have free access to the market, and it would appear that they may obtain a portion of their nutrients from foods not normally available to the rest of the troops. Data for these individuals will be presented under the food intakes of the dependents (see Section VI 3).

Observations from a few areas indicate that soft drinks make up the principal food purchased by the troops. Small amounts of cakes and other prepared items are eaten, but these do not add any significant amount of nutrients to the diet. No good estimate of the caloric intake from carbonated beverages could be obtained, but data available indicated that it would not amount to more than 100 Calories per day. Analysis of carbonated beverages made by the Nutrition Project group indicates that these are a source of Calories only. In certain areas fruits are available on the open market and a small percentage of the troops with access to the market probably utilize these as a snack food. The consumption of these products is, however, relatively small, basing the assumption on observations made during the time of year that this survey was made.

h. Sanitation

(1) Storage and handling

Storage and handling of cooked foods in the units vary considerably and no general statement can be made. In most units leftover foods are simply discarded at the end of the day. If a large amount of rice remains after the first meal, it is usually held for use in the second or last meal of the day. Only a very small amount of food was actually discarded in any unit and in many units all of the prepared food was served and consumed by the troops.

There is no adequate cold storage so that it is not reasonable to assume that leftovers could be held for longer than a short period of time on a given day. Holding of fresh foods, brought in for use on one day or the following morning, offers some problems, particularly in the case of meats. In general, the practice is to obtain meat for the evening meal and the first main meal of the next day during the evening. In all units visited meat was not held over but all of the meat was consumed on the last meal of one day and a

meat substitute, such as dried prawns or "ngapijaw" (a mixture of fish paste, onion and garlic cooked in oil) was used. Food wastage, due to overpreparation, was not of major importance during the period of the survey.

(2) General cleanliness

Most of the kitchens observed did not practice a uniform program of cleanliness, particularly in regard to the disposal of food preparation waste. Hot water was not used to clean utensils and except for one location it was not available for cleaning any of the cooking or eating utensils. Cold water was used without soap. Most of the cook houses were kept fairly clean under the prevailing circumstances, but sickness due to food-borne bacteria originating from the kitchen would have to be considered a distinct potential.

Screens were not used in most kitchens and dining halls. Flies were not a problem in the higher central and eastern areas of the country, but in the lower lands these insects were prevalent. Screening of the dining hall did not appear to be effective since many of the soldiers ate in the open. Insect contact was high. Added screening in kitchens, particularly with the provision of screen doors, would be useful in areas where a fly population is large.

The cleaning of individual eating utensils could be carried out on a more reasonable scale if hot water were readily available. A simple procedure such as building a fire under an open tank of water and checking that the water temperature was at least 180° F., would be useful to insure adequate cleaning of equipment. Units that are permanently stationed in an area could have mess gear held in the dining hall and washing facilities with adequate provision for hot water and hot rinsing could prove satisfactory in terms of both sanitation and cleanliness.

i. Vitamin supplementation

At the time of the survey large supplies of vitamin capsules were available in storage as were supplies of fortified yeast tablets. We were informed that these products were routinely given to the soldiers, but evidence at the local units suggested that distribution was on a limited basis. Supplies at the time of the survey (October-November 1960) were such that adequate vitamins for an Army of 100,000 men at the rate of 1 pill per day for 660 days were currently in stock, or listed on storage records. Some of the vitamins were rather old (prepared in April 1953) and their potency would be questionable.

The standard vitamin supplement had the following composition, in milligrams:

Iron	10
Thiamine	1.5
Riboflavin	2.0
Niacin	15
Vitamin C	25

In some areas a yeast tablet is issued, though again it is not widely used. This tablet has the following composition, in milligrams:

Thiamine	1.5
Riboflavin	2
Niacin	5

An additional source of vitamins is found in the sweetened condensed milk that is distributed on a basis of 2 ounces per man per day. Three different types of this product were found in the Army camps. The most widely used was a brand enriched with 700 I.U. of vitamin A per gram. One used on a limited basis contained no evidence of added vitamin A or D. The third type, also available on a limited basis, contained 700 I.U. of vitamin A, 0.59 milligrams of thiamine and 100 I.U. of vitamin D per 100 grams. The Army keeps a close control of milk used, and, on the basis of our survey, it is available and used at least once a day in every Army camp. Sweetened condensed milk could serve as a vehicle for vitamin supplementation. Routine use of milk of the last type described would have added a considerable amount of thiamine to the daily ration (0.32 milligrams per man per day).

j. Defense Services Academy

The Defense Services Academy, located at Maymyo, uses a dietary plan differing significantly from that used in the other units observed. This academy does not, however, have kitchen or food storage facilities of a quality superior to that of other units, although its mess hall is in much finer condition and individual table service prevails.

(1) Food consumption

The food consumption in this unit appears to be somewhat superior in terms of individual nutrients consumed on the average in the military units studied. In addition to an increase in variety men at this academy were given an added fresh milk allowance to be served each evening, heated, with sugar added. It was stated that addition of sugar increased the acceptability of the milk.

A breakdown of the nutrient intakes at this location by the recipe and food composite method is found in Table 50.

TABLE 50. DAILY NUTRIENT INTAKE, DEFENSE SERVICES ACADEMY, BURMA

	Recipe Method, 2 Days	Food Composite
Calories	3,646	3,344
Protein, gm	120 1/	86.5
Fat, gm	94	64
Carbohydrate, gm	580	615
Calcium, mg	1,051	1,595
Iron, mg	14.7	21.6
Vitamin A, I.U.	2,825	4,700
Thiamine, mg	1.50	0.62
Riboflavin, mg	1.83	2.24
Niacin, mg	16.7	13.3
Vitamin C, mg	114	38.8
Vitamin B_6, mg	--	2.14
Vitamin B_{12}, mcg	--	2.50
Folic Acid, mg	--	0.093
Iodine, mg	--	0.135
Fluorine, mg	--	0.62
Pantothenic Acid, mg	--	0.496

1/ Includes 20 grams per day of milk protein not added to composite.

(a) Calories. Adequate Calories were available in approximately the same quantity as was found in the rest of the military units.

(b) Protein. The protein level supplied, as indicated by either method, was adequate. Animal protein supplies a larger proportion of the protein in this unit as compared to other military units, as meat was served generally twice each day, plus the added milk allowance.

(c) Fat. A slightly higher fat intake was found in this unit as compared to the average of the other units. The same difference between the fat content of the diet as determined by the recipe and food composite methods was observed.

(d) Vitamins

(i) Thiamine. The thiamine content of the basic diet, as calculated from the recipe method, was essentially the same as that in the other military units. By food composite analysis thiamine intake was approximately 10 percent higher than in any other unit, but still below the "acceptable" range. It was stated that the distribution of vitamin pills to this unit was carried on in a systematic manner and it is possible that the true intakes of thiamine and riboflavin are well within the "acceptable" range.

(ii) Riboflavin. The riboflavin content of the diet by either the recipe or food composite method was considerably higher than the average for other units. The food composite analysis gave a value twice as high (2.24 milligrams per man per day) as that found in the average of the other military units studied (1.10 milligrams per man per day).

(iii) Niacin. The niacin intake by the recipe method was the same as that found in other military units. However, the food composite analysis indicated that niacin intake was approximately 50 percent greater than that found in the average of the other military units.

(iv) Vitamin A. Vitamin A intake by food composite analysis was at the higher end of the "acceptable" range and was almost twice the average of the other military units. A greater use of vegetables and fruits in this unit would explain this improved vitamin A picture.

(v) Vitamin C. Vitamin C levels were within the "acceptable" range by both methods. Values by both the recipe and food composite methods were higher than those found for the other military units.

(e) Minerals

(i) Iron. Iron intakes were "high" compared to the ICNND standards by either the recipe or food composite procedure.

(ii) Calcium. The added milk allowance led to an increased calcium intake. A comparison of the food composite results showed that the Defense Services Academy had an average calcium intake 3 1/2 times the average of the other military units.

(f) Minor nutrients. Intakes of minor nutrients were essentially the same as those found in other military units (see Table 50). The principal exception was fluorine.

The fluorine content of the diet from three other units (see above) was found to average approximately three times that in the food served at the Defense Services Academy. The fluorine intake of 0.62 milligrams per day was less than 1.0 milligrams per day, which was suggested as being effective in the reduction of dental caries.

The intake of vitamin B_6 appeared to be acceptable when compared with the Recommended Dietary Allowances of the (U.S.) Food and Nutrition Board (4).

Folic acid intakes are lower than those recommended in the (U.S.) NRC Dietary Allowances, but do compare favorably with those recently reported to be present in typical American diets (5).

Pantothenic acid intakes appear to be unreasonably low, based on the analysis that was made. It is possible that pantothenic acid was lost during storage due to its instability under the conditions employed. Pantothenic acid intakes from normal diets in the United States range from 2-6 milligrams per day. In no case did the intakes of any of the five units so studied reach even 1 milligram per day.

Iodine intakes of 0.10 to 0.15 milligrams per day have been suggested as typical within the United States and are claimed to prevent goiter. Iodine intake was adequate when compared to this arbitrary standard.

4. Dental survey

a. Introduction

A total of 2,467 military males received a dental examination. Of these 1,999, 158 and 254 were in service with the Army, Navy and Air Force, respectively. In addition 56 cadets of the Defense Services Academy were given a dental examination. Distribution of the dental sample is outlined by service and by age groups in Table 11. This sample included 374 men on whom one or more biochemical determinations were carried out.

Diseases of oral tissues have been reported as highly prevalent in most populations from which information is available. To disclose differences between groups it is often necessary to resort to contrast in severity as well as prevalence. For this reason some discussion of the general levels of dental caries and periodontal diseases seen in Burma might aid in orienting the dental findings for the military and other segments of the Burma sample.

Mean numbers of decayed, missing and filled (DMF) teeth and severity of periodontal diseases, as estimated by scores for the periodontal index, are presented in Appendix Table 3U for the total Burma sample and for whole country populations examined during ICNND surveys conducted in Thailand (2) and Vietnam (3). Similar information also is included for a quasi-random sample of civilians examined in Baltimore, Maryland, USA (6). Due to the heterogeneous nature of these populations the data are not directly comparable but some generalizations can be made.

b. Results:

Findings for dental caries and periodontal diseases in Burma were similar to those reported for persons examined in Thailand and Vietnam. In these groups, dental caries experience was very much lower and severity of periodontal diseases very much higher than for civilians living in Baltimore.

The prevalence of dental caries (Table 51) in men of the Burma Armed Forces was very low. The total military group through the age of 39 years averaged less than one decayed, missing, or filled permanent tooth per person; men over 50 years of age averaged approximately three DMF teeth. There appeared to be no important differences in dental caries prevalence between men in the different services. Dental caries experience was low in all groups.

TABLE 51. MEAN NUMBERS OF DECAYED, MISSING AND FILLED (DMF) PERMANENT TEETH[1/], MILITARY SAMPLE, BURMA

Age (years)	Army	Navy	Air Force	Total Military	Defense Services Academy
15-19	.48	.78	.63	.55	.77
20-29	.62	.64	.70	.64	2.88
30-39	.88	2.14	1.17	.91	--
40-49	1.94	--	--	1.91	--
50+	2.71	--	--	2.71	--

1/ Exclusive of teeth crowned for cosmetic purposes.

In contrast the condition of the supporting tissues (periodontium) of the teeth in military males was poor. Two methods were used to evaluate status of the periodontal structures -- the periodontal index (PI) and the gingival recession score. Periodontal index scores estimate present and active disease and reflect severity as well as prevalence. This score is a morbidity measure and can disclose improvement (as after treatment) or deterioration in the periodontium. Gingival recession scores, for practical purposes, are irreversible and assess the cumulative experience with gingival atrophy consequent to resorption of underlying alveolar bone. In both instances increasing scores indicate advancing stages of disease. Criteria used in applying these measures and the general relation between PI score and a clinical evaluation of periodontal involvements are given in Appendix IE.

Periodontal index scores for the military sample are shown in Table 52. These are relatively high scores and indicate that inflammatory and degenerative changes in periodontal tissues were widespread. As summarized in Table 53, over 90 percent of all men examined had some clinical evidence of overt gingivitis. In men as young as 15-19 years of age, more than 50 percent had gross gingival changes and 6 percent had advanced destruction of periodontal tissues. Severity increased steadily with age until after 40 years gross gingival changes were almost universal and clinical signs of advanced destruction were present in about 80 percent of the men.

TABLE 52. MEAN SCORES FOR PERIODONTAL DISEASE (PI) AND GINGIVAL RECESSION, MILITARY SAMPLE, BURMA

Age (years)	Army	Navy	Air Force	Total Military	Defense Services Academy
			Periodontal Disease (PI)		
15-19	.48	.62	.61	.52	.26
20-29	.79	.71	.85	.79	.43
30-39	1.48	1.06	2.14	1.51	--
40-49	2.93	2.30	--	2.92	--
50+	3.91	--	--	3.91	--
			Gingival Recession		
15-19	.2	1.0	--	.4	.1
20-29	2.4	2.3	2.1	2.4	1.9
30-39	10.3	11.7	13.1	10.4	--
40-49	31.3	--	--	30.5	--
50+	54.6	--	--	54.6	--

TABLE 53. SEVERITY OF PERIODONTAL DISEASE, MILITARY SAMPLE[1/], BURMA

Age (years)	Percent Free of Disease	Percent with at Least Gross Gingival Disease	Percent with Advanced Periodontal Disease
15-19	11	57	6
20-29	7	67	20
30-39	5	80	50
40-49	2	91	78
50+	0	100	100

1/ Includes men of the Defense Services Academy.

Gingival recession scores, presented in Table 52, were negligible at the younger ages but also increased with age until, in individuals over 50, recession of gingival tissues had, on the average, occurred for about more than half the teeth present.

There appeared to be little difference in levels of periodontal diseases for men of the Army, Navy, or Air Force. There was a tendency toward lower scores and therefore better periodontal health in Defense Services Academy personnel. At comparable ages PI scores for the total military were about twice those for men attending the Defense Services Academy.

The status of oral cleanliness was estimated according to the Oral Hygiene Index (OHI) which includes scores for soft debris as well as for the hard deposits of dental calculus. These deposits act as irritants to periodontal tissues and have been implicated in the etiology of periodontal diseases. Scores for debris, calculus and oral hygiene for the military sample are given in Table 54. They indicate ubiquitous and heavy accumulations of

both types of deposits, but particularly of calculus. Men of the Defense Services Academy tended to score lower than men in the other services, and as reported previously also had lower levels of periodontal disease.

TABLE 54. STATUS OF ORAL HYGIENE (OHI), MILITARY SAMPLE, BURMA

Age (years)	Army	Navy	Air Force	Total Military	Defense Services Academy
			Mean Debris Score		
15-19	.92	1.02	.55	.90	.65
20-29	.93	.81	.86	.91	.70
30-39	1.08	.75	1.14	1.08	--
40-49	1.27	1.30	--	1.27	--
50+	2.00	--	--	2.00	--
			Mean Calculus Score		
15-19	.93	1.04	.72	.93	.57
20-29	1.01	.97	1.02	1.01	.63
30-39	1.35	.98	1.54	1.34	--
40-49	1.72	1.50	--	1.72	--
50+	2.43	--	--	2.43	--
			Mean Oral Hygiene (OHI) Score		
15-19	1.85	2.06	1.27	1.83	1.22
20-29	1.94	1.78	1.88	1.92	1.33
30-39	2.41	1.73	2.68	2.36	--
40-49	2.99	2.80	--	2.99	--
50+	4.43	--	--	4.43	--

Previous ICNND surveys have demonstrated a consistent and pronounced association between oral cleanliness, as measured by this and other methods, and scores for both the periodontal index and gingival recession. Groups relatively free of dental deposits invariably have had better periodontal health. This relationship is demonstrated in Table 55 for a part of the military sample examined in Burma.

TABLE 55. MEAN SCORES FOR PERIODONTAL DISEASES AND GINGIVAL RECESSION RELATED TO ORAL HYGIENE, MILITARY SAMPLE[1/] 20-29 YEARS OF AGE, BURMA

Range of OHI Scores	Periodontal Disease Mean Score	Gingival Recession Mean Score
0 - .9	.13	1.7
1.0-1.9	.38	1.8
2.0-2.9	.88	4.6
3.0-3.9	1.68	9.3
4.0+	2.54	11.8

1/ Biochemical sample including men of the Defense Services Academy.

5. Summary

By Western standards the Burmese military are small people. However, their caloric intakes, when assessed by the various methods, are well above the "accepted" levels as established by previous ICNND surveys. Most of the caloric intake is represented by carbohydrate, the fat content of the diet being relatively low, accounting for between 15 and 20 percent of the Calories. Of this fat, less than 30 percent is composed of saturated fatty acids.

The low incidence of obesity suggests that caloric balance exists. Although Calorie expenditures were not measured, one could predict that they are high. The latter must vary because there were no significant differences in weights between the military groups when broken down according to activities such as active training, garrison duty, etc.

It is also interesting to note that the percents of "standard weight" of the men eating at home are less than they are for those eating at the military base, and this correlates well with the decreased caloric intakes at home (Table 48).

There was no evidence in the clinical, dietary, or biochemical findings of protein deficiency. The hyperglobulinemia is an interesting finding. The most obvious explanation for this is that it represents an immune response to repeated infections. The latter is a common experience in the Burmese population. However, other explanations could be suggested and this is an area worthy of further investigation.

The studies on thiamine metabolism point up again the known discrepancies which exist between the clinical manifestations of thiamine deficiency and those found in the dietary analyses and the urinary excretion values. Although a very low prevalence of clinical evidence of areflexia was found, the dietary survey indicated a borderline to marginal intake of thiamine, and the biochemical data indicated a high percentage of values in the "deficient" range. One can only deduce from this data that a borderline thiamine deficiency exists in the military personnel and that overt beriberi is an ever-present danger which could be precipitated by any one of several stressful situations.

In the case of riboflavin, the clinical lesions that have generally been associated with a deficiency of this vitamin were prevalent. Again, the dietary intakes were borderline, and the urinary excretion values indicated a significant proportion in the "deficient" and "low" ranges. However, both the dietary and biochemical findings are not as striking as is the case with thiamine. The fact that more clinical evidence was found might raise again the question of the significance of angular lesions and scars as a manifestation of riboflavin deficiency. Certainly it is fair to say that riboflavin status in the military is suboptimal and borderline, and therefore highly susceptible to any environmental or dietary stresses that might be incurred.

Intake of niacin and its equivalents appeared to be adequate in practically all situations, which was reflected by the normal excretion values of this vitamin in the urine. The fact that there were no clinical evidences of pellagra or other manifestations of niacin deficiency corroborated these findings. It would appear, therefore, that there is no problem in the military personnel relative to niacin status.

Clinical evidences of vitamin A deficiency, as noted above, were minimal to absent. This is verified by the normal biochemical data on serum vitamin A and carotene levels. The dietary intake data would suggest a somewhat low intake. However, one can only say that our evidence would suggest there is no problem with vitamin A in the military personnel examined, and that the dietary "standards" for vitamin A may be too high.

The clinical, biochemical and dietary analyses support the statement that no problem exists in vitamin C nutrition in the military personnel. Although slightly low values for vitamin C in food by the composite analysis method were found, this was not reflected in the biochemical determinations, and therefore can be disregarded.

The levels of hemoglobin and mean corpuscular hemoglobin concentration noted above indicate that anemia is present in the military group. It is true that the prevalence of hemoglobin levels below 12 grams percent is only approximately 5 percent; however, almost 50 percent of the personnel fall in the "below-acceptable" range. This is in contrast to the dietary intakes of iron which are quite adequate and actually higher than the generally accepted values. One can surmise that, although a dietary deficiency in iron does not exist, the hypochromic iron deficiency anemia must, then, be explained by either poor absorption or, more likely, by chronic blood loss. With the supposed high prevalence of parasitic infestation (not proved in this survey) of people in Southeast Asia, one can explain the suggested blood loss. In view of the high intake, however, iron supplementation for the military personnel may be beneficial, but measures taken to suppress parasitic infestation or other methods to reduce the blood loss will probably be more helpful. However, it should be recognized that the hematological examinations were rather incomplete, and the whole area of anemia is one which deserves more intensive investigation.

The relatively low prevalence of goiter in the military personnel is somewhat surprising in view of the low values for urine iodine, and the low-normal iodine intake in food. A well known physiological resistance to goiter in males, as compared to females, may explain some of this dichotomy, but one may question the validity of the established normal excretory levels for iodine. Certainly, in the military it would appear that the intakes of iodine and the excretory values are not associated with any significant prevalence of goiter. However, in view of the low excretory values, supplementation with iodine in the diet would seem to be a reasonable thing to do.

The reported salt intake for the Burma military, averaging 11.8 grams per day, is considerably less than that reported from other Southeast Asian nations. Although this figure is slightly in excess of that reported from the United States, the prevalence of hypertension as mentioned above is considerably less. There would seem to be no reason to make any recommendation concerning the intake of salt in the Burmese military.

The picture in relation to calcium status is unclear from our studies. Since clinical evaluation of calcium status is difficult, if not impossible, one can only presuppose from the suboptimal calcium intake data that a problem might exist over a prolonged period of time. Therefore it would seem reasonable that an attempt should be made to increase the calcium intake in military personnel. Of course, this could best be accomplished by the use of milk products.

The low values of serum cholesterol that were recorded are not surprising. These data correspond with those found in other Southeast Asian nations, and are distinctly different from those generally reported by Western countries. The relatively low fat intake, high in polyunsaturated fatty acids as reported above, would be expected to result in cholesterol levels in the range that was found. How much atherosclerosis and coronary artery heart disease exist in the military personnel is unknown, but one would assume from talking with the various physicians in the military, as well as looking at autopsy reports from Army hospitals, that, although the disease exists, its prevalence is much less than that in the United States. However, it would be unwise from our data to make any strong statements in regard to the association of hypocholesterolemia and atherosclerosis, but only to comment that findings reported herein are in agreement with those found in other population groups.

It is clear that the young men in the Defense Services Academy are better nourished than any other group within the military. Undoubtedly the increased consumption of milk and other animal products by the cadets is in part responsible for this. It is interesting, however, that the mean serum cholesterol for this group is higher than the mean for the rest of the Army. This is not reflected in higher blood pressures. It would seem that the dietary for these young men could serve as a good standard for the entire military.

Dental findings for military males are outlined in Appendix Table 3V according to results of biochemical determinations for several nutritional items. The cumulative characteristics of gingival recession and dental caries make attempts to evaluate these conditions in terms of present and possibly transient nutritive states hazardous. On the other hand, PI scores, being estimates of present and active disease, should reflect possible nutritional influences. However, scores for PI as well aa gingival recession are closely correlated with varying levels of oral hygiene and both increase sharply with age, as do mean numbers of DMF teeth. The influence of these factors, particularly in small samples, could easily obscure a possible relation between nutrition and the dental findings as presented in Appendix Table 3V. Results of this tabulation should be considered tentative until a more detailed analysis can be completed.

Men who, according to ICNND criteria, were found to have "deficient" or "low" values for serum ascorbic acid and vitamin A and urinary excretion levels of thiamine, riboflavin and N^1-methylnicotinamide had about the same general levels of disease as men whose values were in the "acceptable" or "high" range. Dental caries experience was low in all groups. Differences in PI and gingival recession scores were slight.

References

1. Perez, C., N.S. Scrimshaw and J.A. Muñoz. Technique of Endemic Goitre Surveys. Endemic Goitre, p. 369, see esp. p. 376, World Health Organization Monograph Series No. 44, Geneva, 1960.

2. Interdepartmental Committee on Nutrition for National Defense. The Kingdom of Thailand, Nutrition Survey, October-December 1960. Washington, D.C., February 1962.

3. Interdepartmental Committee on Nutrition for National Defense. Republic of Vietnam, Nutrition Survey, October-December 1959. Washington, D.C., July 1960.

4. National Research Council. Recommended Dietary Allowances, Revised 1958. National Academy of Sciences - National Research Council Publication 589, Washington, D.C.

5. Chung, Aurora S.M., W.N. Pearson, W.J. Darby, O.N. Miller and Grace A. Goldsmith. Folic Acid, Vitamin B_6, Pantothenic Acid and Vitamin B_{12} in Human Dietaries. Am. J. Clin. Nutrition 9, 578, 1961.

6. Commission on Chronic Illness. Chapt. 5, Prevalence of Dental Conditions, in Chronic Illness in the United States, Vol. IV, Harvard University Press, Cambridge, 1957.

VI

THE MILITARY DEPENDENTS

1. Clinical survey

a. Historical data

A total of 2,104 dependents of the military personnel was given an abbreviated examination, and 939 a more detailed examination. In addition, 86 boys, sons of the military who were living in a boarding school in Meiktila and eating in a common dining room, are included as a separate group of dependents. A breakdown according to location, sex, age and puerperal status is given in Table 56.

The history of previous illnesses is shown in the following table:

TABLE 57. MEDICAL HISTORY OF THE MILITARY DEPENDENTS, BURMA

	Males		Females			
			Nonpregnant, nonlactating		Pregnant	Lactating
Age (years)	<15	>15	<15	>15	15-44	
Number	75	0	65	154	79	223
Malaria	--		3.1	10.4	8.9	8.5
Trachoma	--		1.5	3.2	0	2.2
Tuberculosis	--		--	1.3	1.3	0.9
Diarrhea	10.7		12.3	7.8	6.3	6.7
Vitamin supplementation	1.3		3.1	9.7	13.9	10.3

b. Anthropometric data

Figures 3 to 8 show the standard State University of Iowa growth charts for all dependents from birth through 18 years of age. In the preschool age group growth appears to be adequate for the first year and then becomes retarded and remains so throughout the entire 18 years. However, if one looks at the admittedly small bit of data on the first year of life in Figures 3 and 4, it would appear that in reality many of the babies are small when born and remain below Western standards even in the first year of life. Thus again the question arises as to validity of using Western standards to assess Eastern growth rates. It would appear that relationships of growth to age are well maintained and that girls reach maximum growth at an earlier age than boys.

The average height of the adult Burmese wife of the military man is 150.7 centimeters, barely over 5 feet. She weighs 44.7 kilograms or a little above 98 pounds (see Appendix Figure 3A).

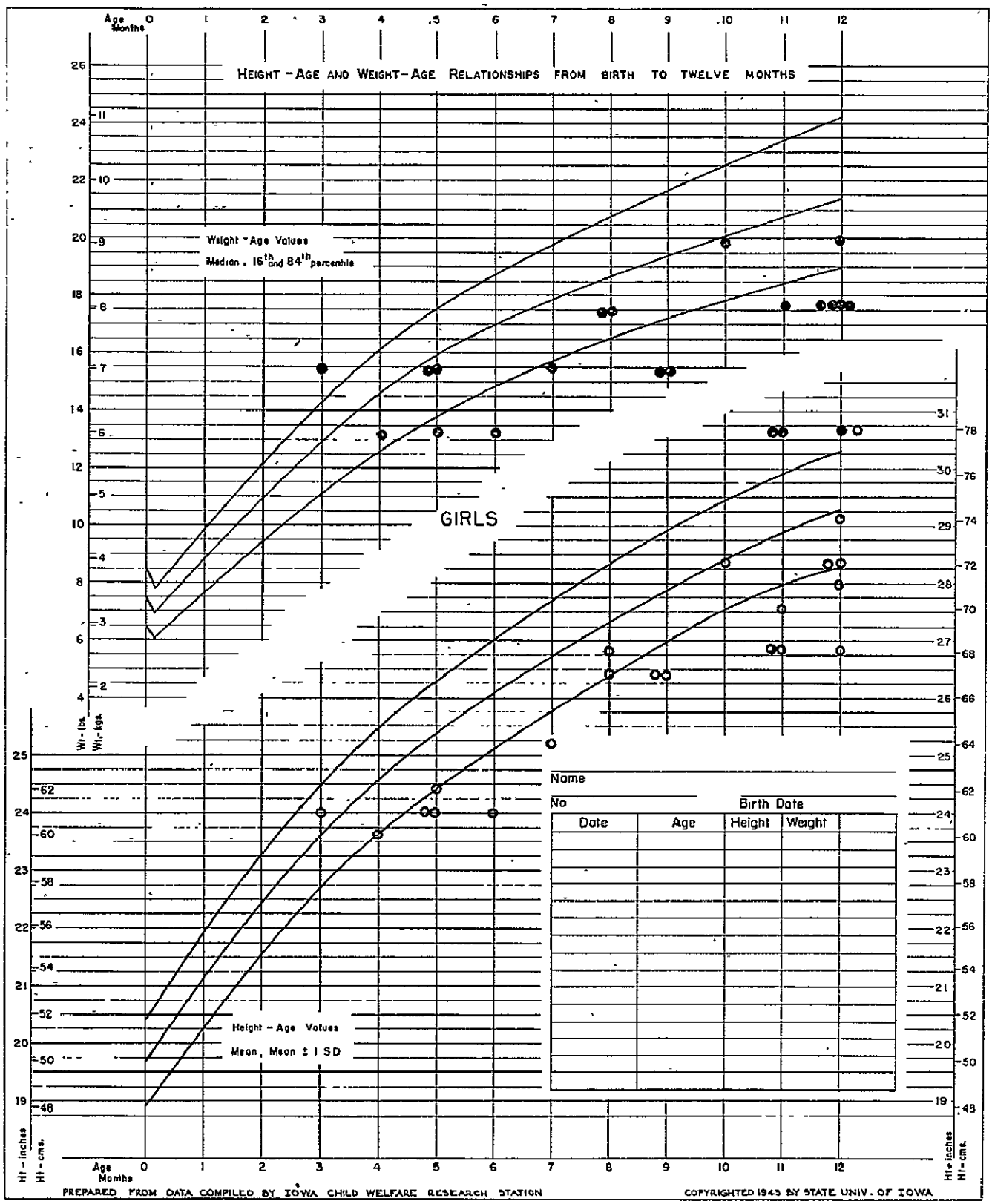
In using above 100 percent of "standard weight" as a criterion for obesity, 13.8 percent of the adult women in the dependent group are obese. Although the number of observations is small, the differences between dependents of the several military services are not obvious.

TABLE 56. AGE GROUPS BY SEX AND LOCATION, MILITARY DEPENDENTS, BURMA

Location	Mingaladon	Seik Kyi and Ratanabon	Indaing	Toungoo	Meiktila Army	Meiktila Air Force	Ba Htoo Myo	Chauk	Maymyo	Moulmein	Total	Boarding School, Meiktila
Males												
Age (Years)												
<15	52	36	68	26	15	14	--	--	18	74	303	37
15-24	--	--	1	--	--	--	--	--	2	--	3	49
Total	52	36	69	26	15	14	--	--	20	74	306	86
Females												
Nonpregnant, nonlactating												
Age (Years)												
<15	39	30	40	17	7	16	--	14	35	87	285	
15-24	11	2	33	51	31	5	19	29	7	53	241	
25-44	33	7	52	58	32	15	30	39	12	30	308	
45+	1	--	8	5	2	1	2	2	3	1	25	
Total	84	39	133	131	72	37	51	84	57	171	859	
Pregnant	23	6	33	50	19	20	47	24	12	26	260	
Lactating	65	15	105	84	102	50	64	54	31	109	679	
Pregnant and lactating												
Age (Years)												
15-24	30	14	64	68	61	31	49	33	18	77	445	
25-44	58	7	74	66	60	39	62	45	25	58	494	
Total	88	21	138	134	121	70	111	78	43	135	939	

MILITARY DEPENDENTS, BURMA, INDIVIDUAL HEIGHT AND WEIGHT MEASURES FOR INFANT GIRLS, 3-12 MONTHS

DEPARTMENT OF PEDIATRICS, STATE UNIVERSITY OF IOWA

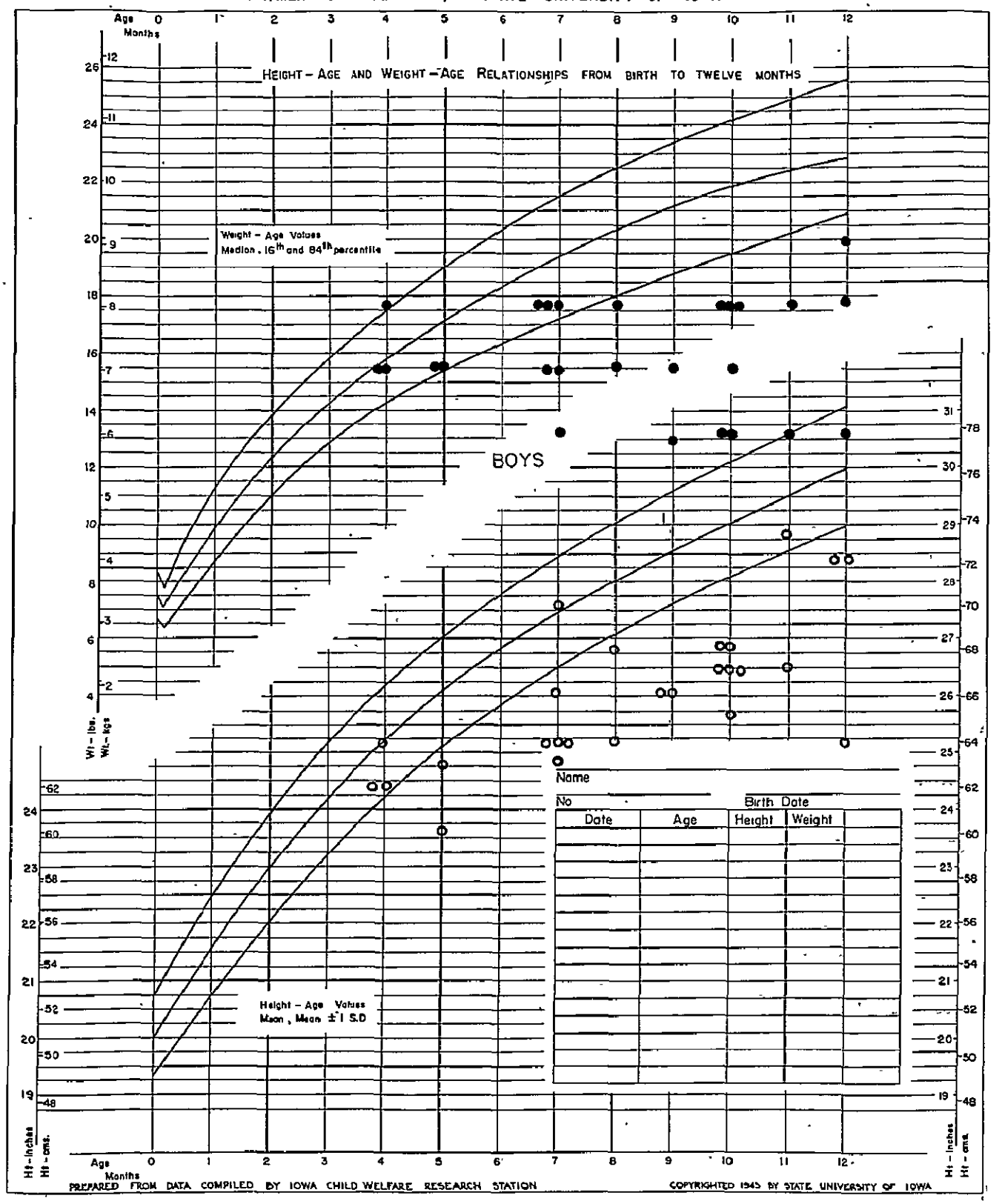


WEIGHTS ● HEIGHTS ○

FIGURE 3

MILITARY DEPENDENTS, BURMA, INDIVIDUAL HEIGHT AND WEIGHT MEASURES FOR INFANT BOYS, 4-12 MONTHS

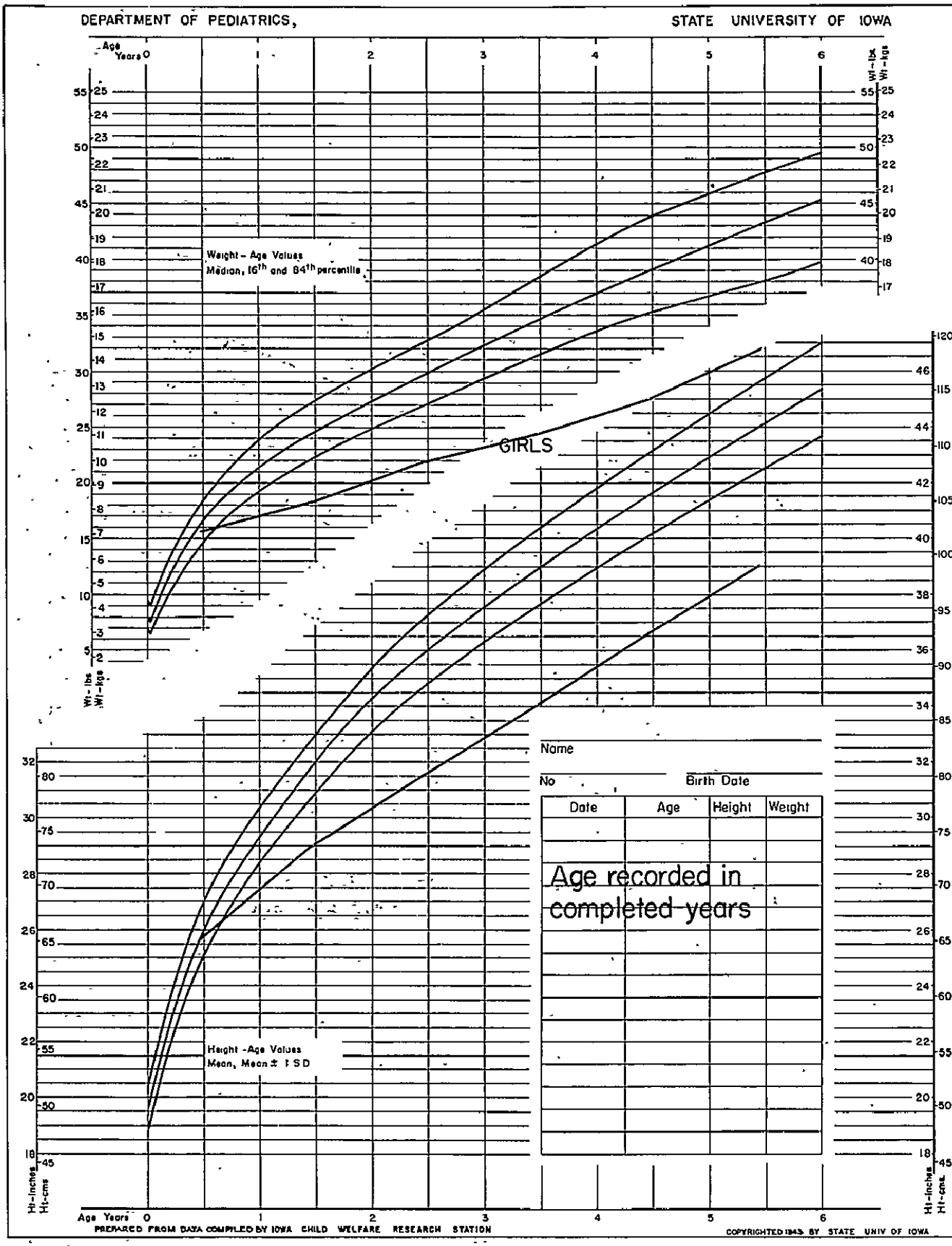
DEPARTMENT OF PEDIATRICS, STATE UNIVERSITY OF IOWA



WEIGHTS • HEIGHTS ○

FIGURE 4

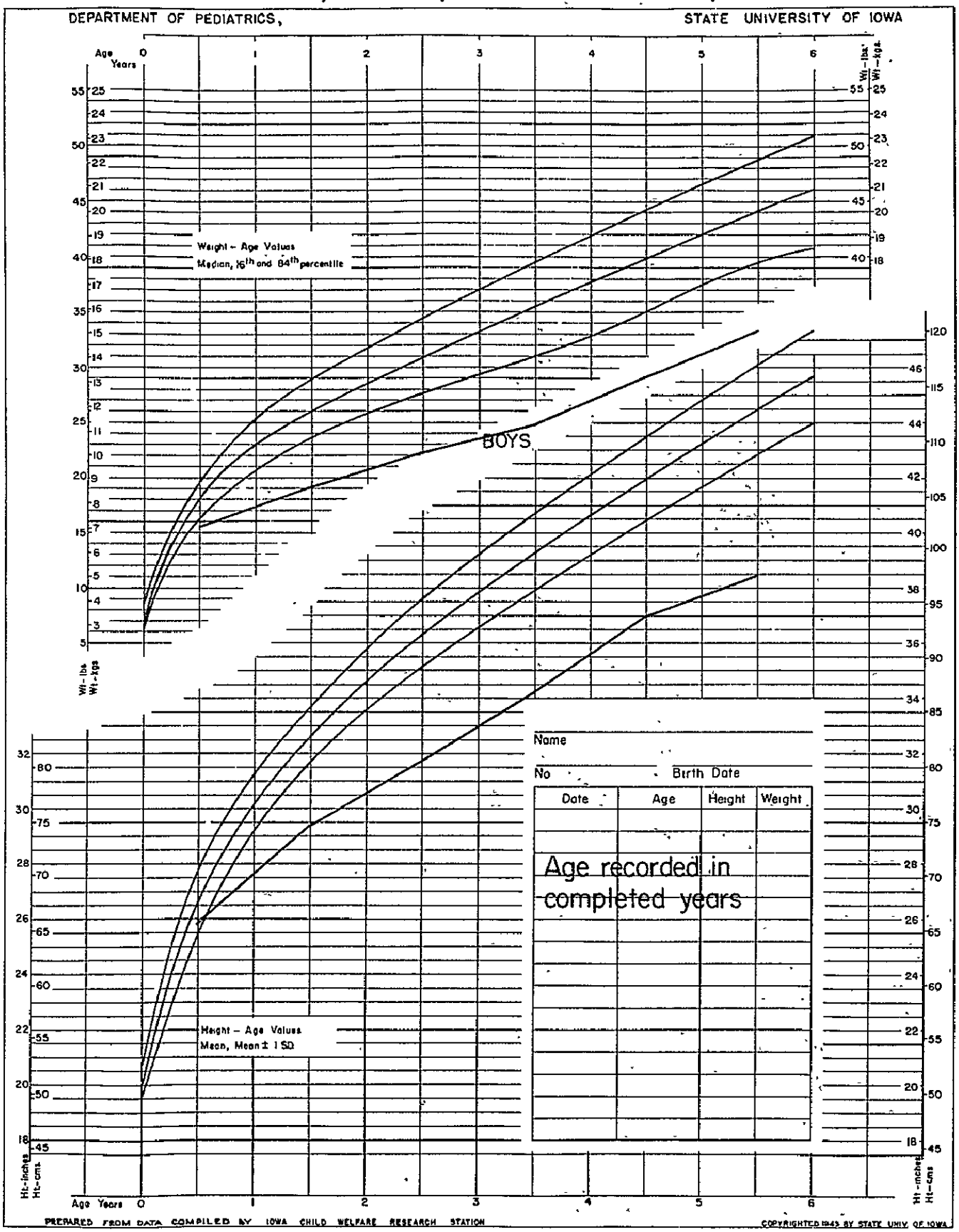
MILITARY DEPENDENTS, BURMA, GROWTH OF GIRLS, 0-5 YEARS



NUMBER 15 20 16 16 26 41

FIGURE 5

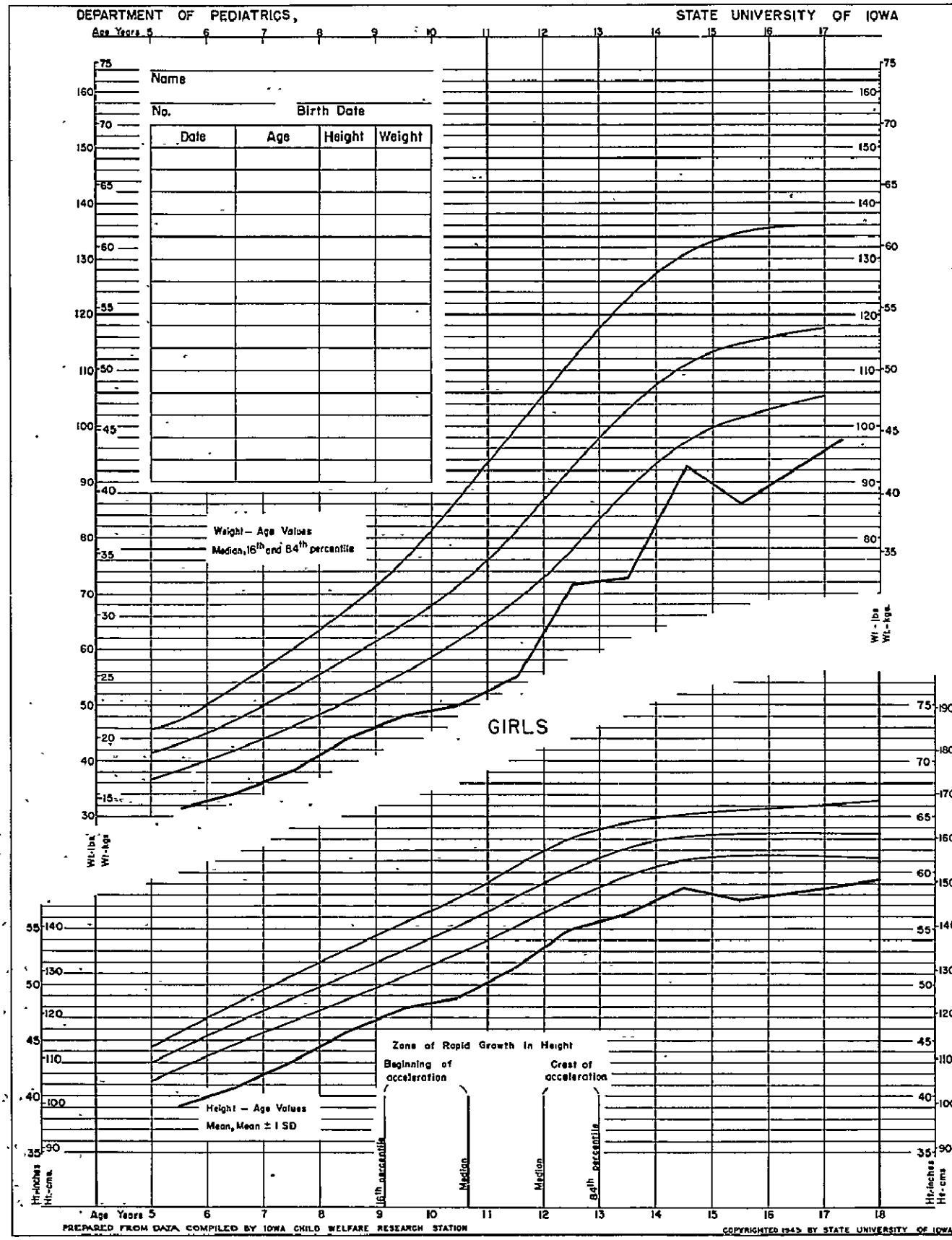
MILITARY DEPENDENTS, BURMA, GROWTH OF BOYS, 0-5 YEARS



NUMBER 23 29 17 14 45 33

FIGURE 6

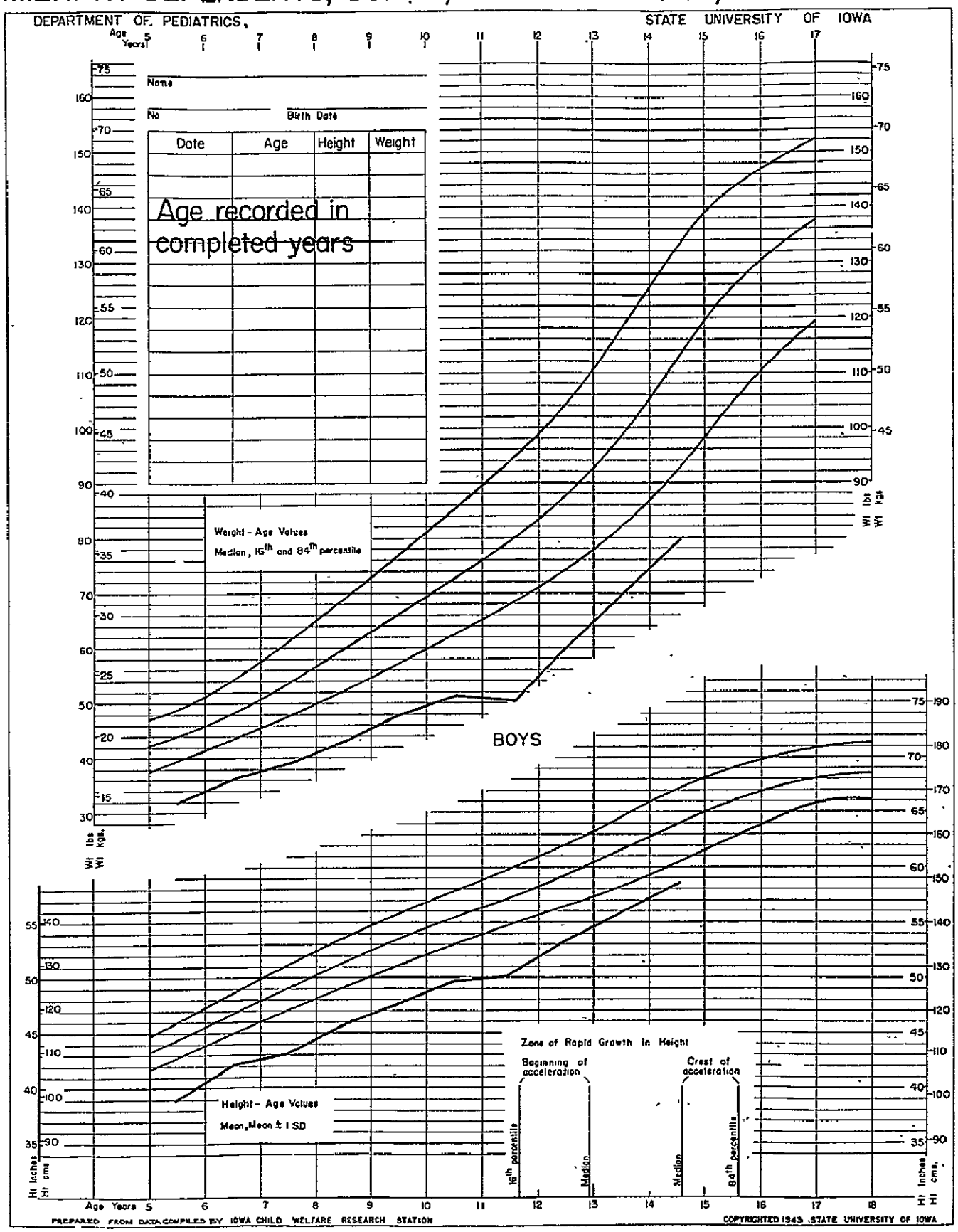
MILITARY DEPENDENTS, BURMA, GROWTH OF GIRLS, 5-18 YEARS



NUMBER 41 25 26 21 15 19 12 9 4 4 3 7 17

FIGURE 7

MILITARY DEPENDENTS, BURMA, GROWTH OF BOYS, 5-14 YEARS



NUMBER 33 34 22 26 17 17 6 12 1 4

FIGURE 8

The mean skinfold thickness measures for the arm and scapula are given in Table 58.

TABLE 58. SKINFOLD MEASUREMENTS OF THE MILITARY DEPENDENTS, BURMA

	Males	Females				Boarding School
		Nonpregnant, nonlactating		Pregnant	Lactating	
Age (years)	<15	<15	>15	15-44		3-20
Arm (mm)	6.7	8.2	11.4	10.9	10.5	7.0
Scapula (mm)	4.8	5.3	12.3	12.2	11.7	7.8

c. Protein status

There was no clinical evidence of protein malnutrition in any dependent examined.

d. Vitamin status

(1) Vitamin B-complex

(a) Thiamine. The over-all prevalence of bilateral loss of ankle reflexes in the military dependents was 1.6 percent. The other signs of bilateral edema and calf tenderness were of insignificant order. A breakdown according to sex and age is shown in Table 59.

TABLE 59. CLINICAL SIGNS OF THIAMINE DEFICIENCY, MILITARY DEPENDENTS, BURMA

	Males	Females				Boarding School
		Nonpregnant, nonlactating		Pregnant	Lactating	
Age (years)	<15	<15	>15	15-44		3-20
		Percent Prevalence				
Bilateral loss of ankle jerk	2.3	1.1	2.5	0.8	1.3	0
Bilateral ankle edema	0	0	0	0	0	0
Calf tenderness	0	0	0	0.4	0	0

No clinically recognizable case of true beriberi was seen.

(b) Riboflavin. The percent prevalence of the various clinical manifestations of riboflavin deficiency is given in Table 60.

TABLE 60. CLINICAL SIGNS OF RIBOFLAVIN-DEFICIENCY, MILITARY DEPENDENTS, BURMA

	Males	Females				Boarding School
		Nonpregnant, nonlactating		Pregnant	Lactating	
Age (years)	<15	<15	>15	15-44		3-20
		Percent Prevalence				
Angular lesions	11.1	8.1	4.0	5.8	8.8	9.3
Angular scars	2.0	0.7	3.1	3.1	2.1	4.6
Cheilosis	0	0	0	0	0.1	0

(c) Niacin. Again, no clinical evidence of pellagra was manifested in any dependent seen. However, glossitis was observed in a slightly greater prevalence than in the men of the military. Table 61 depicts this.

TABLE 61. PERCENT PREVALENCE OF GLOSSITIS, MILITARY DEPENDENTS, BURMA

	Males	Females				Boarding School
		Nonpregnant, nonlactating		Pregnant	Lactating	
Age (years)	<15	<15	>15	15-44		3-20
Glossitis	0.3	0	0.2	1.2	0.7	0

(2) Vitamin A

As with the military, no evidence of xerophthalmia was found, nor was a single instance of a Bitot's spot found in the entire dependent group examined. The percent prevalence of follicular hyperkeratosis is presented in Table 62.

TABLE 62. PERCENT PREVALENCE OF FOLLICULAR HYPERKERATOSIS, MILITARY DEPENDENTS, BURMA

	Males	Females				Boarding School
		Nonpregnant, nonlactating		Pregnant	Lactating	
Age (years)	<15	<15	>15	15-44		3-20
Follicular hyperkeratosis						
arms	3.9	1.4	0.9	0	0.4	2.3
back	6.5	1.8	0.7	0.4	0.9	2.3
thighs	2.9	0.7	0	0	0.1	0

(3) Vitamin C

No overt evidence of scurvy was observed in any individual in this group. Swollen red interdental papillae were observed in a prevalence shown in Table 63, but there is grave doubt that this finding has anything at all to do with ascorbic acid deficiency.

TABLE 63. PERCENT PREVALENCE OF SWOLLEN RED PAPILLAE, MILITARY DEPENDENTS, BURMA

	Males	Females				Boarding School
		Nonpregnant, Nonlactating		Pregnant	Lactating	
Age (years)	<15	<15	>15	15-44		3-20
Swollen red papillae						
localized	2.0	1.0	1.2	2.7	3.7	1.2
diffuse	0.6	0.7	1.0	0.8	2.6	4.6

(4) Vitamin D

No clinical evidence of rickets was observed in any patient examined.

e. Minerals -

(1) Iron

Filiform papillary atrophy of the tongue, presumably due to iron deficiency, was more common among the dependents than in the military, as Table 64 shows.

TABLE 64. PERCENT PREVALENCE OF FILIFORM PAPILLARY ATROPHY OF THE TONGUE, MILITARY DEPENDENTS, BURMA

	Males	Females				Boarding School
		Nonpregnant, nonlactating		Pregnant	Lactating	
Age (years)	<15	<15	>15	15-44		3-20
Filiform papillary atrophy						
slight	2.0	1.0	1.7	4.2	3.2	0
moderate-severe	2.0	0.7	1.9	0.8	2.8	0

(2) Iodine

Here again, with the predominant female population, goiter was found in a much larger proportion of the examinees than in the case of the military. Table 65 depicts the percent prevalence.

TABLE 65. PERCENT PREVALENCE OF GOITER, MILITARY DEPENDENTS, BURMA

	Males	Females				Boarding School
		Nonpregnant, nonlactating		Pregnant	Lactating	
Age (years)	<15	<15	>15	15-44		3-20
Goiter						
Grade I	0	3.2	17.7	20.0	18.1	0
Grade II	0	0	0.9	1.5	1.5	0

f. Findings of dubious or unknown nutritional significance

(1) Nasolabial seborrhea

Nasolabial seborrhea was observed as shown in Table 66.

TABLE 66. PERCENT PREVALENCE OF NASOLABIAL SEBORRHEA, MILITARY DEPENDENTS, BURMA

	Males	Females				Boarding School
		Nonpregnant, nonlactating		Pregnant	Lactating	
Age (years)	<15	<15	>15	15-44		3-20
Nasolabial seborrhea	0.3	0	9.2	9.2	11.3	11.6

(2) Thickened bulbar conjunctivae

As with the other groups examined, this clinical finding was by far the most common. Table 67 depicts its prevalence along with that of pterygium.

TABLE 67. PERCENT PREVALENCE OF THICKENED BULBAR CONJUNCTIVAE AND PTERYGIUM, MILITARY DEPENDENTS, BURMA

	Males	Females				Boarding School
		Nonpregnant, nonlactating		Pregnant	Lactating	
Age (years)	<15	<15	>15	15-44		3-20
Thickened bulbar conjunctivae	0.3	0.4	35.9	28.1	33.3	15.1
Pterygium	0.3	0.4	2.3	0.8	1.0	0

(3) Blood pressure

Hypertension proved to be a very uncommon finding in the relatively young aged military dependents. The mean figures for systolic and diastolic pressure, plus the percent prevalence of those above 150 mm Hg systolic and 100 mm Hg diastolic, are given in Table 68.

TABLE 68. BLOOD PRESSURES, MILITARY DEPENDENTS, BURMA

	Males	Females				Boarding School
		Nonpregnant, nonlactating		Pregnant	Lactating	
Age (years)	<15	<15	>15	15-44		3-20
Mean systolic, mm Hg	89	99	117	111	116	122
Mean diastolic, mm Hg	52	62	73	66	74	71
		Percent Prevalence				
>150 systolic	0	0	1.5	1.4	1.4	0
>100 diastolic	0	0	2.2	0	2.9	0

One lady was found with a blood pressure of 220/120, a truly hypertensive reading.

(4) Other

Xanthelasma was not observed. However, arcus senilis was present in 3 of 9 women over the age of 45. It, of course, was quite rare in younger dependents. Table 69 depicts the prevalence of enlargement of the liver or spleen.

TABLE 69. PERCENT PREVALENCE OF HEPATIC AND SPLENIC ENLARGEMENT, MILITARY DEPENDENTS, BURMA

	Males	Females				Boarding School
		Nonpregnant, nonlactating		Pregnant	Lactating	
Age (years)	<15	<15	>15	15-44		3-20
Hepatomegaly	0	1.5	3.2	0	2.2	0
Splenomegaly	0	0	0	0	0.4	0

2. Biochemical survey

a. Introduction

Samples of blood and urine were collected from approximately 150 military dependents at 10 different locations throughout Burma. About one half of these individuals were pregnant or lactating females. The remaining 75 were about equally distributed between males under 15, females under 15, and nonpregnant, nonlactating females over 15. The last group occasionally included a few additional individuals. A detailed presentation of the data distributed by age, sex and location can be found in the Appendix (Appendix Tables 4C and 4D). This section will consider the nutritional status of the entire group of military dependents. The blood and urine samples were stored in ice and transported to the clinical laboratory, usually arriving within 24 hours after collection. Analyses were then completed on the following day, the samples being stored under refrigeration in the interim. The procedure for collection and a description of the methods employed are included in the section on biochemical procedures (Section III 2).

b. Protein status

Better than 95 percent of the children and nonpregnant, nonlactating females had serum albumin values of 3.5 grams per 100 milliliters or higher. Serum globulin levels were generally elevated, a finding common to several nations in Southeast Asia. The meaning of this elevated globulin would seem to be a worthwhile area for future research. Somewhat lower serum albumin values were noted in the pregnant and lactating females.

TABLE 70. TOTAL SERUM PROTEIN LEVELS, MILITARY DEPENDENTS, BURMA

Description		Children and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
No. of subjects		58	82
Mean		7.8	7.6
		Percent Distribution	
gm protein per 100 ml serum			
<6.00	("Deficient")	0.0	0.0
6.00-6.39	("Low")	0.0	1.2
6.40-6.99	("Acceptable")	6.9	20.7
≥7.00	("High")	93.1	78.0

TABLE 71. SERUM ALBUMIN LEVELS, MILITARY DEPENDENTS, BURMA

Description		Children and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
No. of subjects		58	82
Mean		4.0	3.7
		Percent Distribution	
gm albumin per 100 ml serum			
<2.5	("Deficient")	0.0	2.4
2.5-3.4	("Low")	3.4	22.0
3.5-4.9	("Acceptable")	93.1	75.6
≥5.0	("High")	3.4	0.0

TABLE 72. SERUM GLOBULIN LEVELS, MILITARY DEPENDENTS, BURMA

Description		Children and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
No. of subjects		58	82
Mean		3.8	4.0
		Percent Distribution	
gm globulin per 100 ml serum			
1.0-1.9	("Deficient")	0.0	0.0
2.0-2.9	("Low")	6.9	4.9
3.0-3.5	("Acceptable")	31.0	14.6
≥3.6	("High")	62.1	80.5

c. Vitamin status

(1) Vitamin B-complex

(a) Thiamine. Thiamine excretion levels were in either the "low" or "deficient" range in 55-65 percent of the military dependents examined during the survey. These results, coupled with the 25 percent incidence of transketolase stimulation of the order expected in "deficient" individuals, lead to the conclusion that the nutrition of the military dependents is not adequate with respect to thiamine.

TABLE 73. THIAMINE EXCRETION, MILITARY DEPENDENTS, BURMA

Description		Children and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
No. of subjects		72	79
Median excretion		49	59
		Percent Distribution	
mcg thiamine per gm creatinine			
<27	("Deficient")	27.8	20.2
27-65	("Low")	38.9	35.4
66-129	("Acceptable")	18.0	24.0
≥130	("High")	15.3	20.2

TABLE 74. PERCENT STIMULATION OF RED CELL TRANSKETOLASE ACTIVITY AFTER ADDITION OF THIAMINE *IN VITRO*, MILITARY DEPENDENTS, BURMA

Description		Combined Military Dependents
No. of subjects		56
Percent stimulation of enzyme activity		Percent Distribution
>20	("Deficient")	25.0
16-20	("Low")	7.1
≤15	("Satisfactory")	67.8

(b) Riboflavin. The excretion of riboflavin resembled closely the pattern observed with thiamine. Although the percent of individuals in the "deficient" range was somewhat smaller, from 50-70 percent of the military dependents examined were excreting less riboflavin than is considered indicative of an "acceptable" intake by ICNND standards (see Appendix Table 3G).

TABLE 75. RIBOFLAVIN EXCRETION, MILITARY DEPENDENTS, BURMA

Description		Children and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
No. of subjects		73	81
Median excretion		71	64
		Percent Distribution	
mcg riboflavin per gm creatinine			
<27	("Deficient")	13.7	6.2
27-79	("Low")	43.8	63.0
80-269	("Acceptable")	38.4	27.2
≥270	("High")	4.1	3.7

(c) N^1-methylnicotinamide. There was little biochemical evidence to indicate an insufficient intake of niacin or niacin precursors. Excretion of N^1-methylnicotinamide was "high" in about 50 percent of the samples analyzed and only a small percentage of "low" results was obtained.

TABLE 76. N'-METHYLNICOTINAMIDE EXCRETION, MILITARY DEPENDENTS, BURMA

Description		Children and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
No. of subjects		43	48
Median excretion		4.4	4.0
		Percent Distribution	
mg N'-methylnicotinamide per gm creatinine			
<0.5	("Deficient")	0.0	0.0
0.5-1.59	("Low")	16.3	6.2
1.60-4.29	("Acceptable")	32.6	47.9
≥4.30	("High")	51.2	45.8

(2) Vitamin A

From the results of this study, it would appear that the intake of vitamin A is generally adequate since over 85 percent of the subjects had "acceptable" or "high" serum vitamin A levels. The high carotene values suggest that a substantial portion of the vitamin A is derived from plant carotenoids.

TABLE 77. SERUM VITAMIN A LEVELS, MILITARY DEPENDENTS, BURMA

Description		Children and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
No. of subjects		56	80
Mean		29.1	32.2
		Percent Distribution	
mcg vitamin A per 100 ml serum			
<10	("Deficient")	1.8	0.0
10-19	("Low")	12.5	3.8
20-49	("Acceptable")	85.7	91.2
≥50	("High")	0.0	5.0

TABLE 78. SERUM CAROTENE LEVELS, MILITARY DEPENDENTS, BURMA

Description		Children and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
No. of subjects		57	82
Mean		106	100
		Percent Distribution	
mcg carotene per 100 ml serum			
<20	("Deficient")	0.0	0.0
20-39	("Low")	1.8	1.2
40-99	("Acceptable")	56.1	52.4
≥100	("High")	42.1	46.3

(3) Vitamin C

The nutrition of the military dependents with respect to vitamin C appears to be good. No "deficient" values were recorded and only a small proportion were in the "low" range.

TABLE 79. SERUM VITAMIN C LEVELS, MILITARY DEPENDENTS, BURMA

Description		Children and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
No. of subjects		51	82
Mean		0.49	0.44
		Percent Distribution	
mg vitamin C per 100 ml serum			
<0.10	("Deficient")	0.0	0.0
0.10-0.19	("Low")	7.8	3.6
0.20-0.39	("Acceptable")	41.2	48.8
≥0.40	("High")	51.0	47.6

d. Mineral status

(1) Anemia

Hypochromic anemia was found to a considerable extent among the military dependents. Hemoglobin values below 10 grams per 100 milliliters were found in about 20 percent of the subjects. The situation seemed to be more severe in the pregnant and lactating group, as might be expected. The hypochromic nature of the anemia is indicated by the high (approximately 30 percent) prevalence of mean corpuscular hemoglobin concentration values below 28 percent.

TABLE 80. HEMOGLOBIN LEVELS, MILITARY DEPENDENTS, BURMA

Description		Children and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
No. of subjects		82	71
Mean		11.3	11.2
		Percent Distribution	
gm hemoglobin per 100 ml blood			
<10.0	(Severe anemia)	19.5	18.3
10.0-11.9	("Deficient")	37.8	50.7
12.0-13.9	("Low")	36.6	26.8
14.0-14.9	("Acceptable")	6.1	2.8
≥15.0	("High")	0.0	1.4

TABLE 81. PLASMA CORPUSCULAR VOLUME (HEMATOCRIT), MILITARY DEPENDENTS, BURMA

Description		Children and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
No. of subjects		91	82
Mean		38.4	38.6
percent		Percent Distribution	
<36	("Deficient")	24.2	19.5
36-41	("Low")	57.1	59.8
42-44	("Acceptable")	12.1	13.4
≥45	("High")	6.6	7.3

TABLE 82. MEAN CORPUSCULAR HEMOGLOBIN CONCENTRATION, MILITARY DEPENDENTS, BURMA

Description	Children and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
No. of subjects	81	71
Mean	29.6	29.2
percent	Percent Distribution	
<28.0	25.9	32.4
28.0-29.9	28.4	29.6
30.0-31.9	19.8	18.3
≥32.0	25.9	19.7

(2) Iodine

A value above 50 micrograms per gram of creatinine is normal for the excretion of iodine. Values below this level were found in 32 of 44 (72.7 percent) samples from children and nonpregnant, nonlactating females and in 39 of 52 (75.0 percent) pregnant or lactating females among the military dependents. The means for these two groups were 45 and 44 respectively. These data are indicative of a probable need for an increased intake of iodine.

TABLE 83. URINARY IODINE EXCRETIONS, MILITARY DEPENDENTS, BURMA

Description	Children and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
No. of subjects	38	53
Mean	45	48
mcg iodine per gm creatinine	Percent Distribution	
<50	71.0	71.7
50-99	23.7	17.0
≥100	5.3	11.3

e. Cholesterol

It is interesting to note that while the serum cholesterol values averaged 166 and 172 in the two dependent groups, a greater proportion of +200 values were recorded than was the case in the military male population. The significance of this observation, if any, is not known.

TABLE 84. SERUM CHOLESTEROL LEVELS, MILITARY DEPENDENTS, BURMA

Description		Children and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
No. of subjects		59	82
Mean		166	172
		Percent Distribution	
mg cholesterol per 100 ml serum			
50-99	(Very low)	1.7	0.0
100-149	(Low)	33.9	23.2
150-199	(Average)	45.8	61.0
≥200	(High)	18.6	15.8

3. Dietary survey

a. Population studied

Dietary surveys were carried out in the villages of dependents at 13 military units. Included were two naval units, two Air Force units, and 9 Army units. The breakdown of this sample is given in Tables 8 and 9. The food intake data were obtained by questionnaire, by food weighing (recipe method) and by food composites taken in homes. A table giving the standard man equivalent for various age and sex groups and a distribution of nutrient intakes based on a standard man are presented in the Appendix (Appendix Tables 1D and 4E).

b. Housing of military dependents

Married soldiers are usually provided with houses at the military installation. These quarters are of good design. The houses in a few units had been allowed to fall into disrepair. Family dwelling quarters at the Naval and Air Force installations were of a permanent type and included many modern conveniences. The quality of this housing was judged superior to that of the nonmilitary population of the same income level. In most locations the military keeps a close control over this housing. Water distribution appears to be directly under the control of most units and water supplies at several units were limited.

c. Food supply and preparation

A major portion of the food utilized by the family usually must be purchased at the local market. In units which are not located close to a village or city, small markets are frequently set up within or close by the camp. As in civilian markets, prices of certain products, particularly meat and fish, were consistently high in comparison with the prices for other basic foods. The price of rice and sugar was best controlled. Fruit and vegetable prices tend to fluctuate with the quantity available. Because of the lack of storage in markets, many fruits and vegetables must be sold within one or two days after harvesting to avoid spoilage. It would be advantageous if longer periods of storage could be developed in order to insure a more unified flow of produce for both military and civilian markets.

The dependent families receive a small food allowance from the military, equivalent to the amount of food a soldier would normally receive at the military installation.

For example, 28 ounces of rice would be supplied to the family for each day that the soldier was located in his home unit. Dry items are given to the family bi-weekly or monthly. Fresh items, however, are supplied daily. For example, squash is cut into several pieces, and someone from each family picks up this portion with similar portions of other items such as meat and potatoes. This constitutes a considerable amount of handling of vegetables and meats, and as a consequence can result in large losses of nutrients.

When the soldier is assigned to field duty and must eat in the field his portion of the basic ration is not supplied to the family. Units such as infantry or special combat troops may spend one third of their time in the field. Under such conditions the families are placed in a poorer nutritional situation than other families where the husband is eating at home. Recommendations to improve the entire dependent food situation have been made.

Cooking in the families is usually done once a day, in the morning. Meals consist of rice with some type of curry. Rice is washed three to five times in cold water before cooking in excess water, which is then discarded. Rice cooked in this manner increases in weight 2 to 2.1 times the weight of dry raw rice.

Curries prepared in the home consisted of a small amount of meat or fish plus such items as ngapi, onions, garlic, salt and dry chillies. Soup, often a vegetable type, was frequently prepared. Pulses were sometimes used in the soups. Use of pulses by the dependent population was less than that in the basic military diet.

When meat or fish was not available, vegetable-type curries were prepared. In some cases small amounts of dry fish or dried shrimp were added. Dried fish, fried in oil, was also used as a fresh meat replacement, particularly in the central part of the country.

d. Food consumption

(1) Calories

Calorie intakes appear to be adequate when compared with standard diet requirements for the Burmese population set by the World Health Organization (Appendix Table 4E), although food distribution within the family may not provide adequate Calories in terms of energy needs for certain members of the family. More study of Calorie distribution within the family group should be undertaken by the local research workers at the Nutrition Laboratory. Between 70 and 80 percent of Calories in the diet come from rice. With such a major proportion of the Calories from one item, it is obvious that unless foods rich in other nutrients such as vitamin C, riboflavin and calcium are supplied the diet will be nutritionally inadequate. Foods such as meat and milk, which could serve as excellent complementary foods to a rice diet, are used in relatively small amounts. A breakdown of the foods that supply the major amounts of nutrients is given in Table 85.

(2) Protein

Protein intakes when compared with the standards established by the ICNND (see Appendix Table 3Q) are in the "acceptable" range. Although in several locations intakes slightly below 60 grams were recorded, it is felt that most of the intakes would be considered adequate. The principal protein sources are rice and other vegetables. However, a significant part of the protein comes from meat, fish and the milk group of foods. It is interesting to note that sweetened condensed milk is an item used in significant amounts in each area studied in the dependent population. In contrast, tinned milk was not a factor in the diet of any civilian population group studied, although fresh milk was used in the area around Maymyo.

687462 O - 63 - 8

TABLE 85. FOOD INTAKE BY FOOD GROUPS, MILITARY DEPENDENTS, BURMA, GRAMS PER STANDARD MAN PER DAY

QUESTIONNAIRE

Location	Rice	Vegetables	Sugar		Pulses	Meat	Fish, fresh
			White	Brown			
Mingaladon, BAMC	475	77	27	--	24	53	48
Mingaladon, Air Force	433	112	38	--	10	66	79
Rangoon, Navy	392	86	30	--	12	61	65
Toungoo, 22nd Buregt.	471	92	15.5	4.5	7.5	53	58
Indaing, COD	443	81	30	--	21	48	57
Meiktila, Air Force	438	106	27	--	9	74	37
Meiktila, Art. Depot	448	125	15.5	3.4	11	53	19
Ba Htoo Myo, All Units	545	130	25	--	7	62	22
Maymyo, CBE	560	151	41	--	19	46	18
Chauk, 104th Rgt.	492	137	20	--	17	59	6
Moulmein, 1st Chin Rfl.	607	222	37	--	21	69	47

(3) Fat

Fat supplies approximately 18 percent of the Calories in the diet. The principal source of fat is cooking oil used in the preparation of curry. Some fat is also obtained from the meat. Linoleic acid intakes ranged from 20 to 35 grams per standard man per day.

(4) Vitamins

(a) Vitamin B-complex

(i) Thiamine. Thiamine intakes were "low" by all methods used except in Moulmein by the recipe method (Table 86). The high level in this one sample by one method appears to be inconsistent (Tables 87, 88 and 89), and is open to question. The dependent population has much less variety in its diet when compared to the civilian or military population. Thus rice provides a large portion of the caloric requirements, and as few families have gardens or farm plots vegetables are not as widely used. With daily thiamine intakes averaging less than 0.20 milligrams per 1,000 Calories in the dependent population it is expected that both clinical and biochemical evidence of these "low" intakes should be present.

(ii) Riboflavin. Riboflavin intakes were about two-thirds the "acceptable" levels in every area studied by chemical analysis (Table 87). Recommendations to increase the amounts of riboflavin furnished this population have been made. It is apparent that an increase in riboflavin cannot be accomplished by diet changes alone and the recommendations made include enrichment with riboflavin of certain basic items now used in the diet (see Section I).

TABLE 85 (Continued) FOOD INTAKE BY FOOD GROUPS, MILITARY DEPENDENTS, BURMA, GRAMS PER STANDARD MAN PER DAY

QUESTIONNAIRE

Ngapi	Eggs	Fruit	Oil	Salt	Milk, tinned	Fish, dry	Fish Paste	Milk, fresh
25	11	76	34	11	48	7	--	--
24	14	112	46	12	41	9	2	--
25	17	93	38	8	43	10.5	--	--
17.5	10	57	39	8	13	7	14	--
22	15	88	40	9	32	8	3	--
9	13	56	41	9	36	5.3	14	--
12	8	46	45	11	28	6	10	16
24	8	68	41	10	22	7	--	--
10	9	35	53	11	26	7	12	--
12	7	42	40	10	23.9	6	12	--
12	19	59	34	14	32	10	6	--

(iii) Niacin. Niacin intakes were within the "acceptable" range in all areas studied by food table calculation (Table 86), although results by chemical analysis were lower in two locations (Table 87). No evidence of niacin deficiency was reported by the clinical investigators. It must therefore be assumed that the current diet provides adequate amounts of this nutrient.

(b) Vitamin A. Although vitamin A intakes were slightly less than the standards of the ICNND (see Appendix Table 3Q), biochemical and clinical evidence suggest that adequate amounts of vitamin A are consumed by the population. Wider use of fruits and vegetables would insure intakes at "acceptable" levels, particularly among city dwellers.

(c) Vitamin C. Vitamin C intakes for all areas were within the "acceptable" range by food table calculations, but were low in most areas according to chemical analysis of food composites (Tables 86, 87 and 89). While vitamin C intakes are dependent on the availability of certain fruits and vegetables, there is no reason to believe that less than adequate amounts of these products are consumed by an appreciably significant part of the Burmese population for much of the year.

However, problems related to shipping and storage of fresh fruits and vegetables, particularly in the area around Rangoon, could lead to vitamin C lack in the low income part of the population. Studies should be initiated to determine how these fresh items can be shipped and stored most advantageously without increasing the prices to any great extent.

TABLE 86. NUTRIENT INTAKES, MILITARY DEPENDENTS, BURMA, PER STANDARD MAN PER DAY, RECIPE METHOD (FOOD WEIGHING IN HOME)

	No. Days	No. Families	No. People	Std. Man	Calories	Protein gm	Fat gm
Mingaladon, BAMC	2	10	52	34.75	2,355	59	36.9
Toungoo, 22nd Buregt.	2	10	44	32.2	2,461	62.3	41.6
Meiktila, Artillery	2	10	36	26.45	2,396	64.7	53.5
Meiktila, Air Force	2	12	68	44.85	2,388	59.4	47.4
Ba Htoo Myo, All Units	2	10	35	27.3	2,615	64.5	58.8
Chauk, 104th Regt.	1	20	79	57.56	2,085	47	37.6
Maymyo, Engineer Depot	2	22	113	78.3	2,818	67	69.5
Moulmein, 1st Chin Rfl.	2	22	70	51.35	2,230	59.4	31.5

1/ This value appears to be an error. Food habits in this location do not differ significantly from those of other areas studied. This value is not included in the average in Table 89.

TABLE 87. NUTRIENT INTAKES, MILITARY DEPENDENTS, BURMA, PER STANDARD MAN PER DAY, FOOD COMPOSITE ANALYSIS

	No. Days	No. Families	No. People	Std. Man	Calories	Protein gm	Fat gm
Mingaladon, BAMC	2	5	31	20.9	1,930	62	50.2
Toungoo, 22nd Buregt.	2	2	11	7.6	1,970	54.6	44.3
Meiktila, Air Force	2	2	13	8.1	2,350	56.4	62
Meiktila, Artillery	2	1	2	1.8	1,940	47.1	27.8
Ba Htoo Myo, BANCOS	2	2	8	6.3	2,250	43.5	54.5
Chauk, 104th Regt.	1	2	8	5.65	2,030	52.5	39.0
Maymyo, Engineer Depot	1	2	12	8.2	2,395	75	45.5
Moulmein, 1st Chin Rfl.	2	2	6	4.2	1,965	57.2	26.2
Total		18	91				

TABLE 86 (Continued)

Calcium mg	Iron mg	Vitamin A I.U.	Thiamine mg	Riboflavin mg	Niacin mg	Vitamin C mg
235	8.7	1,127	0.69	0.46	12.1	34
269	8.9	914	0.93	0.45	11.9	45
336	10.8	912	0.70	0.40	11.9	42
288	10.8	612	0.97	0.41	11.1	37
480	9.2	1,439	0.79	0.46	13.8	38
217	7.4	928	0.66	0.40	11.1	40
301	11	1,012	0.80	0.40	15.1	72
289	9.6	3,618	(2.48)1/	0.47	12.4	72

TABLE 87 (Continued)

Calcium mg	Iron mg	Vitamin A I.U.	Thiamine mg	Riboflavin mg	Niacin mg	Vitamin C mg
535	18.7	1,342	0.33	0.90	8.2	14
425	20.6	2,500	0.58	0.72	11.8	11
850	27.3	2,160	0.44	0.76	11.4	28
330	20.8	2,000	0.38	0.82	12	25
575	18.6	1,150	0.32	0.61	8	46
397	19.5	1,008	0.37	0.61	14	14
625	17.5	2,910	0.42	0.62	7	16
390	14.7	2,285	0.40	0.62	19.5	19.5

TABLE 88. NUTRIENT INTAKES, MILITARY DEPENDENTS, BURMA, PER STANDARD MAN PER DAY QUESTIONNAIRE METHOD[1/]

Location	Unit	Calories	Protein gm	Fat gm	Calcium mg	Iron mg	Vitamin A I.U.	Thiamine mg	Riboflavin mg	Niacin mg	Vitamin C mg
Mingaladon	BAMC	2,639	56.6	62.8	327	11.5	2,349	0.75	0.56	11.4	40
Mingaladon	Air Force	2,662	62.7	72.8	329	10.9	2,416	0.70	0.52	11.8	60
Rangoon	Navy	2,377	59.1	63.6	314	10.4	2,400	0.67	0.57	10.9	48
Toungoo	22nd Buregt.	2,469	57.7	59.2	233	11.5	2,187	0.65	0.58	11.1	41
Indaing	COD	2,483	53.6	61.2	288	10.8	2,349	0.69	0.49	10.8	45
Meiktila	Air Force	2,508	57.4	68.1	275	10.1	2,594	0.68	0.50	10.8	45
Meiktila	Artillery	2,466	42.7	66.5	286	10.5	2,938	0.65	0.47	10.5	48
Ba Htoo Myo	All Units	2,794	60.5	64.1	267	11.3	3,050	0.74	0.48	12.5	56
Maymyo	Engineer	3,029	62.0	73.1	291	11.6	3,271	0.93	0.56	12.4	53
Chauk	104th Regt.	2,601	56.9	61.4	282	11.1	3,118	0.73	0.47	10.9	51
Moulmein	1st Chin Rfl.	3,172	74.6	67.4	360	13.3	4,758	0.98	0.61	13.8	79

1/ Cooking losses not considered.

TABLE 89. NUTRIENT INTAKES, MILITARY DEPENDENTS, BURMA, PER STANDARD MAN PER DAY

	Questionnaire Method[1/]	Recipe Method[2/]	Food Composite Analysis[2/]
Calories	2,654	2,413	2,104
Protein, gm	57.6	60.4	56.8
Fat, gm	65.4	47.1	43.6
Vitamin A, I.U.	2,857	1,320	1,919
Vitamin C, mg	51	47	21.6
Thiamine, mg	0.73	0.79[3/]	0.40
Riboflavin, mg	0.51	0.43	0.70
Niacin, mg	11.5	12.4	10.2
Calcium, mg	295	302	516
Iron, mg	11.2	9.5	19.7

1/ 11 locations.
2/ 8 locations.
3/ 7 locations. Value from Moulmein not included in average (see Table 86). If included, average is 1.00 mg/standard man/day.

(5) Minerals

(a) Iron. While iron intake appears to be within the "acceptable" range, clinical evidence of widespread anemia suggests that increased iron intake would be advantageous. Recommendations to increase the iron content of the diet as now consumed probably would be more acceptable than any major change in the dietary pattern of the population.

(b) Calcium. Calcium content of the diets was below the "acceptable" range in every area studied by the food calculation method (Table 86). Chemical analysis showed a higher value which would be "acceptable" (Table 87). Calcium in the diet of the dependents is supplied by ngapi and sweetened condensed milk. With the average calcium intake between 300 and 500 milligrams per day one might anticipate some evidence of low calcium intake within the population. However, the clinical reports give no evidence that calcium deficiency is a problem among the Burmese. Modification of the diet to provide a greater calcium intake could be accomplished by a larger intake of milk products and a greater use of pulses.

(c) Iodine. Intakes for dependents were calculated from analysis of nine food composites representing a total of 91 persons. The analysis indicated that intakes ranged from a low at Meiktila of 0.06 to a high at Toungoo of 0.14 milligrams per standard man per day. Except for the significantly low values, the levels are similar to those found in the military. However, in many areas the prevalence of goiter would suggest that these intake levels are not adequate. Biochemical data on excretion also suggest this possibility.

4. Dental survey

A total of 1,034 military dependents received a dental examination. Of these, 916 were females. The 118 male dependents examined, all less than 20 years of age, included those attending the Boarding School. Distribution of military dependents in the dental sample is outlined by age and sex in Table 12.

Procedures and criteria used in dental examinations on military dependents were the same as those for the military sample. The criteria are presented in Appendix IE and some discussion of interpretations is included in Section V on the military survey.

Impressions of the general levels of dental caries and periodontal diseases in military dependents can be had by referring to Appendix Table 3U. Generally, as with the military, findings approximated those reported for whole country populations examined in Thailand (1) and Vietnam (2), with dental caries prevalence much lower and severity of periodontal diseases much higher than similar findings reported for civilians living in Baltimore (3).

Dental findings for military dependents examined in Burma are summarized in Table 90. Mean numbers of DMF teeth indicated that dental caries experience was low in both males and females. The increase in DMF teeth seen for females over 40 years of age probably reflects loss of teeth from periodontal diseases as well as from neglect of dental caries.

Periodontal index and gingival recession scores were relatively high and support the clinical impression that prevalence and severity of periodontal diseases were widespread in this sample. PI scores tended to be slightly higher for males than for females. As shown in Table 91, in each age range a high percentage of military dependents had signs of at least gross gingival involvement. Advanced destruction of periodontal tissues was a common finding and increased consistently with age.

Deposits of dental calculus and debris were abundant in both males and females. Mean scores for the oral hygiene index are presented in Table 92. As in the military, OHI scores for dependents were directly correlated with PI and gingival recession scores.

TABLE 90. DENTAL CARIES, PERIODONTAL DISEASE AND GINGIVAL RECESSION, MILITARY DEPENDENTS, BURMA

Age (years)	Dental Caries[1/] Mean No. DMF Teeth	Periodontal Disease Mean Score	Gingival Recession Mean Score
		Males	
0-4	--	.28	--
5-9	.1	.41	0
10-14	.4	.62	0
15-19	.9	.94	.4
		Females	
0-4	--	.24	--
5-9	.1	.32	0
10-14	.6	.43	0
15-19	1.1	.56	.30
20-29	1.2	.91	1.9
30-39	1.8	1.56	7.7
40-49	3.4	2.45	19.3
50+	13.0	6.54	68.8

1/ Exclusive of teeth crowned for cosmetic purposes.

TABLE 91. SEVERITY OF PERIODONTAL DISEASE, MILITARY DEPENDENTS, MALES AND FEMALES[1/], BURMA

Age (years)	Percent with at Least Gross Gingival Disease	Percent with Advanced Periodontal Disease
	Males	
15	63	0
15-19	57	0
	Females	
15	58	0
15-19	49	4
20-29	74	26
30-39	86	54
40-49	84	68
50+	100	100

1/. For persons receiving detailed clinical examinations only.

TABLE 92. MEAN ORAL HYGIENE INDEX SCORES, MILITARY DEPENDENTS[1/], BURMA

Age (years)	Calculus	Debris	OHI
	Males		
0-4	--	--	--
5-9	.30	2.00	2.30
10-14	.48	1.28	1.76
15-19	.74	.72	1.46
	Females		
0-4	--	--	--
5-9	.21	1.46	1.82
10-14	.45	1.32	1.74
15-19	.68	.80	1.46
20-29	1.02	.95	1.96
30-39	1.30	1.07	2.37
40-49	1.61	1.14	2.75
50+	1.77	1.57	3.33

1/ For persons receiving detailed clinical examinations only.

5. Summary

On the basis of clinical examination and detailed dietary questionnaire there is no evidence of caloric inadequacy among military dependents. In fact, using above 100 percent of "standard weight" as a criterion, 13.8 percent of the adult women in the dependent group were obese.

Although the average daily protein intake estimated by the questionnaire method was slightly less than usually accepted recommended dietary allowances no clinical evidence of protein malnutrition was seen. Of the total protein intake 36 percent was derived from animal protein sources.

Both dietary evaluation and biochemical analyses provide extensive evidence for an inadequate intake of thiamine. The consistent although low intake of thiamine probably precludes the development of a significant prevalence of acute beriberi in this group. No clinical evidence of overt beriberi was noted. The over-all prevalence of bilateral loss of ankle reflexes in the military dependents was 1.6 percent.

The dietary questionnaire reveals a significantly low intake of riboflavin. The low urinary excretion data for riboflavin correlate well with low dietary intake and the relatively high prevalence of clinical signs of riboflavin deficiency provides further evidence for serious riboflavin malnutrition.

No pellagra was seen in the military dependent group and dietary evidence for an adequate niacin intake correlates well with this. N^1-methylnicotinamide excretions were all in the "acceptable" or higher ranges, providing additional support for adequate niacin nutriture.

Vitamin A nutritional status appeared adequate with an estimated dietary intake of about 2,800-3,000 I.U. per day. This correlates well with the "acceptable" biochemical serum vitamin A and serum carotene levels in the military dependent group. No evidence of xerophthalmia or Bitot's spots was observed, although a small prevalence of follicular hyperkeratosis was found.

No overt evidence of scurvy was observed in the military dependent group. The estimated dietary intake of vitamin C averaged about 50 milligrams per day which correlates well with serum vitamin C levels indicating "acceptable" to "high" intakes.

Rickets was not observed. No estimate of dietary vitamin D intake was made.

Iron deficiency anemia appears to be a significant problem in the military dependent group, influenced no doubt by the physiologic stress of pregnancy and lactation. Actual iron intake by dietary estimation, while not seriously low, i.e., about 11 milligrams per day, was evidently insufficient for the special needs of this group. Filiform papillary atrophy of the tongue, presumably due to iron deficiency, was more common among the dependents than in the military. Hemoglobin levels below 10 grams percent were found in 20 percent of this group and more commonly in the pregnant and lactating females. Generally, hemoglobin values ranged from 10 to 12 grams percent, suggesting iron deficiency by the usual standards.

Goiter, presumably due to iodine deficiency, was the most prevalent clinical sign of malnutrition found in this or any group. It is particularly important in this group, weighted heavily as it is with pregnant and lactating females in whom thyroid function would be exaggerated. Iodine excretion was uniformly low, suggesting a strong correlation between an inadequate dietary intake of iodine and a high clinical prevalence of goiter.

Calcium intakes by dietary questionnaire were less than the "acceptable" values. However, no evidence of clinical calcium deficiency was seen in the population studied.

Serum cholesterol levels in general were lower than those found in Western populations. It is of interest that the percent of Calories derived from fat by this group was also low (21.9 percent; Appendix Table 4F) and obesity relatively uncommon. Xanthelasma was not observed, and glycosuria as a screening test for diabetes mellitus indicated an extremely low prevalence of this disease as a contributor to the atherosclerotic process.

Dental findings for military dependents are outlined in Appendix Table 4G according to results of biochemical determinations of levels of serum ascorbic acid and vitamin A and urinary excretion of thiamine, riboflavin and N'-methylnicotinamide. Interpretation of these data is subject to limitations discussed in connection with the military sample in Section V. However, as tabulated, there is little to indicate that dental findings for military dependents with "deficient" or "low" biochemical determinations are essentially different from those for groups with "acceptable" or "high" values.

References

1. Interdepartmental Committee on Nutrition for National Defense. The Kingdom of Thailand, Nutrition Survey, October-December 1960. Washington, D.C., February 1962.

2. Interdepartmental Committee on Nutrition for National Defense. Republic of Vietnam, Nutrition Survey, October-December 1959. Washington, D.C., July 1960.

3. Commission on Chronic Illness. Chapt. 5, Prevalence of Dental Conditions, in Chronic Illness in the United States, Vol. IV, Harvard University Press, Cambridge, 1957.

VII

THE CIVILIAN SURVEY

1. Clinical survey

a. Historical data

A total of 2,003 civilians, living in eight widely scattered villages throughout south and central Burma, was included in the survey. These people came from various walks of life, but could be roughly categorized as Table 93 shows.

A breakdown according to age, sex and puerperal status is given in Table 94.

Data concerning history of previous disease and vitamin ingestion are presented in Table 95.

TABLE 95. MEDICAL HISTORY OF THE CIVILIAN SAMPLE, BURMA

	Males		Females			
			Nonpregnant, nonlactating		Pregnant	Lactating
Age (years)	<15	>15	<15	>15	15-44	
Number	91	210	75	120	16	36
			Percent Prevalence			
Malaria	2.2	5.7	2.7	9.2	0	13.9
Trachoma	0	3.3	0	3.3	0	2.8
Tuberculosis	0	0.5	0	0	0	0
Diarrhea	2.2	2.4	8.0	5.0	6.2	2.8
Vitamin supplementation	0	0.5	1.3	5.0	12.5	8.3

It should be noted that the reliability of the historical information obtained from this group is more questionable than that obtained for the military and their dependents. Thus, the obvious discrepancy in the prevalence of malaria in the pregnant women is probably not real.

b. Anthropometric data

The State University of Iowa growth charts for the civilian children up to age 18 are presented in Figures 9 to 12. It is obvious again, as with the military dependents, that the growth curves are quite outside those accepted as adequate for American children. However, the curves themselves follow the general pattern quite well and would seem only to indicate a "smaller stature," rather than growth retardation.

As far as the adults are concerned, the mean height for the adult Burmese civilian man is 161.5 centimeters with a weight of 49.3 kilograms. For the civilian woman it is 150.7 centimeters and 42.8 kilograms (Appendix Table 5A; Figure 3A).

Using the previously defined arbitrary criteria for obesity, 4.3 percent of the adult males and 8.9 percent of the adult females fall into such a category.

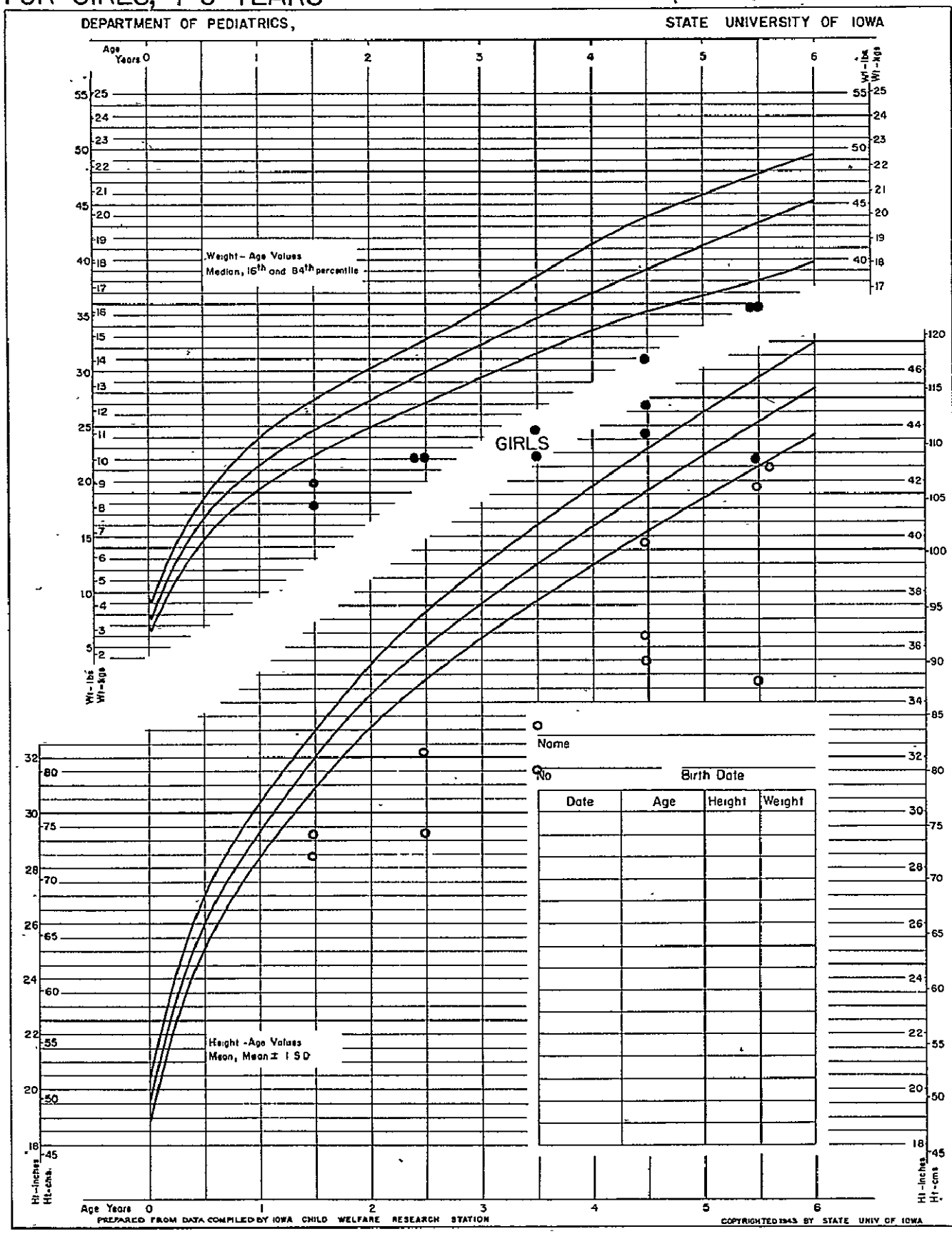
TABLE 93. ACTIVITY BY LOCATION, CIVILIAN SAMPLE, BURMA

Activity	Location: Zigon	Indagaw	Kyee Taw	Shwe Daung	Lauk Sauk	Sé Bauk	Ngayan Chaung	Wet Wun	Employees of Burma Workshop #2 in Chauk	Total
Pre-school	1	20	--	3	--	--	--	--	--	24
School	--	--	1	13	101	107	21	125	--	368
Housewife	56	69	94	82	58	45	85	73	--	562
Female, other	--	1	--	--	2	--	--	--	--	3
Laborer	33	5	17	16	42	6	4	3	20	146
Farmer	29	6	149	156	18	84	25	56	--	523
Skilled laborer	8	4	9	8	22	9	3	2	1	66
Unknown	119	46	30	50	8	8	36	14	--	311
Total	246	151	300	328	251	259	174	273	21	2,003
Males	125	48	177	208	124	194	53	154	21	1,104
Females										
Nonpregnant, nonlactating	95	57	95	86	108	54	103	95		693
Pregnant	6	15	8	3	5	1	2	10		50
Lactating	20	31	20	31	14	10	16	14		156

TABLE 94. AGE GROUPS BY SEX AND LOCATION, CIVILIAN SAMPLE, BURMA

	Location: Zigon	Indagaw	Kyee Taw	Shwe Daung	Lauk Sauk	Sé Bauk	Ngayan Chaung	Wet Wun	Chauk	Total
Males										
Age (Years)										
<15	54	33	1	26	35	85	20	92	--	346
15-24	7	2	35	55	36	22	3	3	3	166
25-44	28	8	97	82	46	31	12	22	15	341
45+	36	5	44	45	7	56	18	37	3	251
Total	125	48	177	208	124	194	53	154	21	1,104
Females										
Nonpregnant, nonlactating										
Age (Years)										
<15	65	24	7	15	54	12	27	37	--	241
15-24	1	11	19	17	16	7	13	8	--	92
25-44	9	9	27	23	16	9	36	17	--	146
45+	20	13	42	31	22	26	27	33	--	214
Total	95	57	95	86	108	54	103	95	--	693
Pregnant	6	15	8	3	5	1	2	10	--	50
Lactating	20	31	20	31	14	10	16	4	--	156

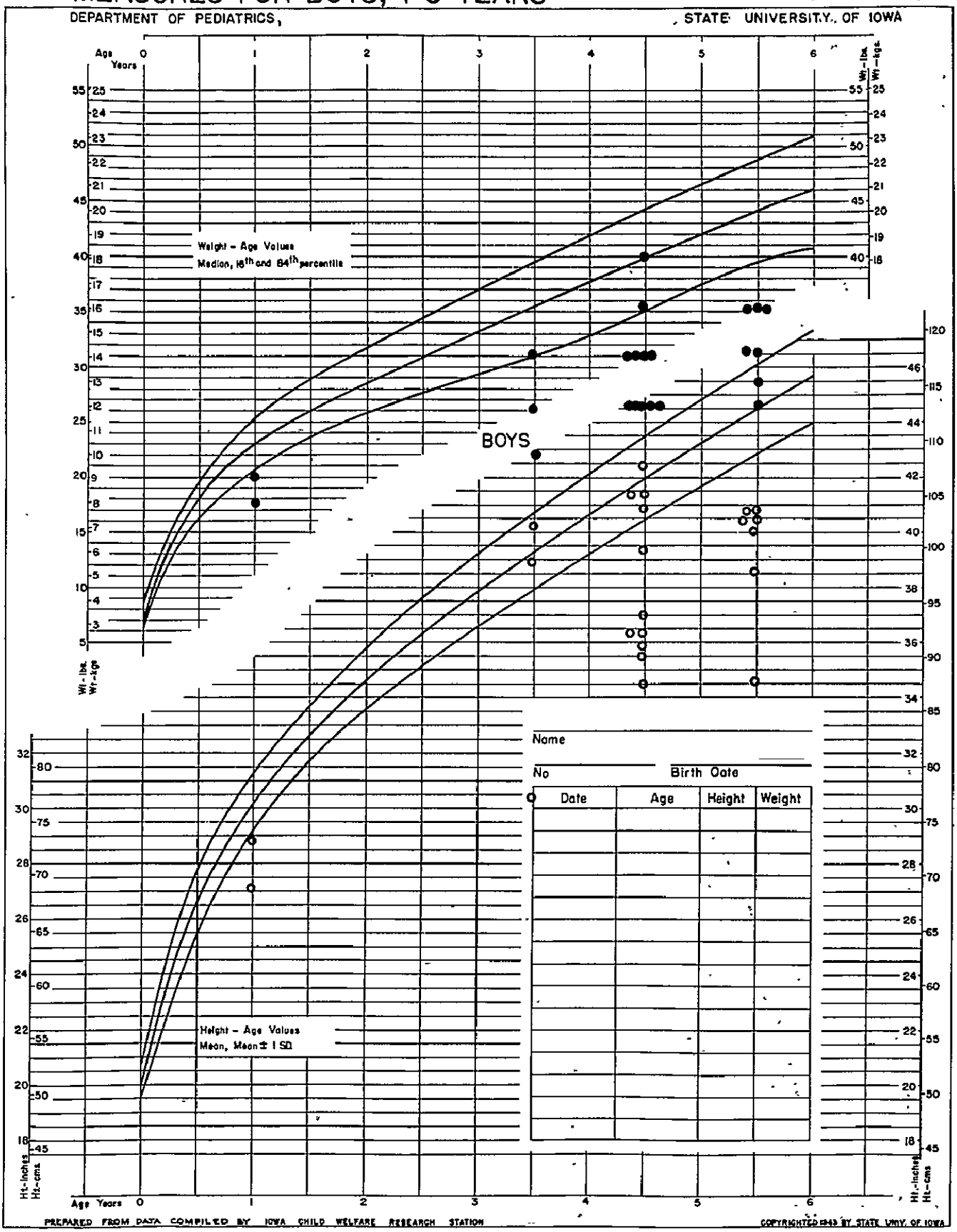
CIVILIANS, BURMA, INDIVIDUAL HEIGHT AND WEIGHT MEASURES FOR GIRLS, 1-5 YEARS



WEIGHTS • HEIGHTS ○

FIGURE 9

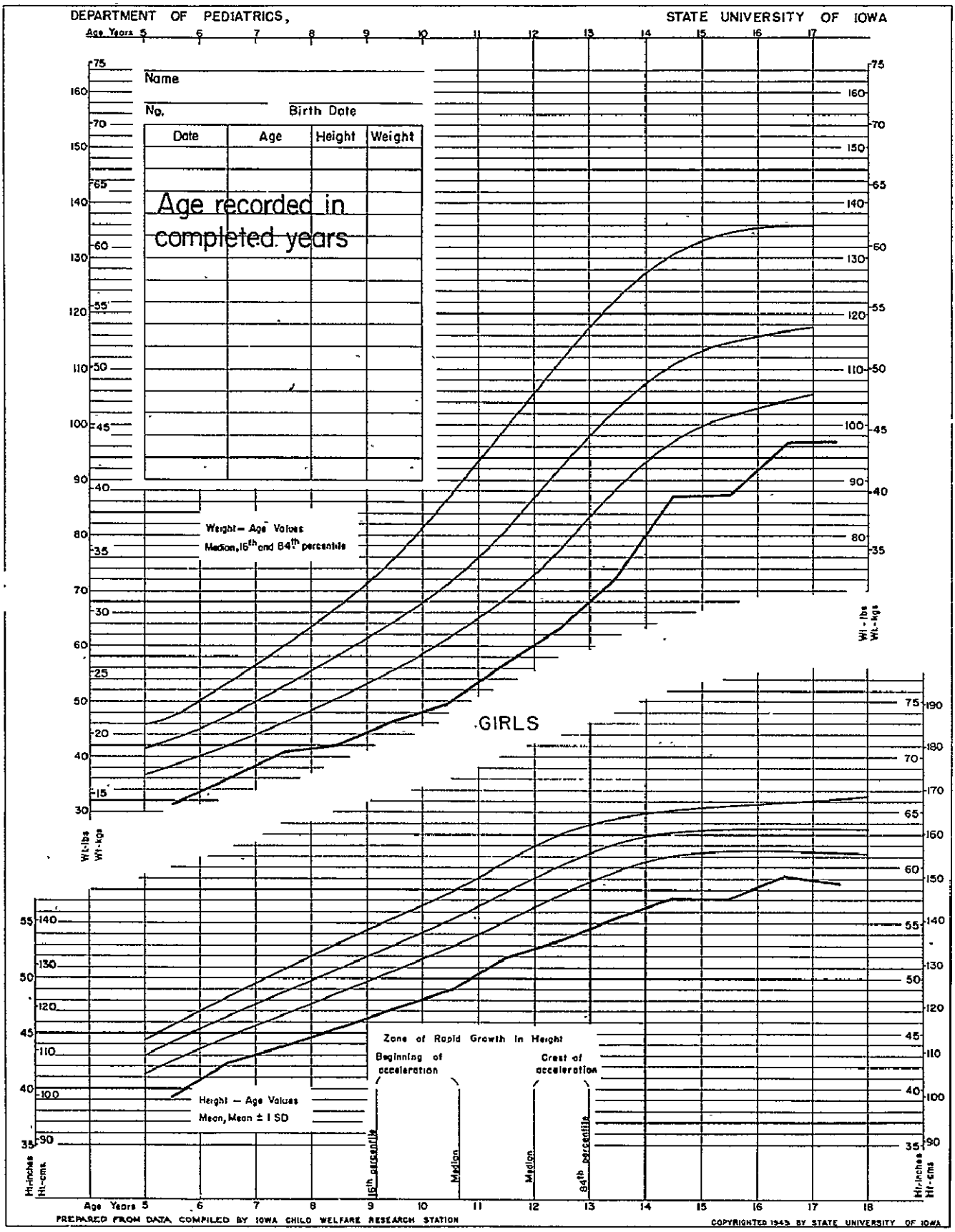
CIVILIANS, BURMA, INDIVIDUAL HEIGHT AND WEIGHT MEASURES FOR BOYS, 1-5 YEARS



WEIGHTS • HEIGHTS ○

FIGURE 10

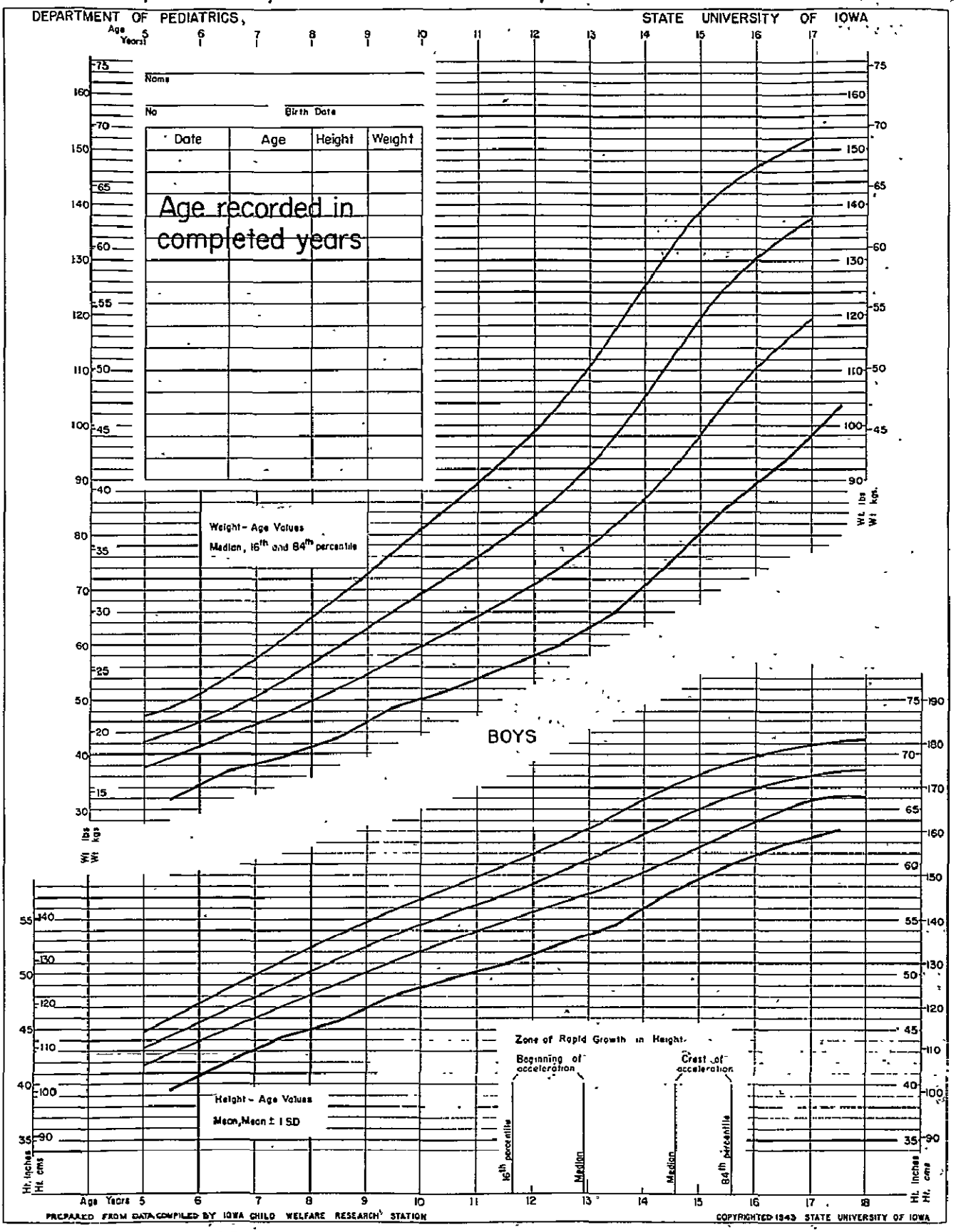
CIVILIANS, BURMA, GROWTH OF GIRLS, 5-17 YEARS



NUMBER 3 9 19 21 27 27 40 28 21 24 11 8 10

FIGURE 11

CIVILIANS, BURMA, GROWTH OF BOYS, 5-17 YEARS



NUMBER 7 18 33 28 36 62 42 35 40 20 12 16 13

Mean skinfold thickness measurements for the civilian population are given in Table 96.

TABLE 96. SKINFOLD MEASUREMENTS OF THE CIVILIAN SAMPLE, BURMA

	Males		Females			
			Nonpregnant, nonlactating		Pregnant	Lactating
Age (years)	<15	>15	<15	>15	15-44	
Arm (mm)	5.4	4.8	7.6	8.3	8.3	8.3
Scapula (mm)	4.6	7.6	5.8	9.3	10.9	10.2

The differences between men and women are what one would expect and suggest, as do the weight and height figures, that obesity is more common in the woman than the man.

c. Protein status

Protein malnutrition in any form was not recognized in the civilian population who were surveyed.

d. Vitamin status

(1) Vitamin B-complex

(a) Thiamine. The average prevalence of bilateral loss of ankle reflexes in the entire group of civilians was found to be 3.4 percent. Bilateral edema and calf tenderness were rare. One adult civilian male was encountered with a clinical picture compatible with the diagnosis of "wet" beriberi. A breakdown into the various groups is given in Table 97.

TABLE 97. CLINICAL SIGNS OF THIAMINE DEFICIENCY, CIVILIAN SAMPLE, BURMA

	Males		Females			
			Nonpregnant, nonlactating		Pregnant	Lactating
Age (years)	<15	>15	<15	>15	15-44	
			Percent Prevalence			
Bilateral loss of ankle jerk	0.6	5.2	2.5	4.0	3.4	2.5
Bilateral ankle edema	0	0.1	0	0.2	0	0
Calf tenderness	0	0.3	0	0	0	0

(b) Riboflavin. Angular lesions and scars were seen with increased frequency in the civilian group over the others examined. Table 98 depicts these results in percent prevalence:

687462 O - 63 - 9

TABLE 98. CLINICAL SIGNS OF RIBOFLAVIN DEFICIENCY, CIVILIAN SAMPLE, BURMA

	Males		Females			
			Nonpregnant, nonlactating		Pregnant	Lactating
Age (years)	<15	>15	<15	>15	15-44	
Angular lesions	28.3	8.8	16.2	5.1	4.0	19.2
Angular scars	9.8	3.6	2.9	2.4	2.0	3.8
Cheilosis	0.6	0.3	0	0	2.0	0.6

One should be cautious in interpreting angular lesions, particularly in young children. Upper respiratory infections were present in many of the children, which might have contributed in some degree to the findings. However, the striking increase of this lesion in the lactating mother cannot be explained in this manner.

(c) Niacin. Pellagra was not recognized in the civilian population by any of its various manifestations. Nonspecific glossitis occurred rarely.

(2) Vitamin A

There was not a single instance of xerophthalmia recognized in the civilian population sample. The percent prevalence of other lesions associated with vitamin A competence is given in Table 99.

TABLE 99. CLINICAL SIGNS OF POSSIBLE VITAMIN A DEFICIENCY, CIVILIAN SAMPLE, BURMA

		Males		Females			
				Nonpregnant, nonlactating		Pregnant	Lactating
Age (years)		<15	>15	<15	>15	15-44	
Bitot's spots		0.9	0.1	0	0.2	0	0
Follicular hyperkeratosis	- arms	2.3	0.5	1.2	0	0	0
	back	3.5	2.8	1.2	0.7	0	0.6
	thighs	0.3	0	0.8	0	0	0

(3) Vitamin C

There was not a single person examined in whom a clinical diagnosis of scurvy could be made. Table 100 depicts the prevalence of swollen and red interdental papillae, which are thought to be related to poor oral hygiene rather than ascorbic acid deficiency.

TABLE 100. PERCENT PREVALENCE OF SWOLLEN RED PAPILLAE, CIVILIAN SAMPLE, BURMA

		Males		Females			
				Nonpregnant, nonlactating		Pregnant	Lactating
Age (years)		<15	>15	<15	>15	15-44	
Swollen red papillae	localized	3.2	1.4	1.2	0.7	2.0	1.3
	diffuse	2.3	1.4	0.8	0.4	0	3.8

(4) Vitamin D

There was no clinical evidence of rickets recognized in the civilian population sample examined.

e. Minerals

(1) Iron

Moderate to marked pallor was not an uncommon clinical finding in the women and children of this group. Table 101 shows the prevalence of filiform papillary atrophy of the tongue.

TABLE 101. PERCENT PREVALENCE OF FILIFORM PAPILLARY ATROPHY OF THE TONGUE, CIVILIAN SAMPLE, BURMA

		Males		Females			
				Nonpregnant, nonlactating		Pregnant	Lactating
Age (years)		<15	>15	<15	>15	15-44	
Filiform papillary atrophy	slight	2.0	2.1	0.8	4.0	8.0	6.4
	moderate-severe	0.9	0.4	1.6	2.4	6.0	2.6

(2) Iodine

Goiter is a common finding among the women of Burma as Table 102 shows.

TABLE 102. PERCENT PREVALENCE OF GOITER, CIVILIAN SAMPLE, BURMA

		Males		Females			
				Nonpregnant, nonlactating		Pregnant	Lactating
Age (years)		<15	>15	<15	>15	15-44	
Goiter	Grade I	11.8	3.6	13.3	19.9	22.0	24.4
	Grade II	0	0.5	0	2.6	2.0	2.6

f. Findings of dubious or unknown nutritional significance

(1) Nasolabial seborrhea

Nasolabial seborrhea, the questionable manifestation of vitamin B_6 deficiency, was seen in frequencies outlined in Table 103.

TABLE 103. PERCENT PREVALENCE OF NASOLABIAL SEBORRHEA, CIVILIAN SAMPLE, BURMA

	Males		Females			
			Nonpregnant, nonlactating		Pregnant	Lactating
Age (years)	<15	>15	<15	>15	15-44	
Nasolabial seborrhea	0	10.3	0.4	5.8	4.0	4.5

(2) Thickened bulbar conjunctivae and pterygium

Table 104 gives the percent prevalence of these conditions in the civilian population.

TABLE 104. PERCENT PREVALENCE OF THICKENED BULBAR CONJUNCTIVAE AND PTERYGIUM, CIVILIAN SAMPLE, BURMA

	Males		Females			
			Nonpregnant, nonlactating		Pregnant	Lactating
Age (years)	<15	>15	<15	>15	15-44	
Thickened bulbar conjunctivae	2.0	72.0	0.8	56.4	42.0	46.2
Pterygium	0	6.9	0.4	7.5	2.0	2.6

(3) Blood pressure

Hypertension was found a bit more commonly in the civilian population than in the other two groups, probably reflecting the greater number of elderly people in this group. The mean blood pressure readings and the percent prevalence of those above 150 mm Hg systolic and 100 mm Hg diastolic are given in Table 105.

TABLE 105. BLOOD PRESSURES, CIVILIAN SAMPLE, BURMA

	Males		Females			
			Nonpregnant, nonlactating		Pregnant	Lactating
Age (years)	<15	>15	<15	>15	15-44	
Mean systolic, mm Hg	97	116	103	117	111	114
Mean diastolic, mm Hg	58	72	65	75	67	74
			Percent Prevalence			
>150 systolic	0	2.4	0	2.5	0	0
>100 diastolic	0	2.9	0	4.2	0	2.9

(4) Other

Xanthelasma was never observed. However, arcus senilis was seen in 8.6 percent of the men and 9.2 percent of the women over 15 years of age, most of these, of

course, in those over 45 years of age. Enlargement of the liver or spleen was uncommon as indicated in Table 106.

TABLE 106. PERCENT PREVALENCE OF HEPATIC AND SPLENIC ENLARGEMENT, CIVILIAN SAMPLE, BURMA

	Males		Females		
			Nonpregnant, nonlactating		Pregnant or Lactating
Age (years)	<15	>15	<15	>15	15-44
Hepatomegaly	1.1	0.5	1.3	2.5	1.9
Splenomegaly	0	0	0	0.8	0

2. Biochemical survey

a. Introduction

Samples of blood and urine were collected from approximately 150 civilians at 8 different villages. About two thirds of the samples were from males (about age 60) or nonpregnant, nonlactating females (about age 40). The remaining subjects were divided between children and pregnant or lactating females. A detailed breakdown of the data distributed by age, sex and location is given in the Appendix (Appendix Tables 5C and 5D). The procedure for collection of samples and a description of the methods employed can be found in Section III 2 on biochemical procedures.

b. Protein

Total serum proteins were generally elevated among the civilians as were the serum globulins. The majority of the serum albumin determinations fell in the "acceptable" range with only an occasional "deficient" value, but with a modest number with "low" values.

TABLE 107. TOTAL SERUM PROTEIN LEVELS, CIVILIANS, BURMA

Description		Children	Males and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
Age (years)		<15	≥15	15-44
No. of subjects		14	102	17
Mean		7.6	7.6	7.9
			Percent Distribution	
gm protein per 100 ml serum				
<6.00	("Deficient")	0.0	0.0	0.0
6.00-6.39	("Low")	0.0	4.9	5.9
6.40-6.99	("Acceptable")	7.1	13.7	0.0
≥7.00	("High")	92.9	81.4	94.1

TABLE 108. SERUM ALBUMIN LEVELS, CIVILIANS, BURMA

Description		Children	Males and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
Age (years)		<15	≥15	15-44
No. of subjects		15	102	17
Mean		3.5	3.9	3.7
			Percent Distribution	
gm albumin per 100 ml serum				
<2.5	("Deficient")	6.7	1.0	0.0
2.5-3.4	("Low")	26.7	16.7	29.4
3.5-4.9	("Acceptable")	66.6	79.4	70.6
≥5.0	("High")	0.0	2.9	0.0

TABLE 109. SERUM GLOBULIN LEVELS, CIVILIANS, BURMA

Description		Children	Males and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
Age (years)		<15	≥15	15-44
No. of subjects		15	102	17
Mean		4.0	3.7	4.3
			Percent Distribution	
gm globulin per 100 ml serum				
1.0-1.9	("Deficient")	0.0	1.0	0.0
2.0-2.9	("Low")	6.7	12.7	5.9
3.0-3.5	("Acceptable")	26.6	21.6	11.8
≥3.6	("High")	66.7	64.7	82.4

c. Vitamin status

(1) Vitamin B-complex

(a) Thiamine. A "deficient" level of excretion of thiamine was detected in about one third of the civilians over the age of 15. Although only one child of the 34 examined had a "deficient" level of thiamine excretion, 16 of the group fell in the "low" range. Approximately 30 percent of the civilians had inadequate thiamine intakes on the basis of the red cell transketolase evaluation.

TABLE 110. THIAMINE EXCRETION, CIVILIANS, BURMA

Description		Children	Males and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
Age (years)		<15	≥15	15-44
No. of subjects		34	97	11
Median excretion		77	45	41
			Percent Distribution	
mcg thiamine per gm creatinine				
<27	("Deficient")	2.9	34.0	36.4
27-65	("Low")	44.1	35.1	36.4
66-129	("Acceptable")	23.5	14.4	18.2
≥130	("High")	29.5	16.5	9.1

TABLE 111. PERCENT STIMULATION OF RED CELL TRANSKETOLASE ACTIVITY AFTER ADDITION OF THIAMINE *IN VITRO*, CIVILIANS, BURMA

Description		Combined Civilians
No. of subjects		86
		Percent Distribution
Percent stimulation of enzyme activity		
>20	("Deficient")	30.2
16-20	("Low")	10.5
≤15	("Satisfactory")	59.3

(b) Riboflavin. The riboflavin excretion levels of from 50-70 percent of the civilians examined fell in a range indicative of either a "deficient" or "low" intake of this nutrient, a value comparable to that found in the military and military dependents. Pregnant or lactating women had a particularly high percentage (54.5 percent) of "deficient" values. The small number of subjects in this group, however, may have distorted the results.

TABLE 112. RIBOFLAVIN EXCRETION, CIVILIANS, BURMA

Description		Children	Males and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
Age (years)		<15	≥15	15-44
No. of subjects		35	97	11
Median excretion		66	72	26
			Percent Distribution	
mcg riboflavin per gm creatinine				
<27	("Deficient")	8.6	10.3	54.5
27-79	("Low")	51.4	48.4	27.3
80-269	("Acceptable")	28.6	33.0	18.2
≥270	("High")	11.4	8.3	0.0

(c) N^1-methylnicotinamide. The intake of niacin or niacin equivalents appears to be generally good when judged on the basis of excretion of either "acceptable" or "high" levels of N^1-methylnicotinamide by better than 75 percent of the individuals examined. The importance of the somewhat larger percentage of "deficient" values among the pregnant or lactating group is suspect due to the small number of persons in this group.

TABLE 113. N^1-METHYLNICOTINAMIDE EXCRETION, CIVILIANS, BURMA

Description		Children	Males and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
Age (years)		<15	≥15	15-44
No. of subjects		29	53	12
Median excretion		4.1	4.2	1.7
			Percent Distribution	
mg N^1-methylnicotinamide per gm creatinine				
<0.5	("Deficient")	0.0	1.9	16.7
0.5 -1.59	("Low")	13.8	15.1	33.3
1.60-4.29	("Acceptable")	37.9	35.8	33.3
≥4.30	("High")	48.3	47.2	16.7

(2) Vitamin A

There was no evidence of a problem of vitamin A insufficiency among the civilians based on the blood levels of vitamin A and carotene.

TABLE 114. SERUM VITAMIN A LEVELS, CIVILIANS, BURMA

Description		Children	Males and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
Age (years)		<15	≥15	15-44
No. of subjects		9	102	16
Mean		27.1	33.2	35.9
			Percent Distribution	
mcg vitamin A per 100 ml serum				
<10	("Deficient")	0.0	0.0	0.0
10-19	("Low")	22.2	11.8	0.0
20-49	("Acceptable")	77.8	78.4	81.2
≥50	("High")	0.0	9.8	18.8

TABLE 115. SERUM CAROTENE LEVELS, CIVILIANS, BURMA

Description		Children	Males and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
Age (years)		<15	≥15	15-44
No. of subjects		9	103	17
Mean		105	105	89
			Percent Distribution	
mcg carotene per 100 ml serum				
<20	("Deficient")	0.0	0.0	0.0
20-39	("Low")	0.0	1.9	5.9
40-99	("Acceptable")	44.4	49.5	70.6
≥100	("High")	55.6	48.6	23.5

(3) Vitamin C

Serum vitamin C values were indicative of an adequate state of nutrition with respect to this nutrient. Better than 75 percent of the samples analyzed fell in the "high" range with the remainder in the "acceptable" bracket. The average serum vitamin C values for the civilian groups were observed to be somewhat higher than those of the military and military dependent groups.

TABLE 116. SERUM VITAMIN C LEVELS, CIVILIANS, BURMA

Description		Children	Males and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
Age (years)		<15	≥15	15-44
No. of subjects		8	102	17
Mean		0.62	0.56	0.74
			Percent Distribution	
mg vitamin C per 100 ml serum				
<0.10	("Deficient")	0.0	0.0	0.0
0.10-0.19	("Low")	0.0	0.0	0.0
0.20-0.39	("Acceptable")	12.5	24.5	5.9
≥0.40	("High")	87.5	75.5	94.1

d. Mineral status

(1) Anemia

The combined results of the hemoglobin, plasma corpuscular volume and mean corpuscular hemoglobin concentration determinations indicate the presence of a moderate incidence of hypochromic anemia among the civilian sample.

TABLE 117. HEMOGLOBIN LEVELS, CIVILIANS, BURMA

Description		Children	Males and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
Age (years)		<15	≥15	15-44
No. of subjects		43	104	17
Mean		11.6	13.0	10.9
			Percent Distribution	
gm hemoglobin per 100 ml blood				
<10.0	(Severe anemia)	16.3	4.8	41.2
10.0-11.9	("Deficient")	44.2	16.4	29.4
12.0-13.9	("Low")	34.9	49.0	23.5
14.0-14.9	("Acceptable")	4.6	22.1	5.9
≥15.0	("High")	0.0	7.7	0.0

TABLE 118. PLASMA CORPUSCULAR VOLUME (HEMATOCRIT), CIVILIANS, BURMA

Description		Children	Males and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
Age (years)		<15	≥15	15-44
No. of subjects		46	103	17
Mean		39.6	44.1	38.9
			Percent Distribution	
Percent				
<36	("Deficient")	13.0	4.8	23.5
36-41	("Low")	56.5	31.1	47.0
42-44	("Acceptable")	26.1	16.5	17.6
≥45	("High")	4.4	47.6	11.8

TABLE 119. MEAN CORPUSCULAR HEMOGLOBIN CONCENTRATION, CIVILIANS, BURMA

Description	Children	Males and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
Age (years)	<15	≥15	15-44
No. of subjects	43	103	17
Mean	29.3	29.9	28.0
		Percent Distribution	
Percent			
<28.0	32.6	25.2	47.0
28.0-29.9	18.6	27.2	11.8
30.0-31.9	27.9	25.2	35.3
≥32.0	20.9	22.4	5.9

(2) Iodine

A need for an increased intake of iodine is indicated by the low urinary excretion of this element, particularly by the pregnant or lactating group.

TABLE 120. URINARY IODINE EXCRETIONS, CIVILIANS, BURMA

Description	Children	Males and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
Age (years)	<15	≥15	15-44
No. of subjects	26	61	7
Mean	60	73	24
		Percent Distribution	
mcg iodine per gm creatinine			
<50	76.9	65.6	85.7
50-99	7.7	8.2	14.3
≥100	15.4	26.2	--

e. Cholesterol

Serum cholesterol values among the civilians were quite similar to those encountered in the military and military dependents and ranged on the low side of the average results reported from Western nations.

TABLE 121. SERUM CHOLESTEROL LEVELS, CIVILIANS, BURMA

Description		Children	Males and Nonpregnant, Nonlactating Females	Pregnant or Lactating Females
Age (years)		<15	≥15	15-44
No. of subjects		13	103	17
Mean		144	167	157
			Percent Distribution	
mg cholesterol per 100 ml serum				
50-99	(Very low)	7.7	0.0	0.0
100-149	(Low)	61.5	30.1	35.3
150-199	(Average)	23.1	53.4	64.7
≥200	(High)	7.7	14.5	0.0

3. Dietary survey

a. Population studied

Dietary surveys of civilian families were carried out in 8 locations (Table 10) by at least one of the methods described in Section III on Procedures. Because of problems of available transportation and personnel, it was not possible to carry out food weighing in all locations or to obtain representative and useful food composite samples. Questionnaires were utilized at all civilian locations and, if possible, other methods were also incorporated.

b. Food preparation

Food preparation within the civilian population does not differ significantly from that in the military dependent population. Rice is the principal food prepared each day. It may be prepared for the entire day in the morning or, when needed, may be cooked once in the morning and again in the early afternoon. Rice is washed from three to six times before cooking and then cooked initially in an excess amount of water. This water is drained off shortly before the rice is completely cooked and the rice is allowed to come to its final cooking stage without the presence of excess water.

Other items in the meal — curries and soups — are generally prepared once a day.

Families with adequate incomes generally cook with gas pressure stoves. However, the majority of those in the small villages uses wood or charcoal fires. In the larger cities one would expect to find less of this type of cooking because of the cost and difficulty of obtaining wood.

c. Food storage and supply

Most housewives store food in small containers — bags, pans, etc. Villages in the rice growing areas are usually composed of farmers who utilize part of their own harvest for their food supply. This rice is stored in its unpolished form and, as needed, is taken to a local mill and polished. Those individuals not growing their own rice purchase it at Government-established prices in the local market. In terms of Calories and protein, rice seems to be a reasonably priced product.

Refrigerated storage for fresh vegetables and meat is not available. Therefore, perishable products are used as soon as possible after purchase. Meat, particularly, is a problem. In those farms where it is used, it must be purchased each day. Fruits and vegetables, though perishable, have a longer shelf life and can be utilized from 3 to 7 days after purchase without any marked loss of nutritional value.

While much of the population is engaged in agriculture, local markets still appear to supply a significant portion of the fruits and vegetables that the family uses. This is due in part to the fact that farming has become somewhat specialized in some areas and time for gardening and growing other crops is limited. However, in most areas, vegetables that can be readily grown for home consumption are available. Among those frequently observed were gourds, roselle and corn (maize). In addition, the Burmese diet utilizes a large number of leaves from trees and plants in soups and curries. They are also eaten directly with some of the food components such as ngapi (fish paste). Burmese personnel working with the dietary team estimated that 600-700 different species of leaves are eaten by the Burmese people. Little information is available on the nutrient content of these products.

d. Sanitation

Sanitation within the villages is at a very low level. One of the principal problems in many areas is a continuous safe water supply. A program initiated by the Government to develop wells throughout many villages should be continued in order to insure a safe and continuous water supply for the entire population. While it is not reasonable to assume that a water system — bringing water directly to the homes — can be built in the immediate future, an increased number of deep wells could be prepared in villages in order to overcome problems such as sewage in wells during the dry season. It is further suggested that, in cities close to Army camps, cooperative efforts should be developed to provide such continuous water supplies and, when necessary, water purification systems.

Sewage disposal systems are nonexistent and, though the Government program of establishing suitable standards for outdoor latrines has been helpful, a more extensive program must be developed in order to provide adequate disposal of waste. Again, it would appear useful if military and civilian authorities located in a specific area could cooperate in the development of suitable programs. Education would be a phase within this program, but the actual building and demonstrating of suitable facilities on a wide scale would be most important. A program already initiated by the rural health centers is an excellent start. By expansion it could lead to a marked improvement of sanitary conditions.

e. Food consumption

(1) Calories

Caloric intakes appear to be adequate in most areas. In one location, Sé Bauk, the caloric content of the diet was 15 percent less than the average for the civilians, and if the caloric intake was constant at this lower level some problems might develop. In other locations caloric intake was between 2,000 and 2,300 by chemical analysis of food composites (Table 122). This was lower than the values obtained by either the recipe (food weighing) (Table 123) method, or by the questionnaire method (Table 124). However, a reasonably good agreement is found between the methods; and comparisons using the larger amount of data obtained with use of the questionnaire method would in most instances be valid (Table 125).

(2) Protein

With all three methods the protein intake was within the "acceptable" range of the ICNND standards (see Appendix Table 30). The comparison of sources of protein indicate that on an average 19 percent of the protein comes from animal sources in the civilian diet whereas in the diet of the military dependents 38 percent of the protein is from animal sources.

(3) Vitamins

(a) Vitamin B-complex

(i) Thiamine. Intakes of thiamine were less than the "acceptable" ICNND standards by all three methods used for determining intakes (Table 125). When intakes are reported as milligrams per 1,000 Calories values are still very low, averaging 0.24 milligrams per 1,000 Calories by chemical analysis.

Low intakes are related to the method of cooking rice, use of highly polished rice and limited use of pork and pulses. Major recommendations to improve the thiamine content of the diet are included in this report.

TABLE 122. NUTRIENT INTAKES, CIVILIANS, BURMA, PER STANDARD MAN PER DAY, FOOD COMPOSITE ANALYSIS

	No. Days	No. Families	No. People	Std. Man	Calories	Protein gm	Fat gm
Zigon	2	1	6	5.35	2,000	67.5	40.5
Kyee Taw	1	1	3	2.35	2,190	62.5	45.2
Sé Bauk	1	1	6	5.1	1,775	54	22.9
Wet Wun	2	2	18	14.4	2,095	43.8	34.6
Ngayan Chaung	2	2	16	11.75	2,300	46.7	44.5

1/ Whole fish included in sample.
2/ High value possibly related to whole fish in sample.
3/ Value significantly greater than others. Not included in average (see Table 125).

TABLE 123 NUTRIENT INTAKES, CIVILIANS, BURMA, PER STANDARD MAN PER DAY, RECIPE METHOD (FOOD WEIGHING IN HOME)

	No. Days	No. Families	No. People	Std. Man	Calories	Protein gm	Fat gm
Zigon	2	13	77	59.6	2,294	54.3	50.6
Kyee Taw	2	14	54	43.2	2,401	56.1	35.3
Shwe Daung	1	19	111	87.9	2,426	52.5	27.6
Sé Bauk	1	14	73	55.05	2,078	45.4	26.2
Lauk Sauk	2	21	125	94.8	2,373	55	42
Wet Wun	2	17	83	59.8	2,540	54	36
Ngayan Chaung	2	19	120	87.3	3,399	62	67

TABLE 122 (Continued)

Calcium mg	Iron mg	Vitamin A I.U.	Thiamine mg	Riboflavin mg	Niacin mg	Vitamin C mg
1,780[1]	(42.4)[2]	1,780	0.72	1.1	10.1	43
523	18.3	7,300	0.56	0.84	7.6	13.7
445	17.2	1,300	0.36	0.51	6.0	14.6
204	27.7	4,287	0.38	0.60	7.5	25
444	16.8	10,700[3]	0.66	0.87	8.2	61

TABLE 123 (Continued)

Calcium mg	Iron mg	Vitamin A I.U.	Thiamine mg	Riboflavin mg	Niacin mg	Vitamin C mg
191	8.6	1,276	0.65	0.36	10.4	50
216	10.0	1,530	1.6	0.39	11.9	57
224	9.4	918	0.72	0.39	11.0	87
159	7.6	482	0.60	0.30	10.4	32
285	9.0	1,430	0.80	0.47	11	76.5
270	9.4	1,037	0.78	0.43	11	46.5
392	14.0	1,378	1.20	0.66	13.3	61

TABLE 124. NUTRIENT INTAKES, CIVILIANS, BURMA, PER STANDARD MAN PER DAY QUESTIONNAIRE METHOD[1/]

Location	Calories	Protein gm	Fat gm	Calcium gm	Iron mg	Vitamin A I.U.	Thiamine mg	Riboflavin mg	Niacin mg	Vitamin C mg
Zigon	2,906	75.4	66.5	367	15.1	2,732	0.82	0.85	12.1	37
Indagaw	2,832	69.6	47.2	270	16.2	1,911	0.77	0.41	13.1	38
Kyee Taw	2,589	64.0	51.2	223	12.4	2,348	0.72	0.39	12.4	42
Shwe Daung	2,700	58.9	39.7	197	9.4	3,376	0.77	0.39	12.0	58
Lauk Sauk	2,345	47.5	47.3	169	8.6	2,280	0.69	0.33	9.5	44
Sé Bauk	2,249	40.7	45.4	181	9.3	3,228	0.55	0.31	9.2	60
Ngayan Chaung	3,407	67.8	68.0	239	13.2	3,516	1.10	0.60	14.1	58
Wet Wun	2,655	56.9	57.9	248	10.9	3,101	0.72	0.49	12.0	53
Myaing-Gyi	2,930	65.7	57.1	299	11.8	3,952	0.89	0.51	13.0	68

1/ Cooking losses not considered.

TABLE 125. NUTRIENT INTAKES, CIVILIANS, BURMA, BY THREE METHODS

Nutrient	Method: Questionnaire[1/]	Food Weighing (Recipe)[2/]	Food Composite Analysis[3/]
Calories	2,713	2,501	2,077
Protein, gm	58.8	54.1	54.9
Fat, gm	51.7	40.6	37.5
Calcium, mg	228	248	404[4/]
Iron, mg	11.4	9.7	20.0[4/]
Vitamin A, I.U.	2,964	1,150	3,666[4/]
Thiamine, mg	0.77	0.90	0.53
Riboflavin, mg	0.43	0.43	0.78
Niacin, mg	11.9	11.3	8.0
Vitamin C, mg	52	51	31.4

1/ Average for 11 locations.
2/ Average for 7 locations.
3/ Average for 5 locations, except where noted.
4/ For 4 locations only; average for 5 locations as follows: Calcium, 849 mg; Iron, 24.4 mg; Vitamin A, 5,073 I.U. One value in each class significantly higher than average.

(ii) Riboflavin. Riboflavin intakes by analysis are lower than the "acceptable" values of ICNND (Table 122). However, values calculated using food tables and either the questionnaire or food weighing (recipe) method (Tables 123 and 124) are even lower. The low intakes are related to the small intakes of milk, meats and pulses in the diet of the civilian population (See Appendix Table 5E). The status of the civilian population is not any better than that of the dependents with regard to riboflavin nutriture.

(iii) Niacin. While niacin intakes appear low by chemical methods, calculated intakes are in the "acceptable" range (Table 125). With the adequate protein intake levels and mixed sources of protein in the diet one would not expect any clinical or biochemical indications of niacin deficiency.

(b) Vitamin A. While vitamin A intakes appear to be rather low as calculated by the questionnaire and food weighing methods, chemical analysis indicates "acceptable" levels of intake (Table 125). This marked difference is probably due to errors or blanks in the food composition tables used. The supply of fruits and vegetables, particularly dried peppers, should insure adequate sources of vitamin A-rich foods.

(c) Vitamin C. The intake of vitamin C is lowest as determined by the chemical analysis method. While the average value is on the bottom of the "acceptable" range, only two of five locations had intakes rated as "acceptable" by ICNND standards (Table 122). It must be remembered that food composites will represent food eaten on only one or two days, and usually will not include snack foods eaten at other than meal times. Fruits are readily available and the acceptable biochemical picture suggests that vitamin C intakes are generally "acceptable."

(4) Minerals

(a) Calcium. All intakes of calcium were less than ICNND "acceptable" values by calculated methods, but two of five civilian locations had "acceptable" values by chemical analysis (Table 122). The higher values for these locations are due to the use of whole dried fish during the period the sample was collected. The fish and bones were eaten by the population.

The clinical report gives no indication of calcium deficiency, but such signs were not specifically sought by the clinical team.

(b) Iron. The clinical and biochemical evaluations indicate a high prevalence of anemia, yet iron intakes by the analytic method were high (Table 122), and cannot be related to the clinical and biochemical results. Calculated values (Tables 123 and 124) are much lower than the analysis indicates. It is thought that the high iron measured by the chemical method is due to contamination from the iron cooking pots and soil present in some foods.

Careful studies are necessary to determine if all of the iron in the diet is biologically available to the individual.

(c) Iodine. Iodine intakes for the civilian population were determined by chemical analysis of five food samples. The intakes ranged from 0.08 to 0.17 milligrams per standard man per day. While these values are not significantly different from those found in the military, the high prevalence of goiter suggests that in the civilian population these intakes may be inadequate.

687462 O - 63 - 10

4. Dental survey

A total of 929 civilians was given a dental examination during the Burma survey. Of these 466 were males and 463 were females. Distribution of civilians included in the dental sample is presented in Table 12.

As with the military and military dependent samples, dental caries experience was lower and levels of periodontal diseases were higher in Burma civilians than in civilians of Baltimore, U.S.A. Findings for Burma civilians approximated those reported for whole country populations examined in Thailand (1) and Vietnam (2) (Appendix Table 3U).

Dental findings for civilian males and females are summarized in Tables 126 and 127.

TABLE 126. DENTAL CARIES, PERIODONTAL DISEASE AND GINGIVAL RECESSION, CIVILIANS, BURMA

Age (years)	Dental Caries 1/ Mean No. DMF Teeth	Periodontal Disease Mean Score	Gingival Recession Mean Score
		Males	
0-4	--	0	--
5-9	.2	.60	0
10-14	.5	.58	0
15-19	.6	1.21	0
20-29	.6	1.52	2.9
30-39	1.1	2.53	12.8
40-49	2.2	3.81	33.7
50+	10.9	5.30	60.1
		Females	
0-4	--	.30	--
5-9	.1	.51	0
10-14	.7	.61	0
15-19	.7	.55	0
20-29	1.3	.97	.8
30-39	2.1	2.22	6.5
40-49	3.8	3.78	29.5
50+	8.3	5.04	49.1

1/ Exclusive of teeth crowned for cosmetic purposes.

TABLE 127. SEVERITY OF PERIODONTAL DISEASE, CIVILIAN MALES AND FEMALES, BURMA

Age (years)	Percent with at Least Gross Gingival Disease	Percent with Advanced Periodontal Disease
	Males	
<15	85	1
15-19	90	5
20-29	86	25
30-39	93	65
40-49	97	94
50+	100	98
	Females	
<15	67	3
15-19	67	7
20-29	80	26
30-39	95	69
40-49	100	95
50+	100	97

There was little difference in dental caries experience between males and females. Both averaged less than one DMF tooth per person at ages under 30 years. Except at older ages when loss of teeth from periodontal diseases exerts a heavy influence, occurrence of dental caries was similar for military and civilian males (Appendix Table 5F) and for military dependent and civilian females (Appendix Table 5G).

Periodontal index and gingival recession scores indicate that inflammatory and degenerative changes in periodontal tissues were unusually severe in civilians. There was a tendency for scores to be higher in males. However, the percentages of males and females with advanced destructive periodontal diseases were not importantly different.

Differences in dental findings were slight between civilians classified as urban when compared to those classified as rural.

Scores for the oral hygiene index are presented in Table 128. These were the highest recorded during the Burma survey and indicate that oral hygiene in both civilian males and females was extremely poor.

TABLE 128. MEAN ORAL HYGIENE INDEX SCORES, CIVILIANS[1/], BURMA

Age (years)	Calculus	Debris	OHI
		Males	
0-4	--	--	--
5-9	.31	1.67	1.98
10-14	.64	1.44	2.08
15-19	1.03	1.10	2.13
20-29	1.27	1.18	2.46
30-39	1.50	1.34	2.85
40-49	1.98	1.59	3.58
50+	2.34	2.18	4.52
		Females	
0-4	--	--	--
5-9	.18	1.51	1.70
10-14	.47	1.17	1.64
15-19	.62	.93	1.55
20-29	1.09	1.20	2.29
30-39	1.61	1.45	3.06
40-49	1.98	1.71	3.69
50+	2.44	2.15	4.59

1/ For persons receiving detailed clinical examinations.

5. Summary

The caloric intake of the civilian population by dietary questionnaire was adequate. No clinical signs of caloric deficiency were observed. Using the ICNND weight standards, 4.3 percent of the males and 8.9 percent of the females were obese. These values are on a small sample and may not be significant.

No clinical evidence of protein malnutrition was found in the civilian population. Dietary intakes were very slightly less than the ICNND "acceptable" levels. Twenty-seven percent of the daily intake of 58.8 grams of protein is from animal sources.

Although the clinical studies suggest that the civilian population has slightly greater problems with regard to thiamine status than the dependents, no significant differences in thiamine excretion levels were found. This may have been due in part to the small number of analyses completed in each area. Thiamine intakes by dietary questionnaire were below the "acceptable" value of 1-1.2 milligrams per day, and were almost identical to the intakes found for the dependent group.

Clinical signs of riboflavin deficiency exemplified by angular lesions and scars were seen with increased frequency in the civilian group over other groups studied. Dietary intakes by the questionnaire method were lowest in this population group. The majority of the subjects studied had excretions below the "acceptable" limit.

Niacin intakes were "acceptable" as indicated by the dietary, clinical and biochemical methods used.

No evidence of vitamin A deficiency was recognized in the civilian population. Intake of vitamin A by dietary questionnaire was less than the "acceptable" value of the ICNND. However, biochemical data indicated adequate amounts of vitamin A must be consumed by the population.

No clinical evidence of vitamin C deficiency was found in any person examined clinically or biochemically. Intake of vitamin C by dietary questionnaire was in the "acceptable" range.

There was no clinical evidence of vitamin D deficiency recognized in the civilian population.

Anemia was frequent in the civilian population. Moderate to marked pallor was common in women and children. Moderate filiform papillary atrophy was recognized in 2.4 percent of the nonpregnant, nonlactating female population. The prevalence of this sign was 6.0 and 2.6 percent, respectively, in the pregnant and lactating female groups. Thirty-two percent of the total civilian group had hemoglobin values less than 12.0 grams per 100 milliliters of blood. The dietary intake of iron was in the "acceptable" range by ICNND standards, but was obviously not sufficient for the needs of the civilian population.

Goiter is the most common clinical sign observed in the civilian population. In six of the eight locations the urinary excretions of iodine were less than 50 micrograms per gram of creatinine. This level has been associated with areas of high prevalence of goiter in other surveys.

While calcium intakes by the dietary questionnaire method were below the "acceptable" limit, no clinical evidence of calcium deficiency was noted.

Serum cholesterol values averaged 165 milligrams per 100 milliliters of serum, lower than those generally found in Western civilizations. Fat provides about 17 percent of the Calories in the civilian diet.

Dental findings for Burma civilians are outlined in Appendix Table 5H according to estimates of nutritive status based on biochemical determinations for serum ascorbic acid and vitamin A levels and urinary excretion of thiamine, riboflavin and N'-methylnicotinamide. As presented, the influences of age and oral hygiene on dental findings have not been adequately taken into account. A more detailed analysis is in progress. However, as tabulated these data do not indicate any substantial effect of varying levels of nutrition on the dental findings. The general patterns of dental caries and periodontal diseases were similar for groups with "deficient" and "low" or "acceptable" and "high" levels of biochemical determinations.

References

1. Interdepartmental Committee on Nutrition for National Defense. The Kingdom of Thailand, Nutrition Survey, October-December 1960. Washington, D.C., February 1962.

2. Interdepartmental Committee on Nutrition for National Defense. Republic of Vietnam, Nutrition Survey, October-December 1959. Washington, D.C., July 1960.

VIII

CORRELATION OF RESULTS

From what has gone before it is quite clear that the major nutritional problems in Burma are those relating to iron, iodine, thiamine and riboflavin. In the case of the latter two vitamins, overt evidences of clinical deficiencies were uncommon but the weight of evidence would support the proposition that subclinical deficiencies are present and capable of becoming clinically manifest if given the right precipitating circumstances. Other subclinical deficiency states probably exist in the case of calcium and vitamin B_6, but signs and symptoms of such are less exacting and poorly understood.

Anemia is a common problem in Burma, as in other technically underdeveloped, tropical countries. Although our studies were aimed at elucidating the etiology of the anemias, they fall short of the goal. It is clear that the majority of them are at least in part due to iron deficiency secondary to blood loss, multiple pregnancies and parturition compounded by normal or even slightly low iron intakes in the civilian and dependent populations. How much each of these factors plays a role in the inception of the anemia is not disclosed. The uncertainty of the problem is exaggerated by such unknown quantities as possible hemoglobinopathies, the role of dietary folic acid and vitamin B_{12}, infections, etc. It is obvious that this area is badly in need of further definitive study.

As would be expected, anemia is not so apparent in the military personnel as it is in the children and wives of the military and civilians. Although there is some regional variation as exemplified in Figure 14[1/] it is generally a country-wide problem. Therefore any approach to its correction should be directed toward the over-all population.

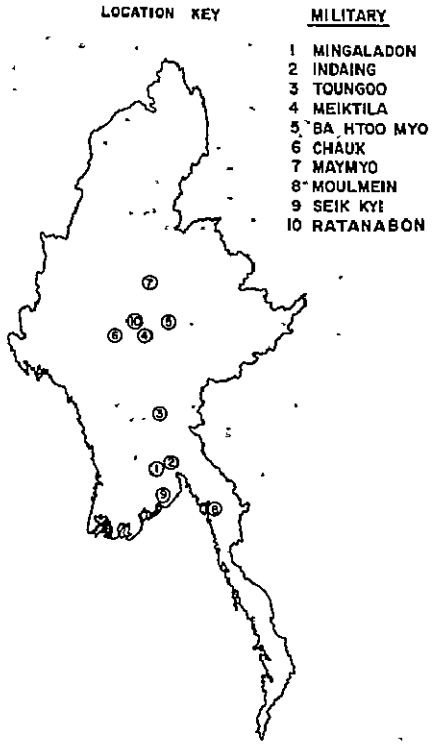
It is not surprising that goiter and iodine deficiency were found in a large section of the population in view of other survey findings in similar environmental circumstances. As one would expect, a potent regional factor is obvious in its occurrence. Figure 15 clearly shows that as one moves away from the delta and central low-lying areas of Burma into the hilly and mountainous regions the prevalence of goiter increases. The latter is associated with a decreased urinary excretion of iodine and a somewhat decreased intake of the mineral. Again, the abnormality is more apparent in the civilian female population and decreases successively in the dependent women, the civilian children, the dependent children and the military. Although, as one would expect, goiter is much less common in men than women on the same dietary intake of iodine, it is found in as high as 4.6 percent of the military. The latter prevalence rate was in a unit of Chin Rifles in Moulmein, again reflecting the geographic predilection mentioned before. Undoubtedly this lesion had its origin prior to induction into the military, which points up the importance of approaching this problem on a country-wide basis.

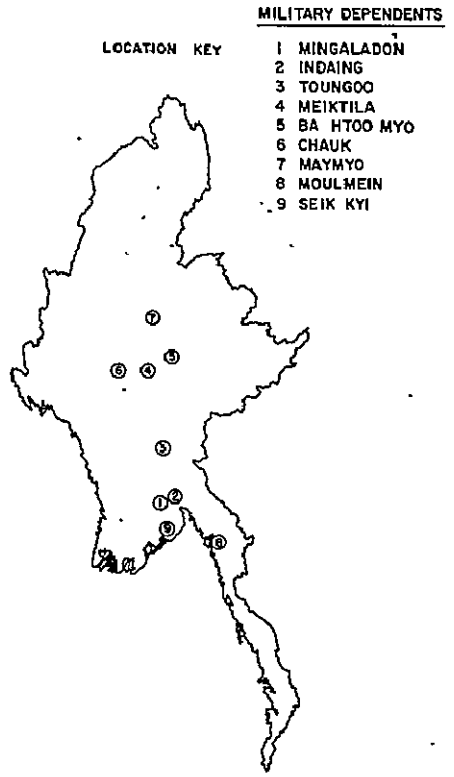
Although cretinism was not recognized in any subject during the survey, it was seen in hospitals which were visited during side trips. One would certainly predict, with the high prevalence of goiter and low urinary iodine excretion values, that cretinism would be a potential if not a real problem. Such a hazard is reason enough for taking steps to correct it.

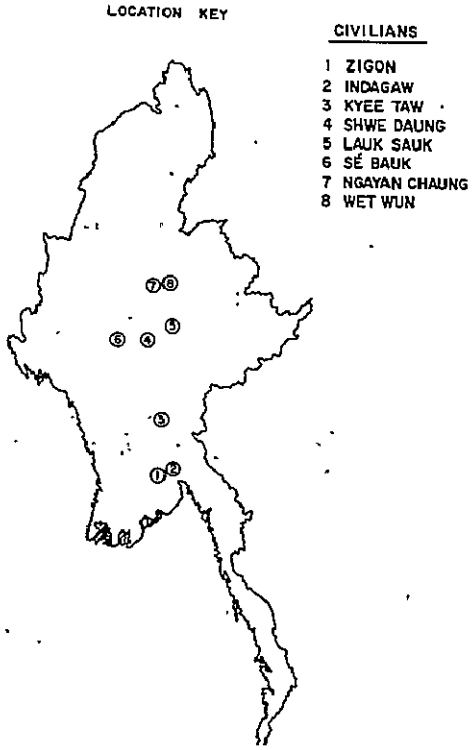
Adult myxedema was not observed in any subject examined. Again, however, such possibilities exist and should be prevented by proper supplementation of the diet with potassium iodide.

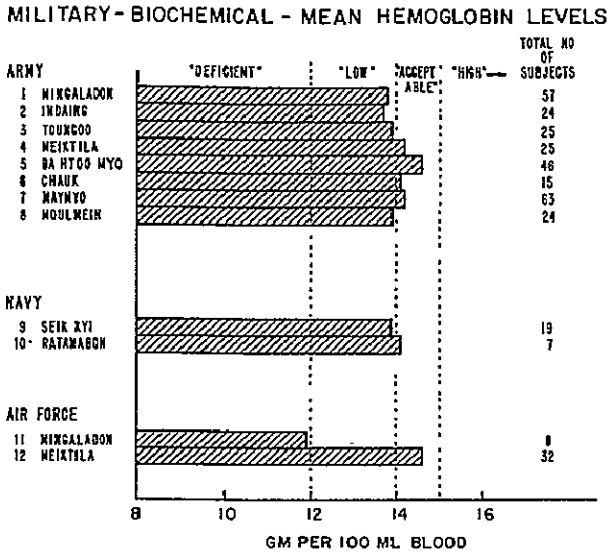
1/ Supporting data for this and the following figures may be found in Appendix Table 6A.

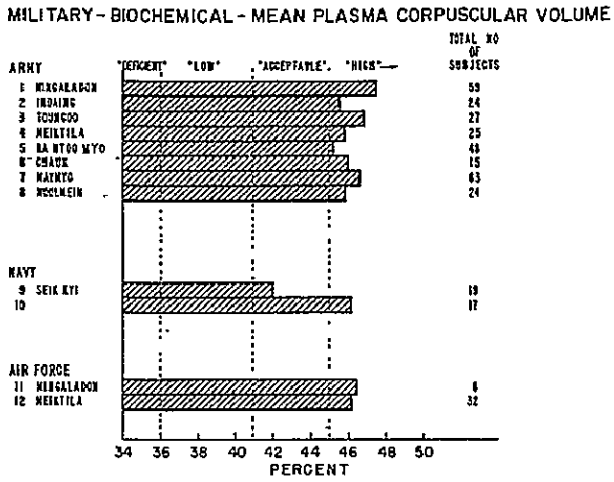
FIGURE 13 KEY TO LOCATIONS, BURMA








MILITARY - BIOCHEMICAL - MEAN HEMOGLOBIN LEVELS
ARMY
"DEFICIENT"
"LOW"
"ACCEPT-ABLE"
"HIGH"
TOTAL NO OF SUBJECTS
1 MINGALADON 57
2 INDAING 24
3 TOUNGOO 25
4 MEIKTILA 25
5 BA HTOO MYO 46
6 CHAUK 15
7 MAYMYO 63
8 MOULMEIN 24
NAVY
9 SEIK KYI 19
10 RATANABON 7
AIR FORCE
11 MINGALADON 8
12 MEIKTILA 32
8
10
12
14
16
GM PER 100 ML BLOOD


MILITARY - BIOCHEMICAL - MEAN PLASMA CORPUSCULAR VOLUME
ARMY
"DEFICIENT"
"LOW"
"ACCEPTABLE"
"HIGH"
TOTAL NO OF SUBJECTS
1 MINGALADON 57
2 INDAING 24
3 TOUNGOO 27
4 MEIKTILA 25
5 BA HTOO MYO 46
6 CHAUK 15
7 MAYMYO 63
8 MOULMEIN 24
NAVY
9 SEIK KYI 19
10 17
AIR FORCE
11 MINGALADON 8
12 MEIKTILA 32
34
36
38
40
42
44
46
48
50
PERCENT

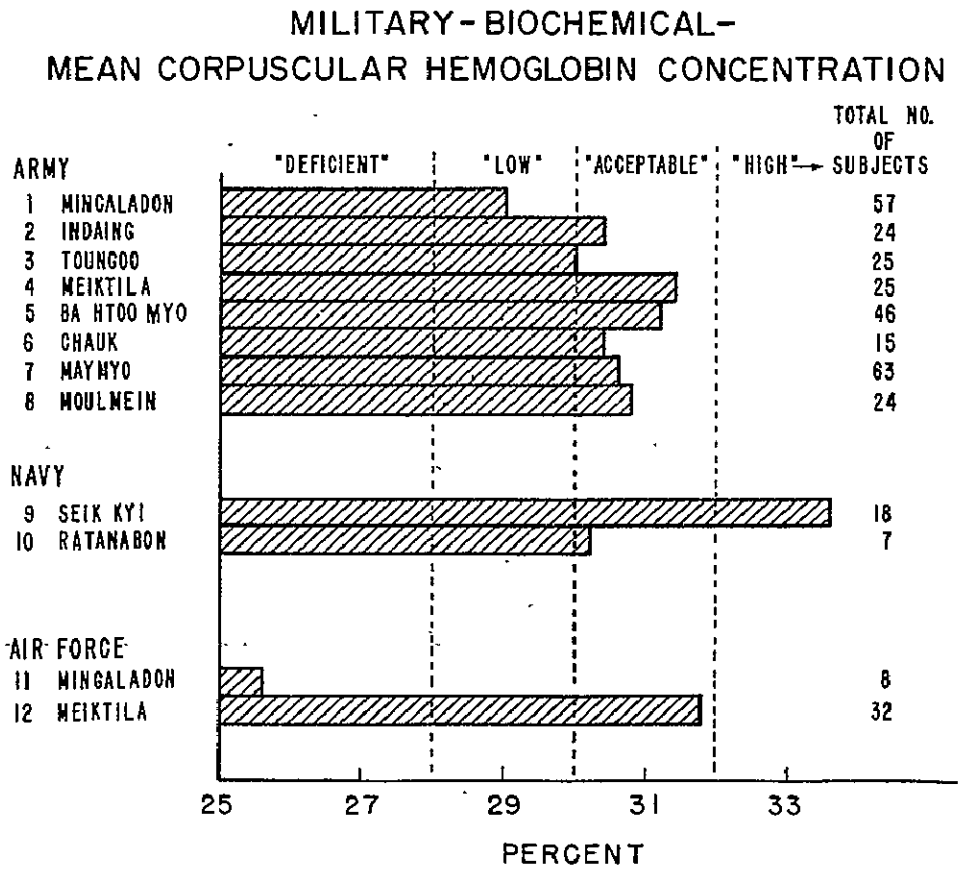
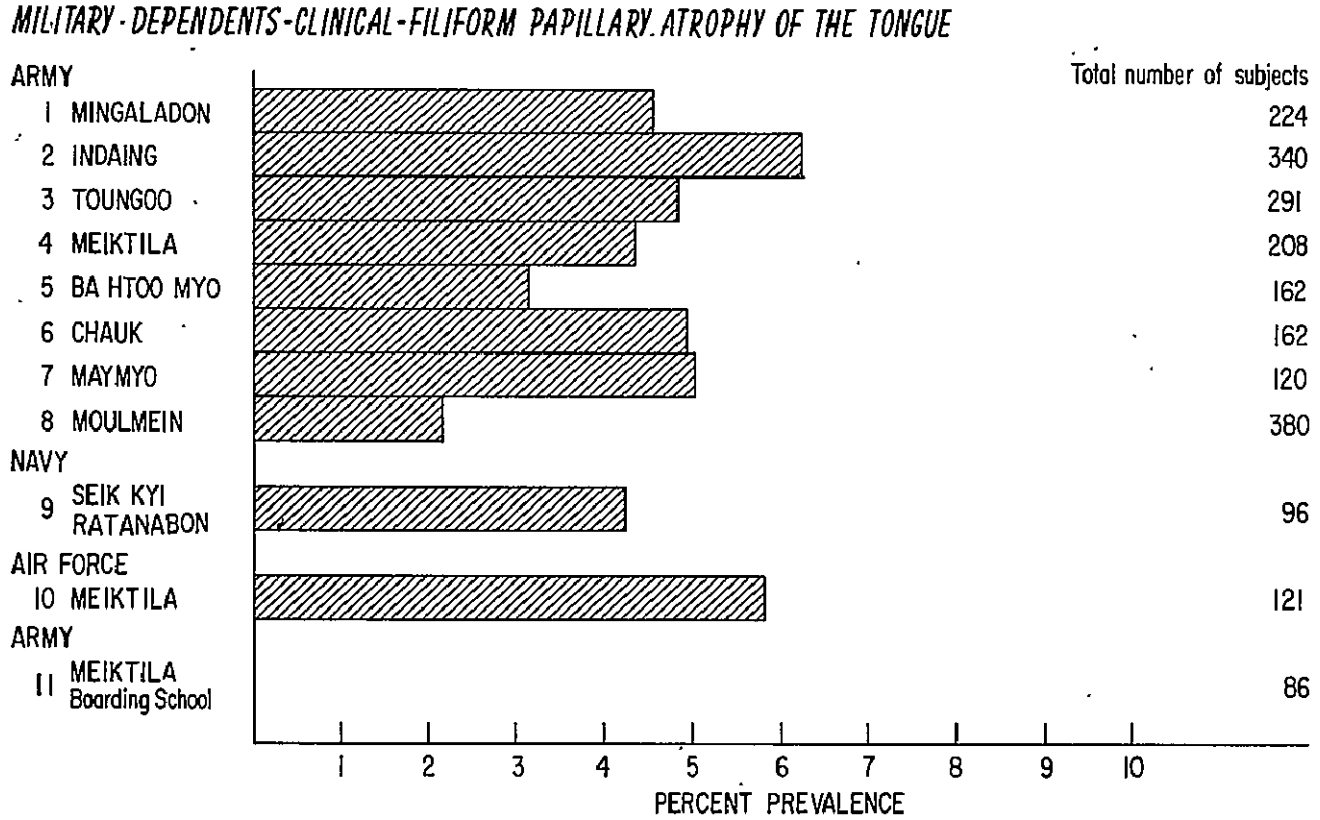
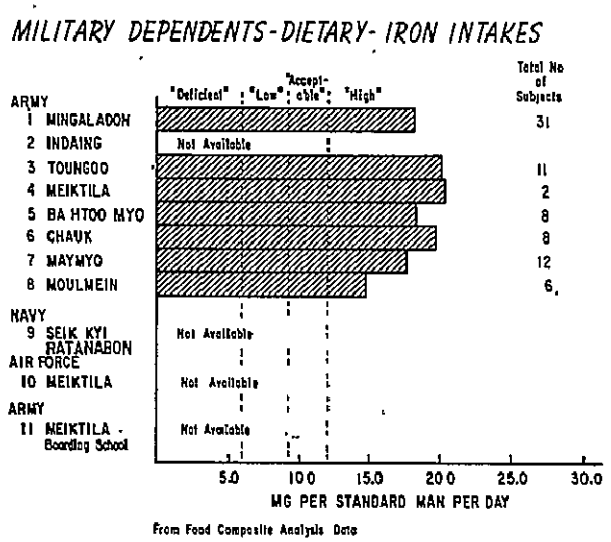

MILITARY - BIOCHEMICAL-
MEAN CORPUSCULAR HEMOGLOBIN CONCENTRATION
ARMY
"DEFICIENT"
"LOW"
"ACCEPTABLE"
"HIGH"
TOTAL NO. OF SUBJECTS
1 MINGALADON 57
2 INDAING 24
3 TOUNGOO 25
4 MEIKTILA 25
5 BA HTOO MYO 46
6 CHAUK 15
7 MAYMYO 63
8 MOULMEIN 24
NAVY
9 SEIK KYI 18
10 RATANABON 7
AIR FORCE
11 MINGALADON 8
12 MEIKTILA 32
25
27
29
31
33
PERCENT

FIGURE 14





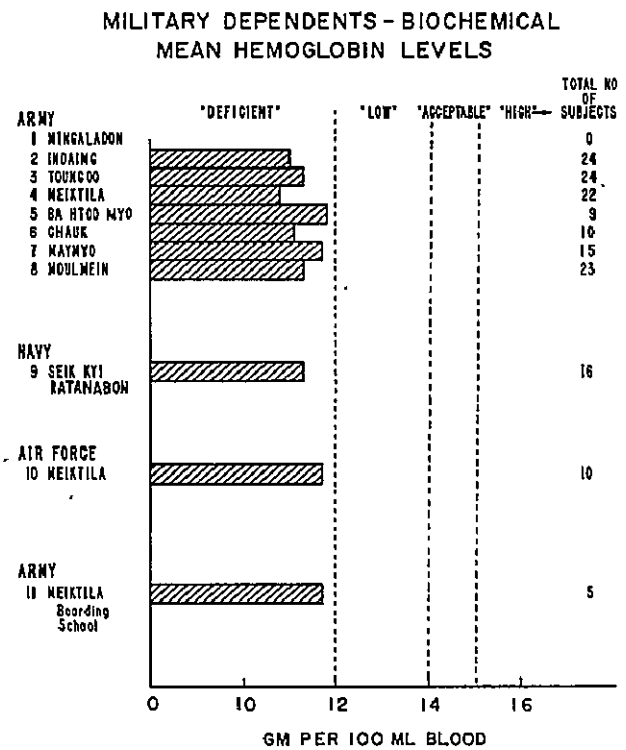
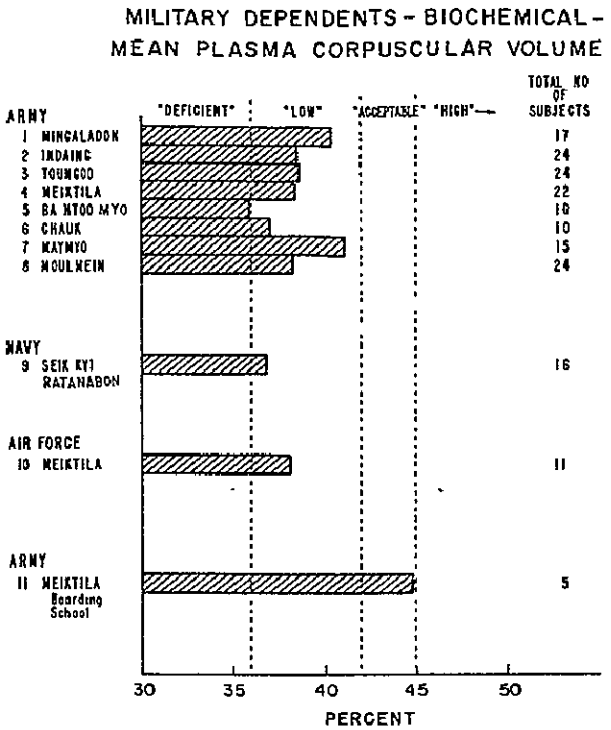
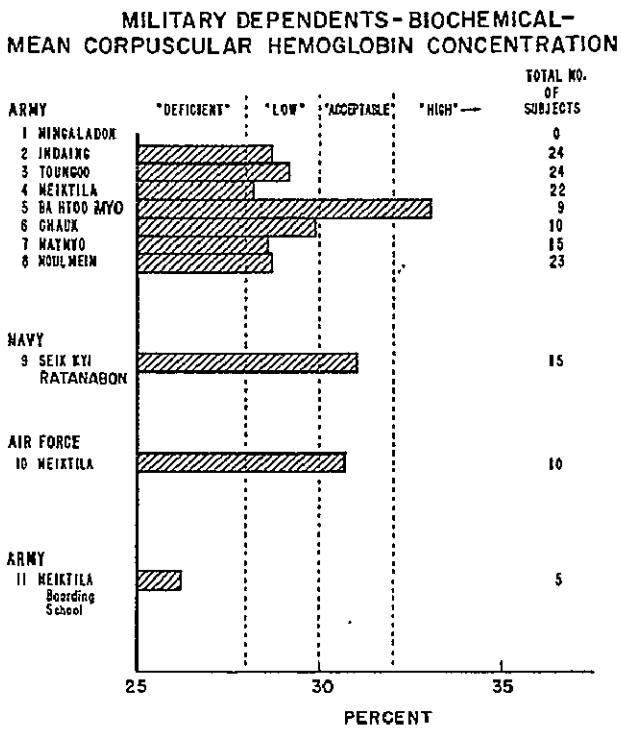
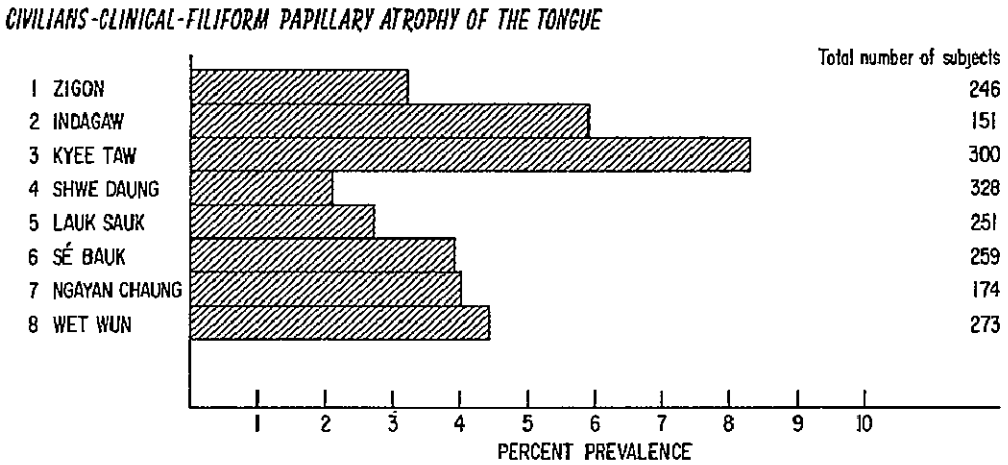
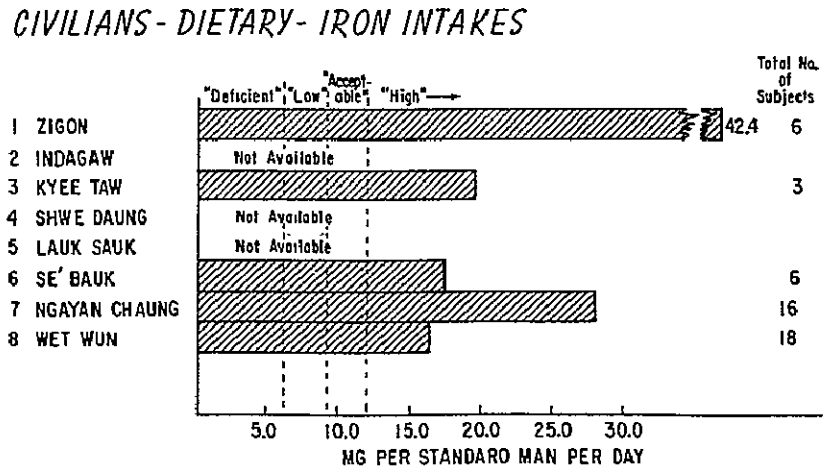


FIGURE 14 (continued)





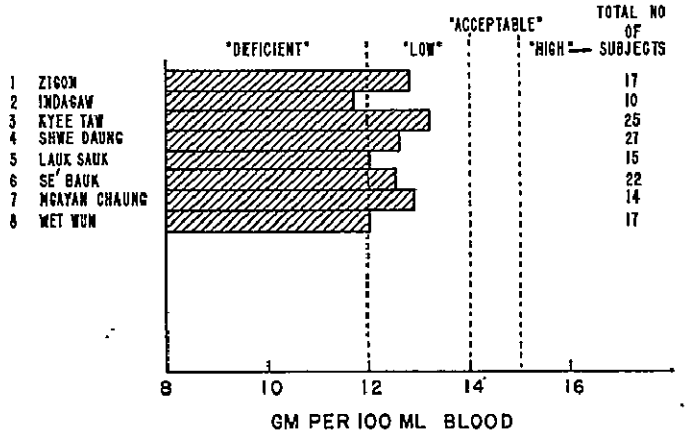




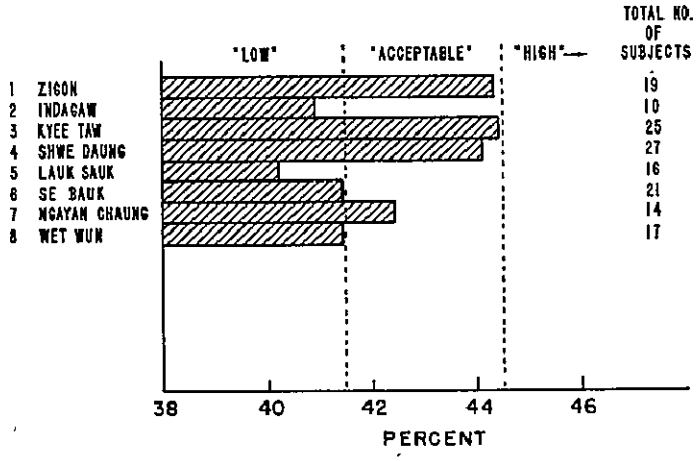
From Food Composite Analysis Data

FIGURE 14 (continued)

CIVILIANS - BIOCHEMICAL -- MEAN HEMOGLOBIN LEVELS



CIVILIANS - BIOCHEMICAL - MEAN PLASMA CORPUSCULAR VOLUME



CIVILIANS - BIOCHEMICAL -- MEAN CORPUSCULAR HEMOGLOBIN CONCENTRATION

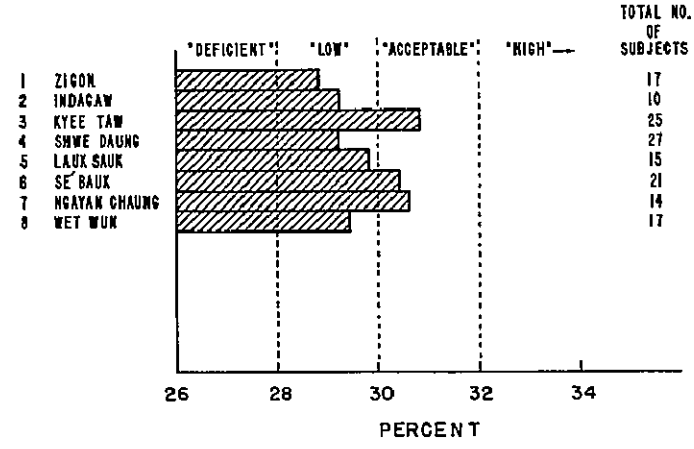
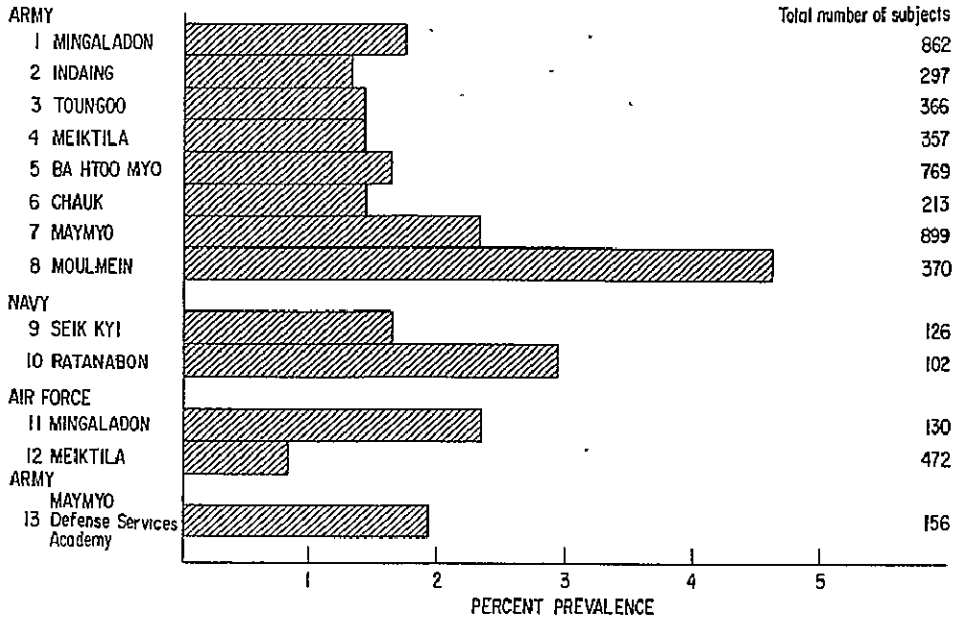


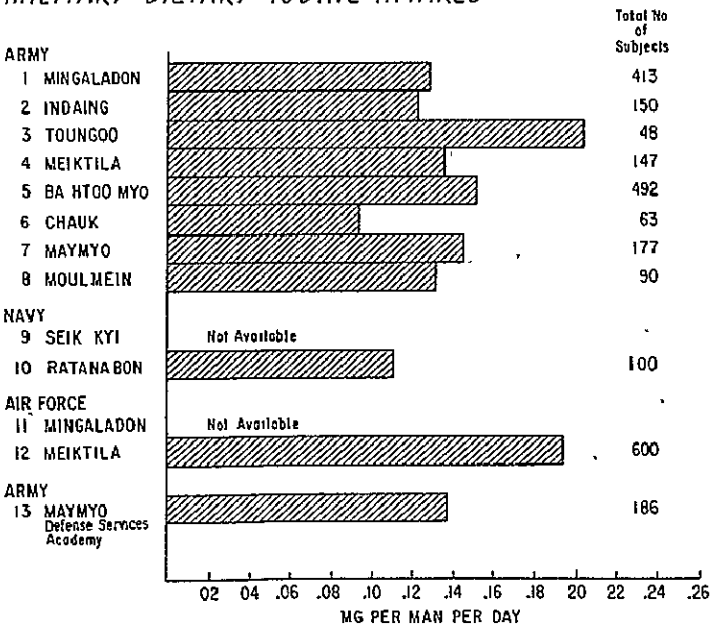
FIGURE 14 (continued)

THE GOITER PROBLEM, BURMA

MILITARY-CLINICAL-GOITER, GRADE I AND GRADE II



MILITARY-DIETARY-IODINE INTAKES



From Food Composite Analysis Data

MILITARY-BIOCHEMICAL-IODINE EXCRETIONS

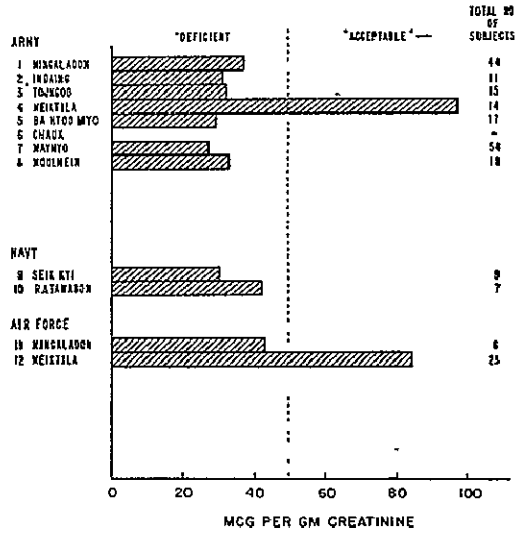
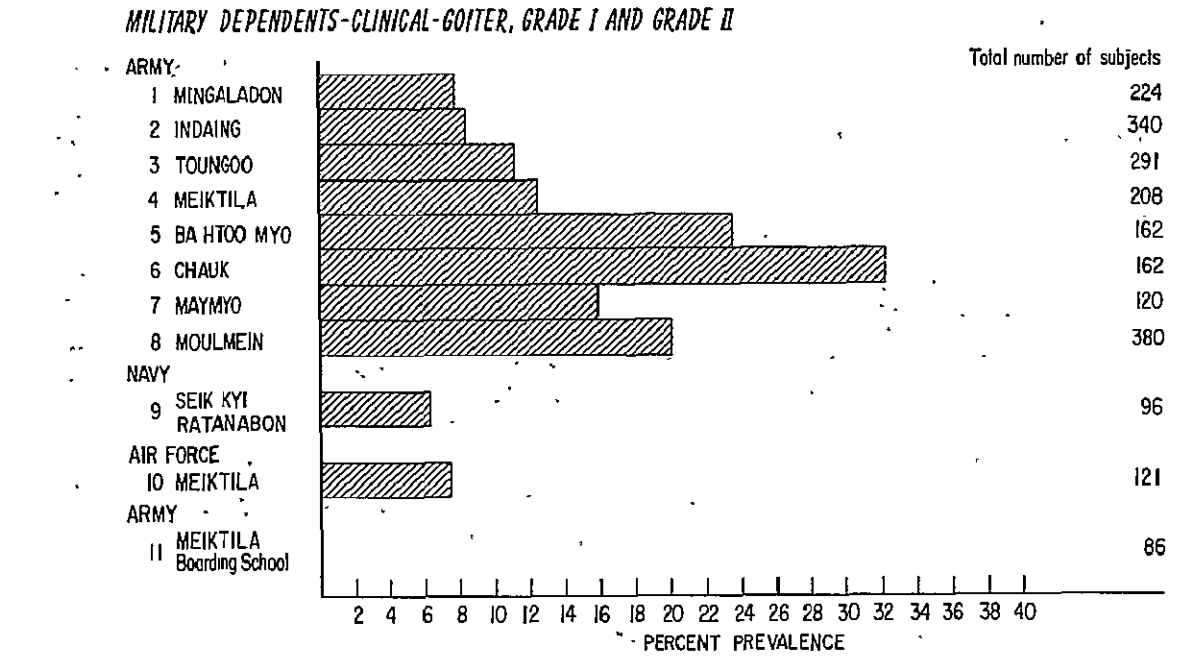
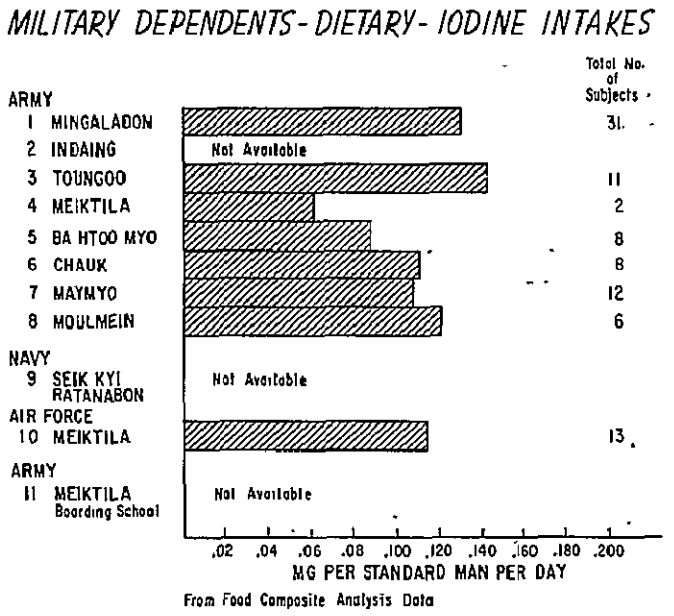


FIGURE 15





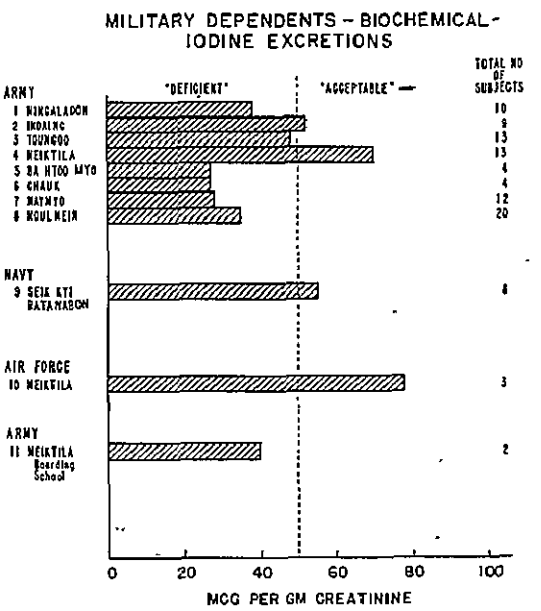
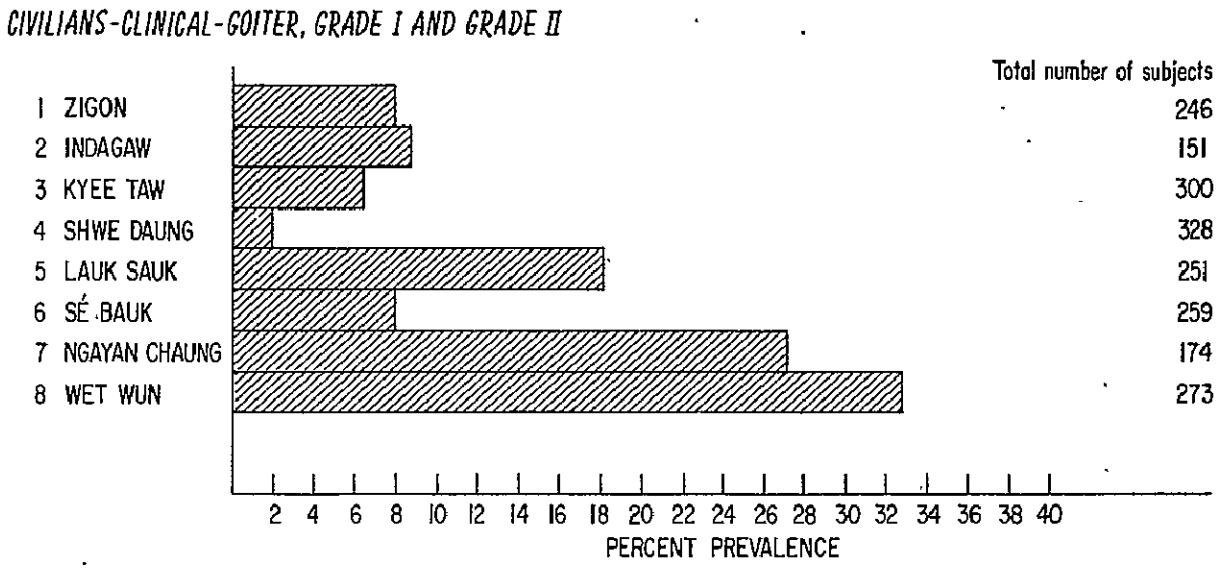
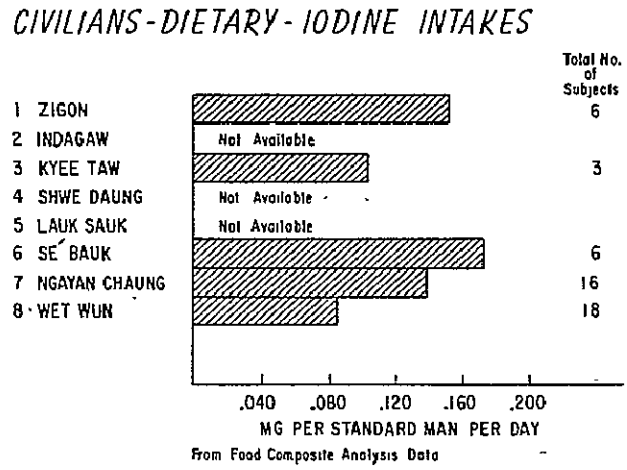


FIGURE 15 (continued)





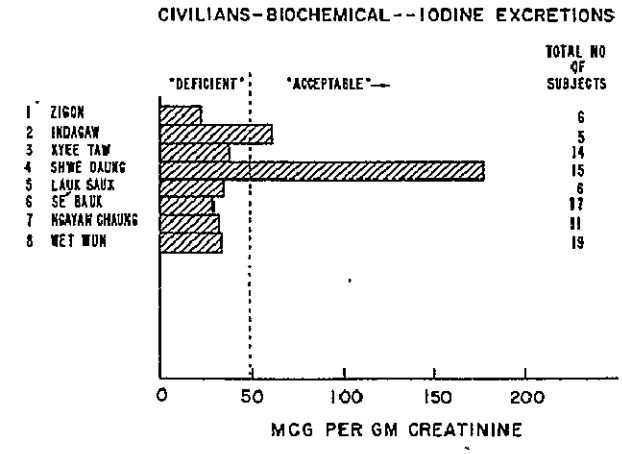


FIGURE 15 (continued)

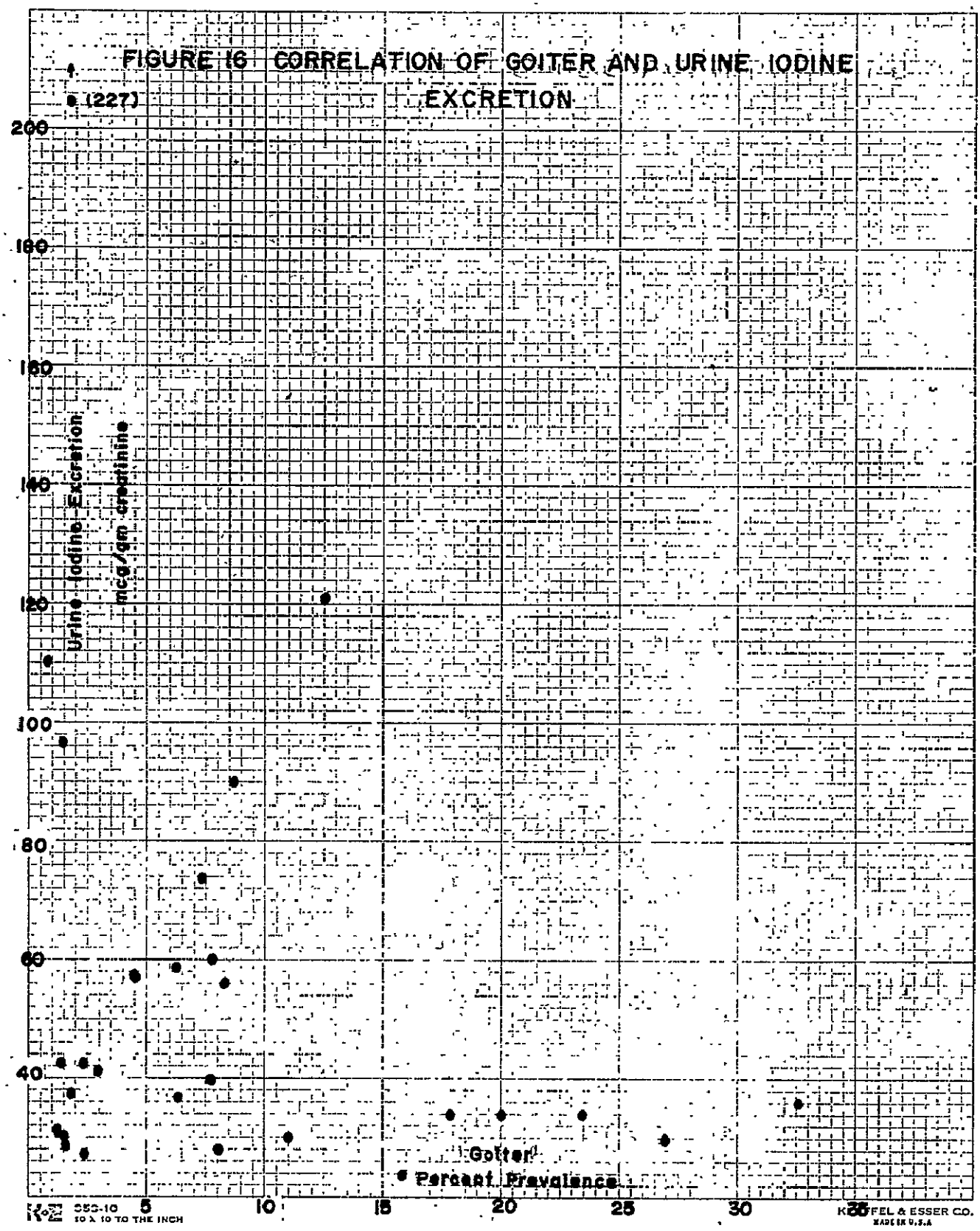
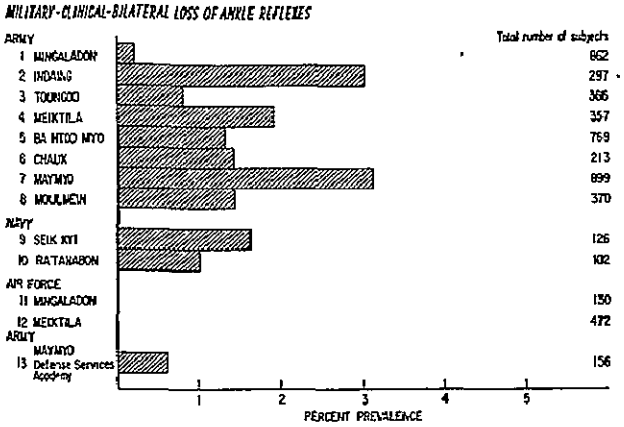
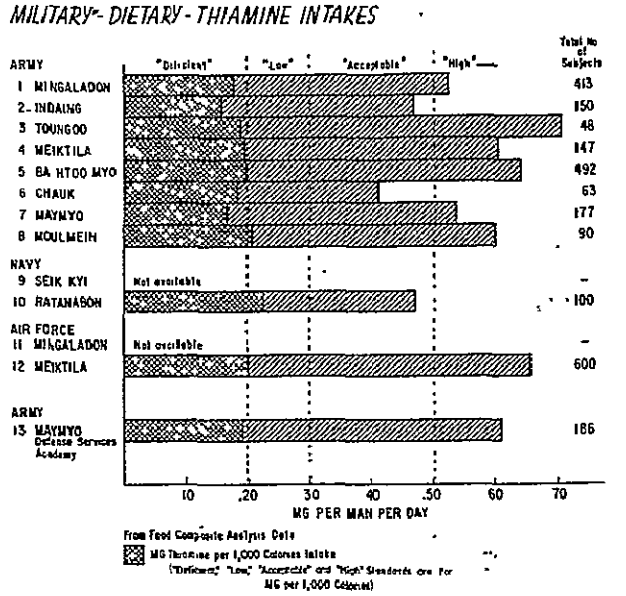


FIGURE 16 CORRELATION OF GOITER AND URINE IODINE EXCRETION

THIAMINE NUTRITURE, BURMA





MILITARY - BIOCHEMICAL - MEDIAN THIAMINE EXCRETIONS

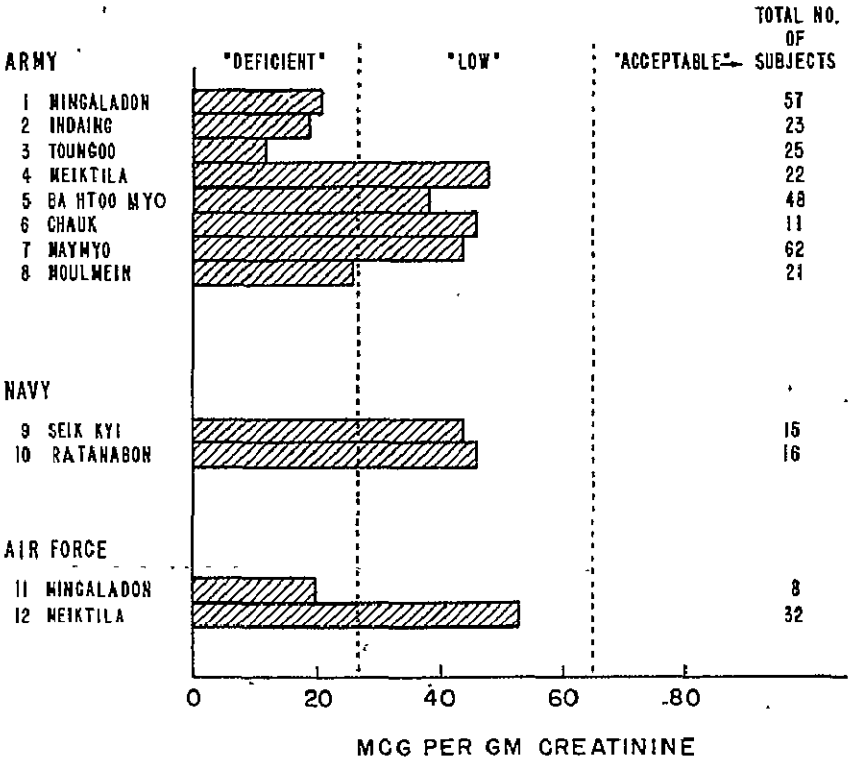
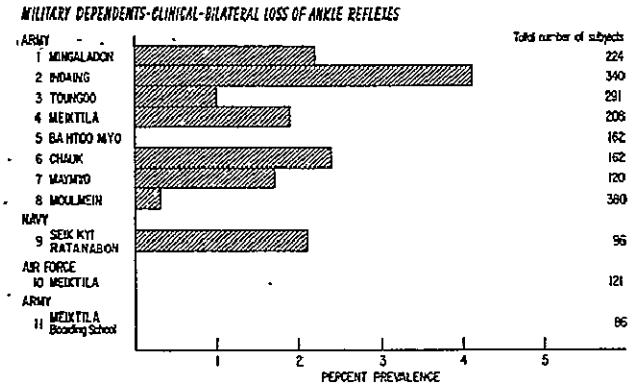
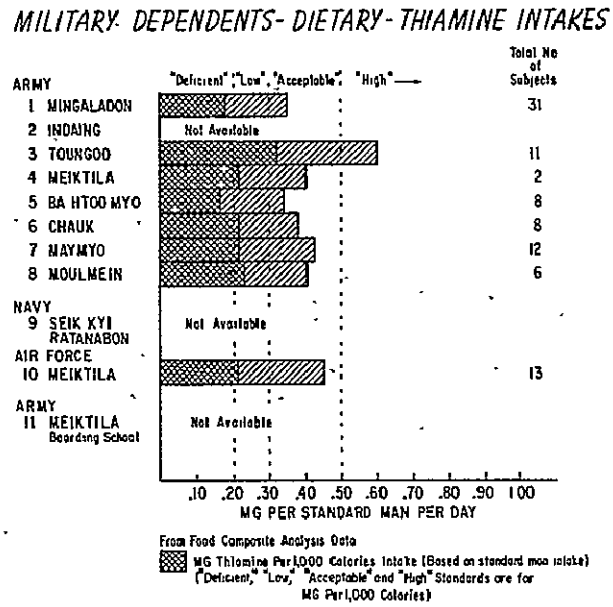


FIGURE 17





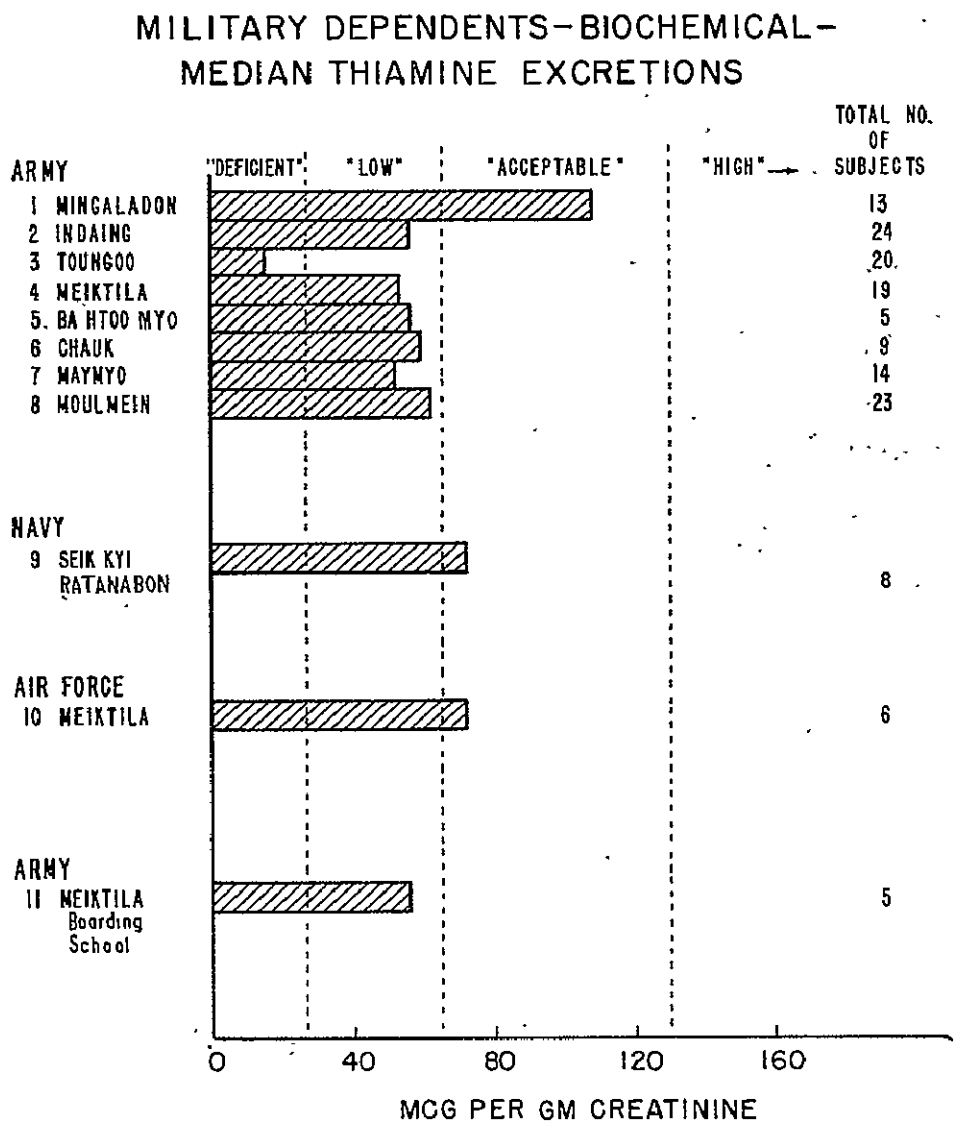
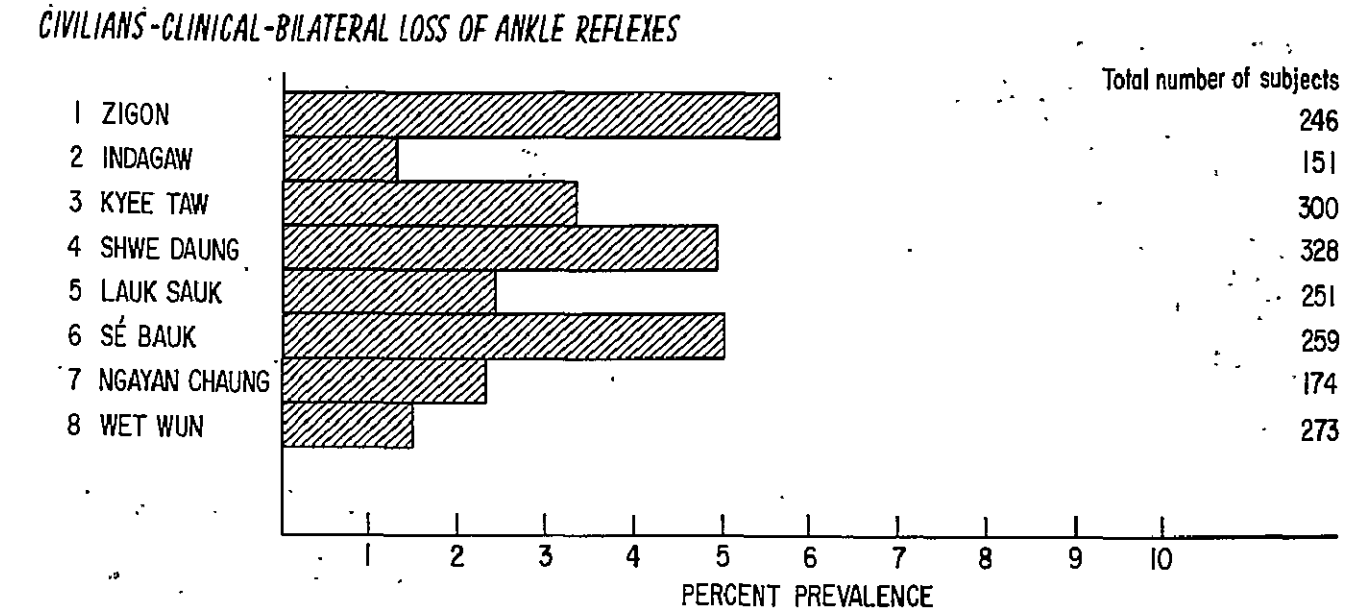
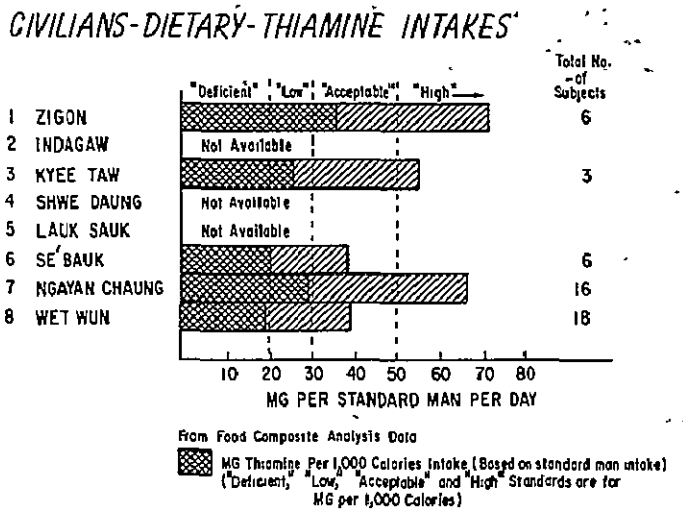


FIGURE 17 (continued)





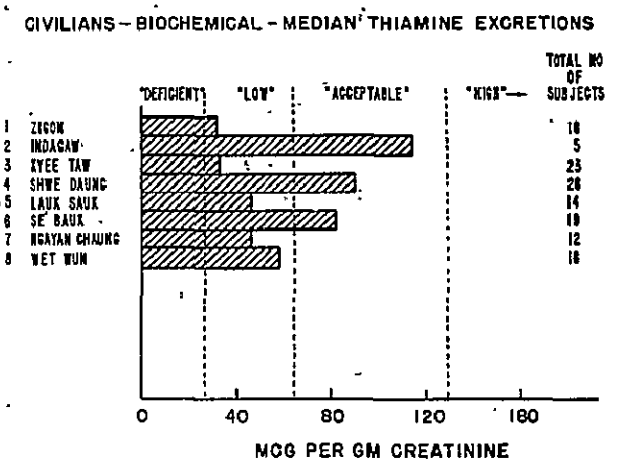
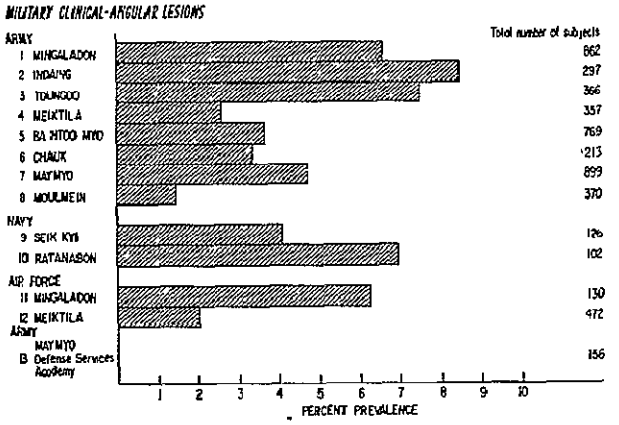
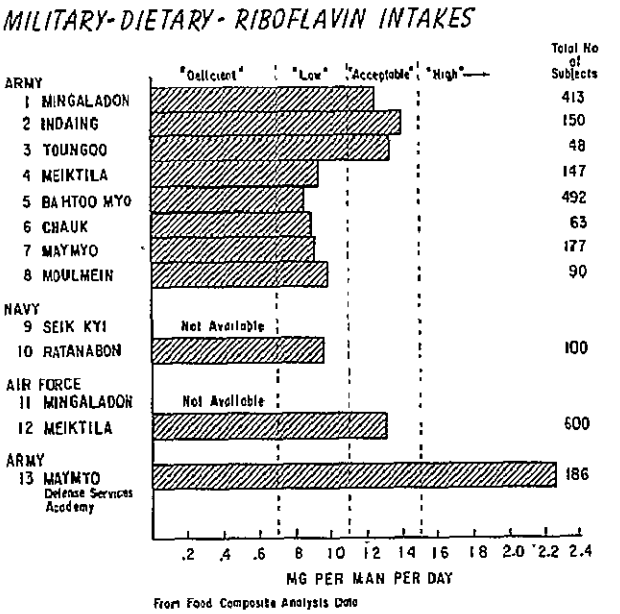


FIGURE 17 (continued)

RIBOFLAVIN NUTRITURE, BURMA





MILITARY - BIOCHEMICAL - MEDIAN RIBOFLAVIN EXCRETIONS

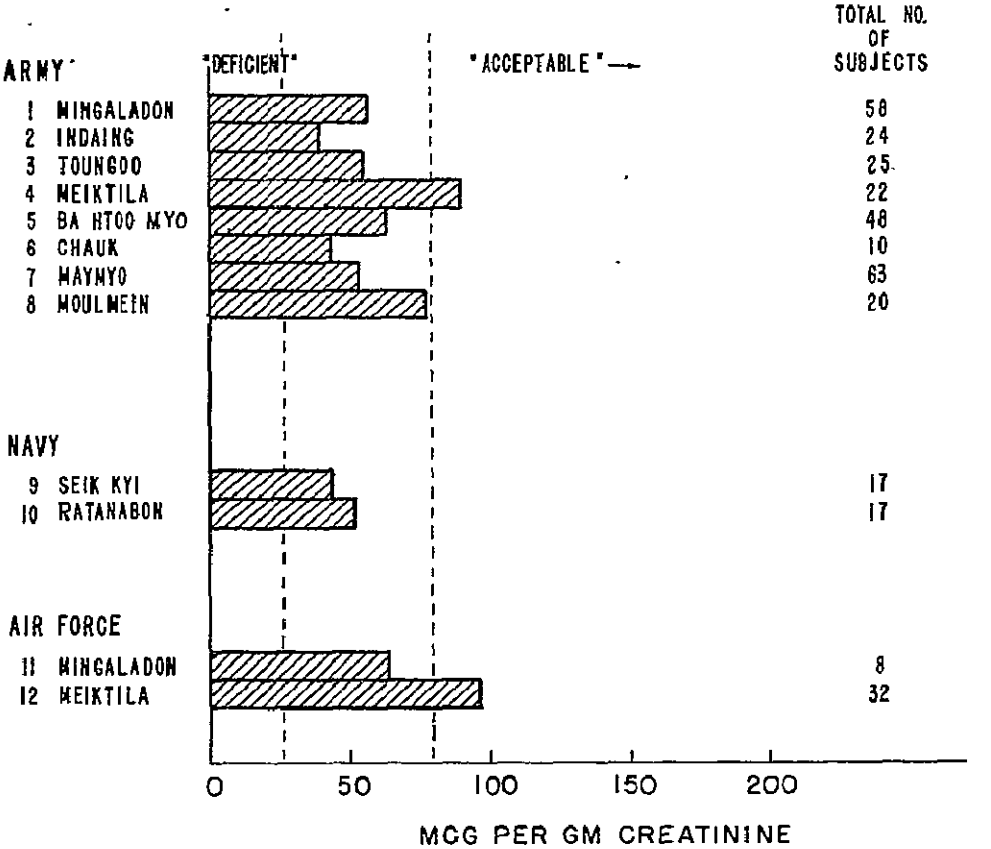
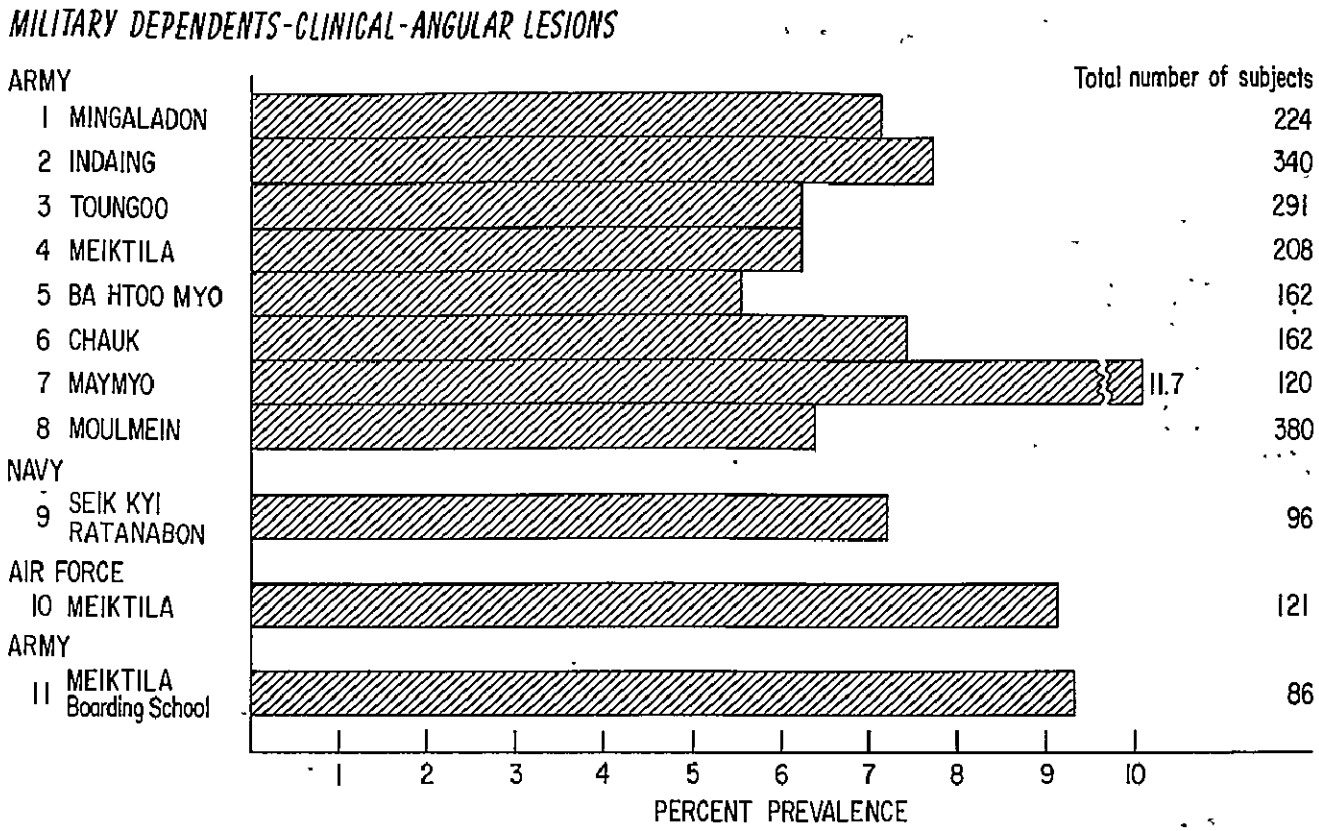
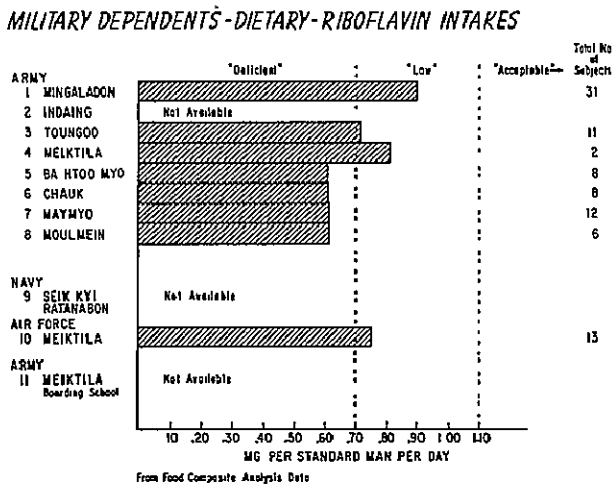


FIGURE 18





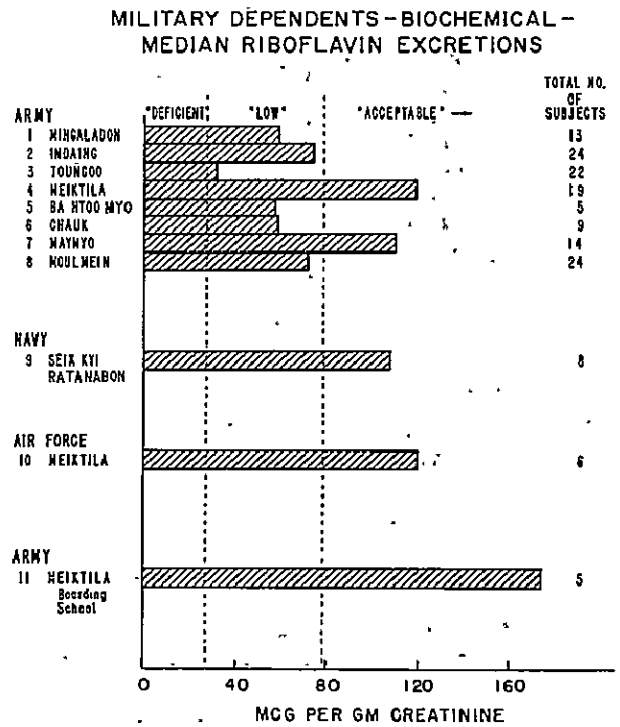
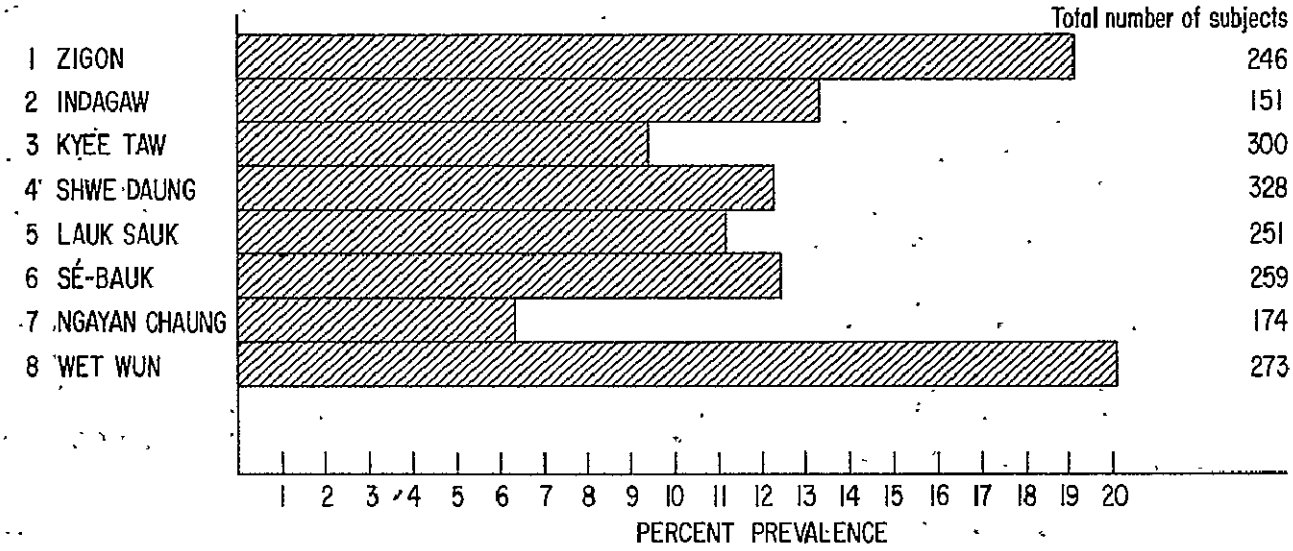
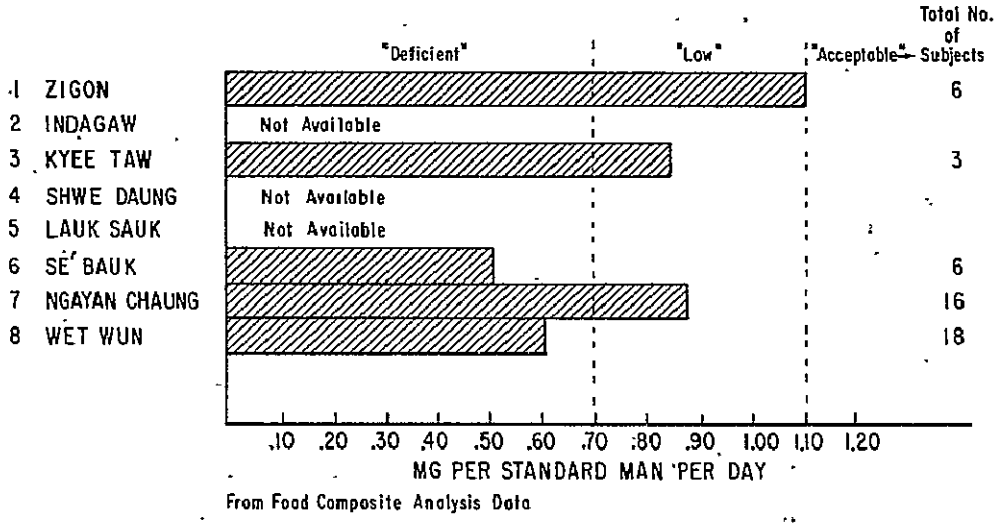


FIGURE 18 (continued)

CIVILIANS-CLINICAL-ANGULAR LESIONS



CIVILIANS-DIETARY- RIBOFLAVIN INTAKES



From Food Composite Analysis Data

CIVILIANS - BIOCHEMICAL - MEDIAN RIBOFLAVIN EXCRETIONS

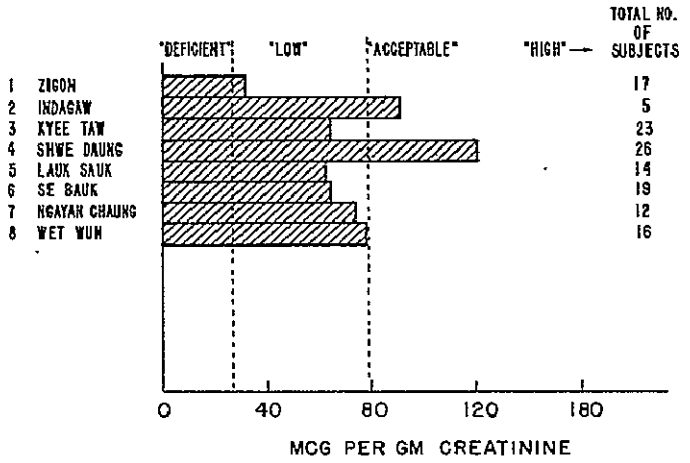


FIGURE 18 (continued)

The problem with thiamine is less precise. The civilian population by all criteria is most deficient, with the military dependents not much better. Although clinical signs of overt deficiency were uncommon, there was some regional variation as indicated in Figure 16. The highest prevalence of bilateral loss of ankle reflexes was 5.6 percent in Zigon, a small village outside of Rangoon, but in reality low urinary excretion rates and suboptimal dietary intakes are prevalent throughout the country and represent, therefore, a country-wide problem. As has been mentioned several times before in this report, the thiamine problem is a borderline one, but experiences outside the survey of several members of the team convince us that beriberi does exist in Burma and in particular is an ever-present danger given the proper stressful situations. The latter could be pregnancy, diarrhea, strenuous military operation or a partial famine from an environmental catastrophe.

The picture with regard to riboflavin is much the same as that with thiamine. Although the human physiologic response to riboflavin deficiency is not well understood, there would seem to be good reason for wanting to increase its intake. From Figure 18 one can see that there is great regional variation in the prevalence of angular lesions and scars, which in general correlate with low mean urinary excretion rates and dietary intakes. However, it would seem unwise to approach the problem on a regional basis since borderline to low excretory rates and dietary intakes exist everywhere.

Perhaps it is well now to re-affirm what has been said before, namely, that clinical evaluation of nutritional status is not as exacting as one might wish. Overt, severe deficiencies can be recognized quite readily by competent observers, but early or borderline deficiencies are not detectable. Some insight into this problem is shown in Tables 129 to 132 which correlate clinical signs with biochemical data.

TABLE 129. CORRELATION OF IODINE EXCRETION WITH ENLARGED THYROID, BURMA

mcg iodine per mg creatinine	No. of Subjects	Enlarged Thyroid	
		No.	Percent
<20	83	10	12.0
20-29	109	9	8.3
30-39	72	2	2.8
40-49	50	2	4.0
≥50	95	4	4.2
Total	409	27	6.6

TABLE 130. CORRELATION OF THIAMINE EXCRETION WITH LOSS OF ANKLE JERKS, BURMA

mcg thiamine per mg creatinine	No. of Subjects	Loss of Ankle Jerks	
		No.	Percent
<27	52	4	7.7
27-65	49	2	4.1
≥66	44	0	0.0
Total	145	6	4.1

TABLE 131. CORRELATION OF RIBOFLAVIN EXCRETION WITH ANGULAR LESIONS, BURMA

mcg riboflavin per mg creatinine	No. of Subjects	Angular Lesions No.	Angular Lesions Percent
<27	64	7	11.0
27-79	302	15	5.0
80-269	170	17	10.0
≥270	36	5	14.0
Total	572	44	7.7

TABLE 132. CORRELATION OF MEAN CORPUSCULAR HEMOGLOBIN CONCENTRATION WITH FILIFORM PAPILLARY ATROPHY OF THE TONGUE, BURMA

Mean corpuscular hemoglobin concentration, Percent	No. of Subjects		Filiform Papillary Atrophy No.		Filiform Papillary Atrophy Percent
20	1		1		
21	1				
22	1				
23	3	38		5	13
24	5		1		
25	6				
26	6				
27	15		3		
28-29	43		1		2
≥30	69		0		0
Total	150		6		4

As can be seen, fair correlations exist between urinary iodine and thiamine and goiter and absent reflexes, respectively, although the number of examples of the latter make the data unconvincing. However, in the case of angular lesions and filiform papillary atrophy the correlation with biochemical data is extremely poor. Such information should not be interpreted to disprove that these clinical signs have no relationship to nutrient deficiencies, since abundant data in the nutritional field could be quoted to support such relationships. However, it is evident that angular lesions, for example, may occur from a variety of causes, one of which is riboflavin deficiency, and this is undoubtedly true of all clinical manifestations. It is imperative that further study be given toward better understanding of the clinical signs of malnutrition and their relationship to specific nutrients.

Obesity and atherosclerosis are relatively uncommon in all of the groups surveyed. The factors responsible for this are undoubtedly multiple. However, dietaries low in saturated fatty acids, which are so characteristic of the Burmese, must be in part responsible. Certainly the low serum cholesterol levels herein reported are consistent with such a hypothesis (Tables 46, 84 and 121). Hard work, exercise, heredity and the like are other factors of importance. Our survey was not properly designed to study the prevalence of atherosclerosis, but observations of hospital inmates, autopsy records and general conversations with Burmese physicians would support the impression that its prevalence was low.

The "calcium problem" in Burma is unclear. The dietary intakes in all groups, save the Defense Services Academy, were somewhat low. This reflects the limited use of milk and its products by a major section of the population. It is unknown by us whether osteoporosis or

osteomalacia are common abnormalities in Burma. One might suspect that they should be with such low calcium intakes. On the other hand, so little is really known about calcium requirements and their relation to clinical diseases that any firm statement is unwarranted. However, this is an area for further investigation in the future.

Vitamins A and C present no problems in any of the groups. This probably reflects the abundance of green and leafy vegetables and fruits which are readily available, even though they are consumed to a limited degree. It is strange that Burma should be so devoid of vitamin A deficiency, when it is so prevalent in some of its neighbors such as East Pakistan and Indonesia. Although no attempts were made to assess vitamin D status, a deficiency of this vitamin also would appear to be of neglible significance.

Dental findings for military, military dependent and civilian males and females are presented in Appendix Tables 5F and 5G. There was little difference between the three groups in mean numbers of DMF teeth up through the age of 29 years. After age 30, however, civilian males averaged more DMF teeth than their military counterparts.

Dental findings during the Burma survey indicated that the prevalence of dental caries was low but that periodontal diseases were unusually prevalent and severe. Although some minor deviations occurred, this was the prevailing pattern of oral disease in all segments of the sample. These general levels of oral disease occurred in a population whose nutritional status, as judged by the survey team, was apparently critical with regard to thiamine and riboflavin but adequate in ascorbic acid and vitamin A.

Comparisons between nutritive status of a population on a given day with the cumulative lifetime experience of dental caries are open to question. Results of this survey indicated that the diet of Burma, which is low in thiamine and riboflavin, did not lead to a high prevalence of dental caries. Clinical evidence of dental fluorosis was minimal. This and results of analysis of water samples did not suggest that fluoride ingestion was responsible for the relative freedom from dental caries seen in these people. Even though over-all prevalence was low, neglect of dental caries resulted in dental health problems throughout the sample studied.

The high level of periodontal diseases seen in persons examined in Burma constitutes probably the most serious and widespread problem of oral health. Inadequate attention to oral hygiene with abundant deposits of dental calculus and debris undoubtedly contribute to this problem. Tabulations of findings for periodontal diseases according to results of biochemical determinations revealed no consistent associations with levels of serum ascorbic acid and vitamin A or with urinary excretion of thiamine, riboflavin, or N'-methylnicotinamide (Appendix Tables 3V, 4G and 5H).

As predicted in the Background Chapter (Section II), Burma is capable of feeding her people. Starvation or famine is rare and most Burmese have enough to eat. Diversification of the diet would be immensely valuable, particularly in regard to more animal protein and its contribution of B-complex vitamins and minerals to correct the deficiencies that were uncovered. This is particularly true in the case of the civilians and military dependents. The poor status of the latter, so little different from the civilians and so much worse than the military, is perhaps one of the most important findings of this survey, because so much can be done to improve it. These matters are detailed in the Chapter on Recommendations (Section I).

IX

SPECIAL STUDIES

1. Field laboratory studies

a. Introduction

The chief responsibility of the field laboratory was the collection and identification of blood and urine samples for biochemical analyses and their prompt and proper shipment to the base biochemical laboratory. From the 9,312 people examined, 694 urine samples and 684 blood specimens were collected for analysis in the laboratory.

In an effort to broaden the scope of the information available from the wealth of clinical material collected, the field laboratory work for the first time in an ICNND survey included the following procedures: specific gravity, glucose, protein, pH, occult blood, bilirubin and ketone bodies in urine; total white blood count, differential count of stained blood smears, microhematocrits, and the preparation of hemoglobin solutions for analysis at the base laboratory by the cyanmethemoglobin method. The highly efficient manner in which the added work load was conducted is attested to by the fact that 642 blood counts and 732 urine analyses were completed. It is evident that this field procedure provides opportunities for health evaluation such as obtaining data on the incidence of diabetes mellitus.

Stool specimens were obtained and examined for parasites from 194 of the total population studied. Unfortunately very few specimens were obtained from women. It would be important to develop a better procedure for the collection of stools, particularly from females and children. This would add a great deal of information about the prevalence of parasitism which may influence nutritional status.

Blood was obtained by venipuncture using B.D. vacutainer equipment and disposable needles. Blood for microhematocrit, smear, white blood count and hemoglobin was collected by finger prick. The hematocrit was determined in the field using an International micro centrifuge and scale reader. The white blood count and blood smears were performed by standard procedures.

Urine was analyzed as follows: specific gravity with a urinometer; glucose, protein and pH with Combistix (Ames); and ketone bodies by Ketostix (Ames). These "dipstick" methods are simple to use, relatively inexpensive and provide a rapid means of screening even larger numbers of people than were studied in the present survey.

Stools were examined for color, presence of mucous and blood. Direct microscopic examinations were made for ova and parasites in fresh stool specimens diluted with saline and placed under a cover slip.

b. Results

(1) Hematologic

The results of the hemoglobin analyses are presented with the biochemical data in Sections V, VI and VII. The approximate distribution of the mean corpuscular hemoglobin concentration and hematocrit values are presented in Tables 133 and 134 respectively, while the results of the white blood cell and eosinophil counts are given in Tables 135 and 136 respectively. These observations indicate that anemia is prevalent among the women of

TABLE 133. DISTRIBUTION OF MEAN CORPUSCULAR HEMOGLOBIN CONCENTRATION, FIELD LABORATORY STUDIES, BURMA

Mean corpuscular hemoglobin concentration - micromicrograms	<20	20-24	25-31	32-36
Military	0	9	259	88
Dependents				
Women	2	10	102	45
Children	0	2	20	7
Civilians				
Men	0	4	38	12
Women	0	6	38	5
Children	2	0	25	6

TABLE 134. DISTRIBUTION OF HEMATOCRIT VALUES, FIELD LABORATORY STUDIES, BURMA

Hematocrit, percent	>51	45-50	40-44	35-39	30-34	<30
Military	46	203	108	26	3	3
Dependents						
Women	2	13	54	55	19	5
Children	0	3	11	5	3	0
Civilians						
Men	7	21	21	9	0	0
Women	1	6	15	9	4	0
Children	0	2	11	10	4	0

TABLE 135. DISTRIBUTION OF WHITE BLOOD CELL COUNTS, BURMA

White blood cells per mm^3 of blood	<4,000	4,000-10,000	>10,000
Military	1	355	37
Dependents	0	135	25
Civilians	1	120	34

TABLE 136. DISTRIBUTION OF EOSINOPHIL COUNTS, BURMA

Eosinophils, percent per 100 white blood cells	<4	5-10	>10
Military	220	112	11
Dependents	97	60	8
Civilians	78	52	12

Burma. The mean corpuscular hemoglobin concentration values suggest that in the majority of cases the anemia is hypochromic in variety. However, examination of the stained blood film reveals occasional macrocytes, target cells and one instance of elliptocytosis. Although we have no evidence, these findings would suggest that hemoglobinopathies may exist in the Burmese population. These studies indicate that a more detailed exploration of the nature of the anemias is badly needed. Neither malarial parasites nor filaria were found on any stained blood smears examined.

Eosinophilia was a rather common finding as has been noted in other Southeast Asian countries. It is interesting that, as with anemia, it occurred more often in the civilian population, on a percentage basis, than in the military. Significant leucocytosis was more common in the civilian group, while significant leucopenia was found in only two individuals.

(2) Stools

Of 194 stool specimens examined the following numbers of parasites were observed: *Ascaris* 32, hookworm 8, *Trichuris* 6, *Giardia lamblia* 6. Red blood cells were noted in six stool specimens. *Amoeba histolytica* were not observed.

(3) Urine

The following summarizes the urine findings on the 694 samples tested in the field laboratory on military, military dependents and civilians:

Urine Characteristic	Military (375)	Military Dependents (154)	Civilians (154)
pH 7 or above	13	3	2
Glucose present	4	0	1
Ketone bodies	0	0	--
Protein	44	15	20
Occult blood	1	1	1
Bilirubin	0	0	0
Specific gravity <1.010	95	62	77

Although proteinuria was noted in a significant prevalence, this was usually a trace to 1+ and may represent amounts within physiologically normal limits.

Glucosuria was likewise present in trace to 1+ amounts and may or may not be significant. Using glycosuria as a screening test for diabetes mellitus, it would appear that the incidence of this disease is low in Burma; certainly very much lower than in the United States, for example.

Of considerable interest is the high prevalence of specific gravities less than 1.010. A number of spot checks with creatinine excretion data on the same individuals shows a high correlation with low creatinine excretions. No explanation is available at present for the hyposthenuria, but it should be evaluated further.

The presence of intestinal parasites as a cause of blood loss and anemia is generally accepted. Unfortunately an evaluation of the data obtained in this survey does not show a statistically valid relationship between individuals with and without parasites and hemoglobin levels. It would appear that factors other than parasitism had a greater influence on hemoglobin levels (see Table 137).

TABLE 137. HEMOGLOBIN LEVELS OF INDIVIDUALS WITH AND WITHOUT INTESTINAL PARASITES, BURMA

	Military			Civilians			Dependents		
	With	Without	Total	With	Without	Total	With	Without	Total
Hemoglobin (mg/100 ml)									
No. of subjects	36	118	154	8	13	21	2	6	8
Mean	13.94	14.02	14.0	13.42	12.38	12.78	10.05	11.62	11.22
				Percent Distribution					
<10	0.0	0.8	0.6	0.0	0.0	0.0	50.0	16.7	25.0
10-12	22.2	15.2	16.9	25.0	53.8	42.8	50.0	50.0	50.0

c. Summary

The experience gained in using the field laboratory for evaluations of blood, urine and stools justifies the modest additional expense and personnel required to conduct this phase of the work. It would seem desirable to include a field laboratory program as a part of a nutrition survey and it is suggested that a portable transistorized spectrophotometer be used to do hemoglobin determinations in the field as well.

Anemia is common in Burma as evidenced by the hematologic findings, although the exact role of nutrition in its genesis is not known at present and must await further study for clarification.

The following studies represent special areas of interest. Some are concerned with nutrients that are difficult to assess for one or more of the following reasons: (1) poorly defined clinical symptoms, (2) lack of information on the long-term effects of marginal intakes, (3) the absence of data giving a precisely defined human requirement, and (4) the need for complicated procedures or specialized equipment for the biochemical determinations. Other studies are included for the purpose of supplementing information from previous sections. Still others were performed primarily because of the special interest of a team member in a particular problem and the hope of accumulating some useful information to serve as a basis for further investigations.

2. Vitamin B_6

a. Introduction

Except in unusual circumstances, clinical signs of vitamin B_6 deficiency have not been recognized in human beings. However, convulsions and anemia have been observed in children fed commercialized formula diets low in vitamin B_6 (1, 2) and seborrheic dermatitis, lesions of the mucous membrane and peripheral neuritis appeared in human volunteers given vitamin B_6 antagonists (3, 4). In addition, this vitamin has been shown to be associated with the development of urinary calcium oxalate calculi in studies in animals (5).

b. Results

An attempt was made to estimate the vitamin B_6 nutriture of a relatively small number of Burmese using the following criteria: Clinical signs, dietary content of vitamin B_6, urinary excretion of the vitamin, urinary excretion of xanthurenic acid and 3-hydroxykynurenine following a tryptophan load, and urinary oxalate levels.

Although the relationship of nasolabial seborrhea to the intake of vitamin B_6 has not been established beyond question, an association between the two has been suggested (6). The prevalence of this lesion in the military, dependent and civilian populations is summarized in Table 138. A detailed breakdown by location and service for the military and location, sex and age for the dependents and civilians is included in the Appendix (Appendix Tables 3B, 4B and 5B).

TABLE 138. PERCENT PREVALENCE OF NASOLABIAL SEBORRHEA, BURMA

	Military			
Service branch	Army	Navy	Air Force	Total
No. of subjects	4,133	228	602	4,963
	Percent Prevalence			
	6.6	3.1	6.1	6.3

	Military Dependents and Civilians						
	Males		Females				Boarding School
			Nonpregnant, Nonlactating		Pregnant	Lactating	
Age (years)	<15	≥15	<15	≥15	15-44		3-20
	Percent Prevalence						
Military Dependents	0.3	--	0.0	9.2	9.2	11.3	11.6
Civilians	0.0	10.3	0.4	5.8	4.0	4.5	--

The daily intake of vitamin B_6 averaged 1.70 milligrams per man per day based on determinations at six different locations, with five of the six values falling between 1.75 and 2.10 milligrams. While definitive data on the requirement of human beings are not available, an intake of 1-2 milligrams per day is generally considered adequate but not optimal.

The urinary excretion of vitamin B_6 was determined on urine samples collected at random, preserved with toluene at an acid pH and shipped in the dark and under refrigeration to the Mingaladon Laboratory. The procedure employed was measurement of the growth of a vitamin B_6-dependent organism (Saccharomyces carlsbergensis, American Type Culture Collection No. 9080) after the addition of aliquots of urine as compared to the growth obtained with added synthetic vitamin. This procedure is outlined in detail in a report from the U.S. Army Medical Research and Nutrition Laboratory, Denver, Colorado, U.S.A., entitled "Vitamin and Amino Acid Assay Procedures." An excretion of less than 20 micrograms per gram of creatinine is considered to be indicative of a deficient intake of this vitamin. Deficient excretions were found in 79 of 130 samples analyzed, a prevalence of 60.7 percent. These results are summarized in Table 139.

TABLE 139. URINARY EXCRETION OF VITAMIN B_6, BURMA

	Military	Dependents		Civilians		
	Males	Females	Children (<15)	Males	Females	Children (<15)
No. of subjects	67	20	7	9	13	14
Vitamin B_6 excretion mcg/gm creatinine						
		Percent Distribution				
<20 ("Deficient")	86.6	45.0	14.3	33.3	23.1	35.7
≥20 ("Acceptable")	13.4	55.0	85.7	66.7	76.9	64.3

Oral tryptophan loads (10 grams of DL-tryptophan) were administered to 55 subjects during the survey and the excretion of xanthurenic acid during the subsequent six hours was compared to the amounts found prior to the test dose. Xanthurenic acid was measured according to the method described in the (1957) Manual for Nutrition Surveys (7). A significant number (24) showed increases in excess of 30 milligrams per gram of creatinine, an excretion considered to be indicative of a deficiency of vitamin B_6. These data are summarized in Table 140.

TABLE 140. DISTRIBUTION OF HIGH XANTHURENIC ACID EXCRETION FOLLOWING TRYPTOPHAN LOADING, BURMA

	Military	Dependents	Civilians
	Males	Females	Males
No. of subjects	38	6	11
Xanthurenic acid excretion mg/gm creatinine			
		Percent Distribution	
<30 ("Acceptable")	50.0	100.0	54.5
≥30 ("Deficient")	50.0	0.0	45.5

Recent investigations in human volunteers at the U.S. Army Medical Research and Nutrition Laboratory have suggested the possibility that the excretion of 3-hydroxykynurenine following a tryptophan load test is a more sensitive indicator of vitamin B_6 deficiency than the excretion of xanthurenic acid. Consequently, determinations of the 3-hydroxykynurenine content of 10 of the urine samples obtained following a tryptophan load test were made. The method employed was that described by Brown and Price (8, 9). On the basis of the work of Boyland and Williams (10) as well as the results of the recent studies at the Denver laboratory, an excretion of greater than 60 milligrams during the first six hours following the test load of tryptophan indicates a deficiency of vitamin B_6. Only three of the samples showed an "acceptable" excretion rate. Four were markedly elevated while the remaining three were in the questionable range.

Studies in human beings (11), cats (12) and rats (13) have shown that endogenous oxalate excretion is inversely related to the amount of dietary vitamin B_6, and that renal calcium oxalate calculi develop in the vitamin B_6-deficient rat (5). Aliquots from 110 urinary samples were preserved with toluene, frozen and the oxalate content determined by

the method of Archer et al. (14). Oxaluria (oxalate excretion in excess of 16 milligrams per gram of creatinine) was detected in 27 percent of the samples tested. The results are summarized in Table 141.

TABLE 141. URINARY EXCRETION OF OXALATE, BURMA

	Military	Dependents		Civilians		
	Males	Females	Children (<15)	Males	Females	Children (<15)
No. of subjects	68	15	3	3	8	13
Oxalate excretion mg/gm creatinine			Percent Distribution			
≤ 16 (Normal)	73.5	80.0	66.7	100.0	62.5	61.5
> 16 (Oxaluric)	26.5	20.0	33.3	0.0	37.5	38.5

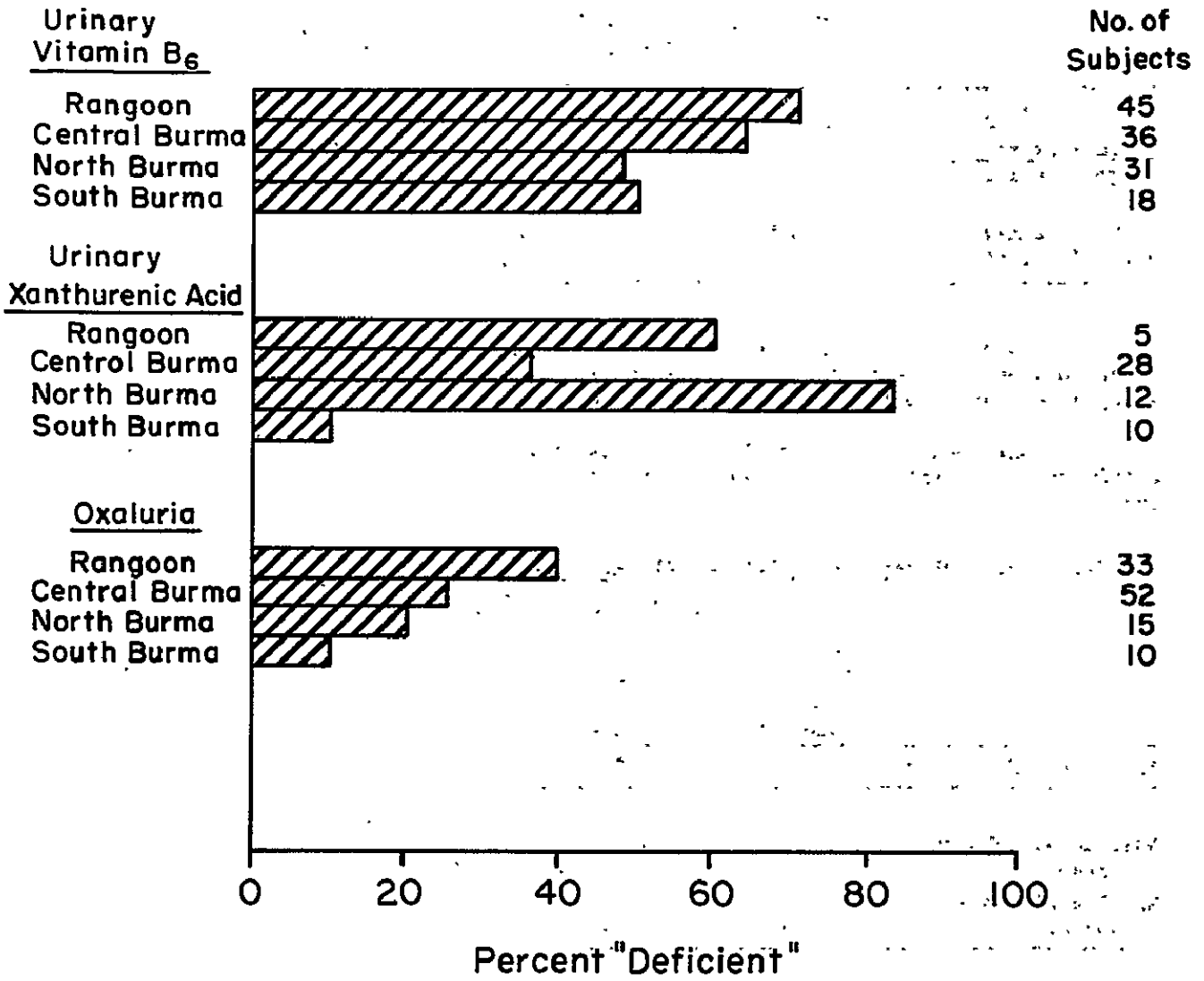
Comparison of the values for urinary vitamin B_6, xanthurenic acid and oxalate by location showed a trend toward a diminished incidence of deficiency in the south (Moulmein area) as compared to the other regions (see Figure 19).

Although correlation of the results obtained between the various criteria was not a primary aim of this study, it is of interest. This comparison is presented in Tables 142 and 143.

TABLE 142. PREVALENCE OF NASOLABIAL SEBORRHEA ASSOCIATED WITH BIOCHEMICAL CRITERIA OF VITAMIN B_6 DEFICIENCY, BURMA

	Urinary vitamin B_6		Urinary oxalate		Urinary xanthurenic acid	
	"Acceptable"	"Deficient"	Acceptable	Oxaluric	Acceptable	Abnormal
Total no. of subjects	51	73	79	29	29	21
			No. of individuals			
Nasolabial seborrhea present	0	16	14	5	11	9
Nasolabial seborrhea absent	51	57	65	24	18	12

Comparison of Various
Criteria of Vitamin B_6 Deficiency
By Location, Burma[1]



[1] All population groups combined

Figure 19

TABLE 143. PREVALENCE OF DEFICIENT EXCRETION OF VITAMIN B_6 ASSOCIATED WITH ABNORMAL OXALATE OR XANTHURENIC ACID VALUES, BURMA

	Urinary oxalate		Urinary xanthurenic acid	
	Acceptable	Oxaluric	Acceptable	Abnormal
Total no. of subjects	23	4	17	20
	No. of individuals			
"Deficient" urinary vitamin B_6 excretion	13	3	10	16
"Acceptable" urinary vitamin B_6 excretion	10	1	7	4

c. Summary

Since a clearly defined clinical syndrome resulting from a simple deficiency of vitamin B_6 has never been described, one must rely principally upon dietary and biochemical measurements in determining the state of nutriture of this vitamin. Dietary analyses showed that the average vitamin B_6 intake fell within the presumed range for the minimal requirement (1 to 2 milligrams per day). However, a considerable portion of the persons studied revealed biochemical abnormalities related to the metabolism of vitamin B_6, and the excretion of the vitamin was generally quite low. We are reluctant to recommend enrichment because of the considerable expense and because little is known concerning the specific effects of a marginal intake of vitamin B_6 upon individual health and work capacity. On the other hand, it seems obvious that increased intake of vitamin B_6 either through enrichment or diversification of the diet would be desirable. Further exploration of this problem, as outlined in the recommendations for future research, would certainly seem to be indicated. The supposedly high prevalence of urinary calculi in Southeast Asia is only one suggestion of the possible clinical implications of the vitamin B_6 problem.

3. Fractionation of serum proteins by paper electrophoresis

a. Introduction

The chemical determinations performed in Burma showed a consistent trend toward elevated serum globulins in all groups and a slight depression of serum albumin in the females, particularly the pregnant and lactating subjects. It was thought that fractionation of the serum proteins by means of paper electrophoresis might be of value in confirming the results of the chemical determinations and aiding in their interpretation. Accordingly, aliquots of serum were taken from 97 samples, sealed in ampules along with 10-25 milligrams of ascorbic acid and 1-2 milliliters of toluene, frozen and returned by air to the U.S. Army Medical Research and Nutrition Laboratory, Denver, Colorado. Following electrophoretic separation, the proteins were stained with a bromphenol blue solution and the percent distribution of the total protein within the five common fractions (albumin, alpha$_1$ globulins, alpha$_2$ globulins, beta globulins and gamma globulins) was determined with the Spinco Analytrol.

b. Results

The results are summarized in Table 144.

TABLE 144. ABNORMAL DISTRIBUTION OF SERUM PROTEINS, BURMA

	Military		Dependents		Civilians					
	Males		Females		Males		Females		Children	
No. of subjects	42		24		7		14		7	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
				Abnormal Distribution						
Low serum albumin	6	(14.2)	6	(33.3)	4	(57.1)	6	(42.9)	3	(42.9)
High alpha$_1$ globulins	5	(11.9)	0	--	1	(14.3)	1	(7.1)	0	--
High alpha$_2$ globulins	1	(2.4)	1	(4.2)	0	--	0	--	0	--
Low alpha$_2$ globulins	1	(2.4)	2	(8.4)	0	--	0	--	0	--
High beta globulins	5	(11.9)	2	(8.4)	0	--	4	(28.7)	2	(28.7)
High gamma globulins	13	(31.0)	9	(37.5)	5	(71.4)	7	(50.0)	5	(71.4)

Values were considered to be abnormal when they fell outside of the range obtained by Ehrmantraut with the same procedure (15). This range is listed in Table 145.

TABLE 145. NORMAL DISTRIBUTION OF SERUM PROTEINS FOLLOWING SEPARATION BY PAPER ELECTROPHORESIS, BURMA

	Percent of Total Protein	
Component	Mean	Range of Values
Serum albumin	59.2	47-71
Alpha$_1$ globulins	4.1	2.7-5.8
Alpha$_2$ globulins	8.4	5.1-12.0
Beta globulins	11.4	4.5-15.7
Gamma globulins	16.6	11.3-24.0

These results confirm the conclusion based on the biochemical determinations that hyperglobulinemia is not an uncommon finding in the population sampled. They also demonstrate that the elevation is not confined to the gamma globulin fraction alone since an appreciable number of samples with elevated alpha$_1$ or beta fractions were noted, although it is obvious that the majority of the extra globulin migrates in the gamma region.

Comparison of the average albumin and globulin values obtained chemically for these 97 individuals revealed that the abnormalities were due primarily to an elevated globulin fraction in the military and civilian males, but that there was both an elevated globulin and a depressed albumin in the dependents and civilians. The data are presented in Table 146.

TABLE 146. ELECTROPHORETIC VERSUS CHEMICAL FRACTIONATION OF THE SERUM PROTEINS, BURMA

	Military		Dependents		Civilians			
	Males		Females		Males		Females	
Total no. of subjects	38		21		6		11	
	Chemically Determined Values							
	Albumin	Globulin	Albumin	Globulin	Albumin	Globulin	Albumin	Globulin
Subjects with normal globulins as determined electrophoretically								
No. of subjects	26		13		2		4	
Mean (gm/100 ml)	4.1	3.5	3.9	3.8	3.4	3.4	4.0	3.4
Subjects with elevated globulins as determined electrophoretically								
No. of subjects	12		8		4		7	
Mean (gm/100 ml)	4.0	4.2	3.6	4.3	3.8	4.1	3.3	4.0

4. Transketolase activity studies

The results of the transketolase determinations have been included in the body of this report. However, since this was the first time this test was performed on a large scale in a survey, it was felt advisable to include a detailed outline of the procedure and a comparison of the enzyme activity with the urinary thiamine levels in this section. The details of the assay procedure for red blood cell transketolase activity are set forth below.

a. Preparation of red cell hemolysate solution

(1) Place approximately 4 cc of heparinized blood in a 15 cc graduated centrifuge tube and centrifuge at 1,500 rpm (revolutions per minute) for 15 minutes.

(2) Record the red cell volume. Draw off the plasma and carefully resuspend the cells in sufficient 0.9 percent saline solution to give a final volume of 8 cc.

(3) Centrifuge the cells once more at 1,500 rpm for 15 minutes.

(4) Draw off the saline wash and carefully resuspend the cells in a volume of deionized water equal to three times the volume of red cells. Allow the tube to sit at room temperature for about 30 minutes. This hemolysate may be frozen and stored for at least 24 hours.

b. Reagents

(1) Buffer

(a)	0.9 percent sodium chloride (NaCl)	4 cc
(b)	1.15 percent potassium chloride (KCl)	103 cc
(c)	3.82 percent magnesium sulfate ($MgSO_4 \cdot 7\ H_2O$)	1 cc
(d)	pH 7.4 potassium phosphate	20 cc
		128 cc

Solution (d) is prepared by dissolving 17.5 grams potassium phosphate (K_2HPO_4) in 800 cc of deionized water. Next 1 N hydrochloric acid (HCl) is added (approximately 20 cc) until the pH is 7.4. Water is added to achieve a final volume of one liter.

(2) Ribose-5-phosphate solution

One and sixty-two hundredths grams of barium ribose-5-phosphate is dissolved in a minimum of 1 N HCl (about 6 cc) and brought to a volume of 40 ml with deionized water. The barium is completely precipitated by addition of approximately 10 cc of concentrated sodium sulfate (Na_2SO_4). After centrifugation, the supernatant is removed and the barium sulfate is washed twice with 4 cc of deionized water. The combined supernatant and washings are brought to pH 7.4 with 10 N and 1 N potassium hydroxide (KOH) and the final volume is adjusted to 100 cc with deionized water. This solution is stored in the frozen state until required.

(3) Thiamine pyrophosphate solution

Ten milligrams of thiamine pyrophosphate are dissolved in 10 cc of buffer. This solution is distributed into small polyethylene bottles and kept frozen until required.

(4) Standard ribose solution

Stock standard contains 1 gram ribose dissolved in 1 liter of saturated benzoic acid.

Working standard. Dilute stock standard 1 to 100 in saturated benzoic acid. Working standard contains 10 micrograms of ribose per cubic centimeter.

(5) 10 percent trichloroacetic acid

Dissolve 10 grams trichloroacetic acid in 80 cc water and adjust final volume to 100 cc with water.

(6) Solution "A"

Prepare immediately before use in the assay. Mix three volumes of ribose-5-phosphate solution with one volume of buffer.

(7) Solution "B"

Prepare immediately before use in the assay. Mix eight volumes of buffer with one volume of thiamine pyrophosphate solution.

(8) Solution "C"

Prepare immediately before use in the assay. Mix two volumes of solution "A" with fifty volumes of 10 percent trichloroacetic acid.

(9) Orcinol solution

Prepare immediately before use in the assay. Dissolve 0.5 grams orcinol and 0.1 gram ferric alum in 50 cc of concentrated HCl.

c. Assay procedure

The assay requires the use of three tubes per blood sample. The destruction of substrate by a given amount of enzyme per hour is determined from the first tube. The stimulation of activity accompanying addition of thiamine pyrophosphate to the incubation mixture is determined from the second tube. The original substrate concentration is calculated from the third tube.

(1) Add 1.0 cc of the hemolysate to each of the three tubes.

(2) Add 1.0 cc of buffer to tubes 1 and 3.

(3) Add 1.0 cc of solution "B" to tube 2.

(4) Incubate all tubes at 38° C. for 30 minutes.

(5) Add 0.4 cc of solution "A" to tubes 1 and 2 and incubate both tubes at 38° C. for exactly 60 minutes.

(6) Terminate the enzyme activity of these tubes at the end of the hour by addition of 4.8 cc of 10 percent trichloroacetic acid to each.

(7) While tubes 1 and 2 are incubating, add 5.2 cc of solution "C" to tube 3.

(8) Following the addition of the trichloroacetic acid and solution "C," mix the suspensions well, then centrifuge them for 20 minutes at 2,000 rpm.

(9) Transfer a 0.1 cc aliquot from the supernatant of each tube to separate Pyrex spectrophotometer tubes.

(10) Add 2.9 cc of water and 3.0 cc of orcinol reagent to each tube.

(11) After preparation of a blank and 10, 15 and 20 microgram standards, the tubes are capped with marbles and placed in a boiling water bath for 45 minutes.

(12) The optical density of each tube at 670 millimicrons (mμ) is determined after the tubes have cooled at room temperature for 30 minutes.

(13) The enzyme activity is expressed as micrograms (mcg) ribose consumed per cubic centimeter of red blood cells per hour. It is calculated as follows:

(a) The K value (mcg ribose per 1.00 optical density (O.D.) unit) is determined from the standard curve.

(b) The O.D. of each tube x K = mcg ribose per specific tube.

(c) (2 x mcg ribose in tube 3) - mcg ribose in tube 1 (or 2) = mcg ribose consumed in tube 1 (or 2).

(d) mcg ribose consumed in tube 1 (or 2) x 288 = mcg ribose consumed per cubic centimeter red blood cells per hour.

$$\left(288 = \frac{\text{7.2 initial assay tube volume}}{\text{0.1 cc aliquot}} \times \frac{\text{1.0 cc red blood cells}}{\text{0.25 cc red blood cells in assay tube}}\right)$$

(14) The percent stimulation of enzyme activity resulting from addition of thiamine pyrophosphate to the incubation mixture is equal to:

$$\frac{\text{Enzyme activity tube 2 - enzyme activity tube 1}}{\text{enzyme activity tube 1}} \times 100$$

Arbitrary range of values:

Up to 15 percent stimulation	= "acceptable"
16-20 percent stimulation	= "low"
Greater than 20 percent stimulation	= "deficient"

(15) The accuracy of this assay is dependent upon the exercise of a great amount of caution during the procedure particularly with regard to the following points:

(a) The red cells must be washed thoroughly with saline.

(b) The period of incubation must be exactly one hour for all tubes.

(c) All pipetting must be done with great accuracy.

The comparison of individual transketolase results versus individual thiamine excretions is summarized in the following table:

TABLE 147. DISTRIBUTION OF TRANSKETOLASE VALUES ACCORDING TO URINARY THIAMINE EXCRETION LEVELS, BURMA

		Urinary thiamine in mcg per gram creatinine					
		0-27 ("Deficient")		28-65 ("Low")		65 ("Acceptable")	
Percent stimulation of transketolase activity following *in vitro* addition of thiamine pyrophosphate		No. of subjects	(%)	No. of subjects	(%)	No. of subjects	(%)
>20	("Deficient")	36	(37.9)	34	(30.1)	14	(20.0)
16-20	("Low")	10	(10.5)	11	(9.7)	4	(5.7)
<16	("Acceptable")	49	(51.6)	68	(60.2)	52	(74.3)
Total no. of individuals		95		113		70	

It can readily be seen that the percentage of individuals with a "deficient" or "low" transketolase value falls from 48.4 to 39.8 to 25.7 as urinary thiamine levels increase. Thus it appears that a reasonably good correlation does exist between thiamine excretion and the percent of saturation of red cell transketolase with thiamine pyrophosphate. The occurrence of "deficient" or "low" transketolase values in 25 percent of the population excreting "acceptable" or good levels of thiamine at the time of sampling does not necessarily cast doubt upon the procedure since urinary thiamine quickly reflects daily status of the individual over a longer period of time.

5. Dietary and urinary magnesium

a. Introduction

The classic symptoms of magnesium deficiency in man are muscular twitching, convulsions and delirium. A deficiency of this mineral has never been considered a nutritional problem, however, since the acute clinical syndrome usually appears as a sequel to alcoholism or electrolyte imbalance rather than as a result of an inadequate dietary intake. Indeed, it would be difficult to formulate a natural food ration so low in magnesium as to produce an acute deficiency while providing satisfactory amounts of the other nutrients.

Phosphatic renal lithiasis is a consequence of magnesium deficiency in the rat (16). However, recent studies have shown that much higher levels of magnesium are required to prevent urolithiasis than are necessary to achieve positive mineral balance and maximal growth (17, 18). Furthermore, the situation is complicated by the fact that the amounts of calcium (17, 19), phosphorus (19), protein (18), fat (20) and vitamin B_6 (17) in the diet have been found to influence the magnesium requirement and the subsequent urolithiasis.

In view of these results, it is reasonable to propose that dietary magnesium may be one factor in the etiology of human kidney stone disease. Since Burma is reported to have a high prevalence of urolithiasis, it seemed desirable to gather information on the intake and urinary excretion of magnesium during the survey.

A number of magnesium balance studies have been performed under various conditions. Most have been summarized in a publication of the United States Department of Agriculture (21). Considerable variations in excretion and retention have been encountered. These are probably related to difficulties in analysis, nonavailability of magnesium in various natural foodstuffs, and complex interrelationships with other nutrients. In general, however, it appears that balance is achieved with a natural food ration which supplies 250-300 milligrams of magnesium daily and that approximately 100 milligrams will be excreted daily in the urine on this intake. This is the amount selected by most authorities as the recommended daily allowance of magnesium. Since the daily creatinine excretion averages 1-2 grams, it follows that an excretion of 50-75 milligrams of magnesium per gram of creatinine is indicative of a satisfactory intake of the mineral. It has also been observed that urinary magnesium values are reduced linearly with decreasing intakes of dietary magnesium. Therefore, these values can be used to estimate the intake of magnesium in a population.

b. Results

Urine specimens collected during the survey were stored under a layer of toluene, frozen and returned to the U.S. Army Medical Research and Nutrition Laboratory (USAMRNL),

where an aliquot was wet ashed and analyzed for its magnesium content by an ethylene diamine tetraacetic acid titration method (22). Twelve samples from USAMRNL personnel were similarly treated and analyzed to serve as a partial control. Portions of the diet samples prepared by the nutritionists were also ashed and analyzed in the same manner. The results of these determinations are presented in the following four tables.

TABLE 148. URINARY MAGNESIUM EXCRETION BY USAMRNL PERSONNEL

Subject No.	24-hour urine volume (ml)	mg creatinine per ml urine	Total mg Mg per 24 hours	mg Mg per gram creatinine
1	1,420	1.031	130.2	88.9
2	1,130	1.516	71.5	41.8
3	950	1.797	134.6	78.9
4	1,190	1.516	109.1	60.5
5	860	1.688	96.1	66.2
6	1,970	0.781	128.1	83.2
7	2,090	1.063	223.0	100.4
8	1,150	1.406	76.7	47.4
9	2,150	0.719	111.2	71.9
10	3,450	0.547	218.4	115.7
11	1,380	1.453	140.3	70.0
12	1,690	0.875	177.5	120.0
Average			134.7	78.7

TABLE 149. DISTRIBUTION OF URINARY MAGNESIUM EXCRETION LEVELS BY POPULATION GROUP, BURMA

Subjects	Military	Military Dependents		Civilians			Total
	Males	Females	Children <15 years	Males	Females	Children <15 years	
Total No.	49	16	6	10	15	4	100
Urinary magnesium, mg/gm creatinine	No. of individuals						
<20 (Very low)	26	10	3	1	5	2	47
20-35 (Low)	8	3	3	2	2	2	20
36-70 (Acceptable)	12	2	0	5	3	0	22
>70 (High)	3	1	0	2	5	0	11
Average mg Mg/gm creatinine	31.3						

TABLE 150. DISTRIBUTION OF URINARY MAGNESIUM EXCRETION LEVELS BY LOCATION, BURMA

Location	Rangoon Area	Central Burma	Upper Burma	Lower Burma
Total No. of Subjects	20	56	7	17
Urinary magnesium, mg/gm creatinine	No. of Individuals			
<20 (Very low)	16	20	3	8
20-35 (Low)	3	10	1	6
36-70 (Acceptable)	1	17	2	2
>70 (High)	0	9	1	1

TABLE 151. DIETARY CONTENT OF MAGNESIUM, BURMA

Source	Region	mg Mg intake per std. man per day
BAMC, Mingaladon (Military)	Rangoon	213
Family, BAMC, Mingaladon (Military Dependents)	Rangoon	163
Family, Zigon (Civilians)	Rangoon	364
Family, Toungoo (Military Dependents)	Central Burma	258
Kyee Taw (Civilians)	Central Burma	257
Family, Meiktila (Military Dependents)	Central Burma	234
Family, Ba Htoo Myo (Military Dependents)	Central Burma	205
Ba Htoo Myo, Noncommissioned Officers School	Central Burma	391
Family, Sé Bauk (Civilians)	Central Burma	249
Ngayan Chaung (Civilians)	Upper Burma	416
Family, Maymyo (Military Dependents)	Upper Burma	183
Family, Wet Wun (Civilians)	Upper Burma	319
Family, Moulmein (Military Dependents)	Lower Burma	178
Average	All Burma	264

c. Summary

The relatively low intake combined with a markedly low urinary excretion of magnesium suggest that the consumption of this mineral has been marginal for a considerable time.

Too little is known at present about magnesium nutrition to enable one to define the metabolic consequences (if any) of this situation. If, however, subsequent research verifies a role for magnesium in the etiology of human kidney stone disease, it is obvious that this study would take on added significance. The question of availability of magnesium from the typical Burmese diet should also be explored since this could have a profound effect on urinary excretion of this mineral. Diversification of the diet to increase the consumption of prawns, vegetables, and grains other than rice would be of value in increasing the magnesium intake.

6. Dietary and serum fatty acid analyses

a. Introduction

In order to obtain additional information concerning the nature of the fat consumed in the diet, part of the diet composites collected was analyzed for content of individual fatty acids. Similarly, a small number of serum samples was analyzed for fatty acid composition of the total serum lipids.

The diet samples were extracted by heating for 30 minutes at 50° C after the addition of 75 volumes of a chloroform-methanol mixture (2:1, volume for volume). The extract containing the lipids was filtered and reduced to dryness with a stream of nitrogen gas. The residue was dissolved in chloroform, dried with anhydrous sodium sulfate, and filtered into tared flasks. The chloroform was removed with the aid of nitrogen and the weight of the lipid material was obtained. The lipid extracts were then saponified with 0.5 N alcoholic potassium hydroxide for 40 minutes. After acidification with 1 N hydrochloric acid, the samples were extracted twice with ethyl ether and the extracts were dried over anhydrous sodium sulfate. Esterification of the extracts was carried out with methanol-boron trifluoride (23), and the methyl esters were purified by sublimation (24).

The serum samples were sealed in ampules along with 10-25 milligrams of ascorbic acid and 1-2 milliliters of toluene, frozen and returned frozen by air to the U.S. Army Medical Research and Nutrition Laboratory. Here they were extracted with 10 volumes of chloroform-methanol (2:1, volume for volume) and centrifuged. The extraction was repeated and the two supernatant fractions combined and reduced to dryness under a stream of nitrogen. The extracted lipids were then saponified and treated as indicated above for the diet samples.

Gas chromatographic analysis of the lipid samples was made with a hydrogen flame detector and the use of 8-foot, 1/4-inch aluminum columns packed with 20 percent DEGS[1/] prepared according to Craig (25) on Gas Chrom P (100-140 mesh)[2/]. Helium flow was regulated so that the retention time of methyl palmitate was 12 minutes. Identification of fatty acids was by comparison of retention times with those of known methyl esters[3/] and area measurement was made by triangulation.

1/ Cambridge Industries Company, Cambridge, Mass.
2/ Obtained from Applied Science Laboratory, State College, Pa.
3/ Obtained from Hormel Institute, Austin, Minnesota.

b. Results

Table 152 presents data on the fatty acid composition of the fat present in the individual diet composites obtained from the locations indicated.

The lipids in the diets contained, on the average, 32 percent saturated, 38 percent monounsaturated, and 30 percent polyunsaturated fatty acids. Stearic acid was present in the lipids to the extent of only 6.3 percent. Differences were noted in the fatty acid composition of the lipids of the individual diet composites. This was particularly noticeable in the palmitic, oleic and linoleic acid content. For example, the diet composite from Ngayan Chaung was the lowest of all diets analyzed in content of oleic and linoleic acids and the highest in stearic acid and one of the highest in palmitic acid.

As was noted previously in this report, the serum cholesterol level of the average Burmese subject was lower than that normally observed in the United States and other Western countries. This may be of interest in view of the low intake of fat in Burma (45 grams per person per day or 15-20 percent of the caloric intake), the high degree of unsaturation of the consumed fats, and the relatively low prevalence of obesity in Burma, all factors that have been associated with a lower prevalence of atherosclerosis and coronary heart disease.

The fatty acid composition of serum lipids of selected Burmese subjects is presented in Table 153. The subjects were selected on the basis of increasing serum cholesterol levels. No general differences were noted in the fatty acid composition of the serum lipids between subjects with low and high serum cholesterol levels in the limited number examined. The serum fatty acid composition was essentially the same as that noted for a group of normal young adult American males (Table 153).

7. Vitamin E and peroxide-induced red cell hemolysis

a. Introduction

On the basis of present evidence, a recommended dietary allowance for vitamin E cannot be stated (26). In fact, the human requirement for this vitamin has been found to vary six-fold or more under controlled conditions, depending on other dietary factors, primarily the content of unsaturated fat. Thus, additional information on the vitamin E status of various populations would be most valuable, particularly in areas such as Burma where the intake of linoleic acid is somewhat higher than in Western nations.

Measurement of the serum tocopherol level is a rather difficult task, however, and most methods also measure other biological antioxidants unless a prior purification such as separation with paper chromatography is performed. For these reasons, many surveys of vitamin E nutriture have measured instead the susceptibility of the red cell to oxidative hemolysis. It has been determined that a significant degree of hemolysis in both children and adults occurs only when the serum or plasma tocopherol falls below 0.5 milligrams per 100 milliliters, the level arbitrarily chosen as indicative of an insufficiency of vitamin E (27).

Blood samples were collected from 197 military and military dependent personnel at Mingaladon. Since the red cell hemolysis test must be begun within two hours after obtaining the sample, only persons in areas near the base laboratory could be studied. The coöperation of Major Kyaw Sein Tun and Captain Maung Maung in obtaining volunteer subjects was indispensable and greatly appreciated.

TABLE 152. FATTY ACID COMPOSITION OF LIPIDS IN BURMESE DIETS

	Military		Military Dependents						Civilians				
Location	Mingaladon	Ba Htoo Myo, BANCOS	Mingaladon, BAMC	Toungoo	Meiktila	Ba Htoo Myo	Maymyo	Moulmein	Zigon	Kyee Taw	Sé Bauk	Ngayan Chaung	Wet Wun
Fatty Acid	Percent Fatty Acid in Lipids[1/]												
C_{14}:0	2.1	0.8	3.3	0.9	1.5	0.9	1.3	2.2	1.2	0.7	2.5	2.2	1.1
C_{14}:1	0.6	T	0.9	0.5	T	0.3	--	--	0.6	T	T	--	--
C_{15}:0	0.5	0.2	0.7	0.4	0.4	0.3	0.5	0.9	0.2	0.6	0.3	0.9	--
C_{15}:1	T[2/]	T	0.4	T	T	0.2	--	--	T	T	T	--	--
C_{16}:0	17.3	20.7	30.4	19.9	17.8	17.6	26.0	20.7	23.5	20.0	17.1	25.2	13.6
C_{16}:1	1.5	2.1	2.7	1.9	1.9	3.5	2.7	2.9	3.0	1.0	3.1	1.9	0.9
C_{18}:0	5.0	7.2	4.2	5.9	7.6	6.0	4.6	8.2	4.7	6.4	7.0	10.3	4.4
C_{18}:1	37.3	37.9	29.4	37.8	35.6	36.9	33.2	37.3	32.4	31.3	31.8	23.9	32.0
C_{18}:2	30.9	24.4	25.3	23.7	24.8	25.6	26.0	17.1	29.4	18.4	30.5	15.5	40.1
C_{18}:3	1.1	1.1	0.6	2.4	1.5	1.4	0.6	1.0	1.3	2.2	0.7	1.6	1.7
C_{20}:0	0.9	T	0.4	1.0	2.4	T	0.9	--	0.7	4.7	0.9	1.8	1.6
C_{20}:1	1.0	1.1	T	T	T	1.2	0.7	1.8	T	--	0.6	--	1.6
C_{20}:2[3/]	--	2.6	T	1.8	2.9	3.4	2.2	5.9	0.2	4.1	3.9	10.9	0.8
C_{20}:4	T	T	0.3	T	T	--	T	--	0.6	--	T	T	--
C_{21}:0	0.2	--	T	2.3	2.1	--	--	--	0.2	6.0	--	--	--
C_{22}:0	1.4	1.9	0.2	1.4	1.6	2.6	1.3	1.9	0.9	3.2	1.1	3.9	2.2

1/ The C_{12}:0 was not considered in the above calculation, but was present in amounts of less than 1 percent; shorter chain fatty acids were also not included. The C_{18}:1 fraction may have included isomers that were not separated with the column used.

2/ T = trace.

3/ Tentative identification of this fraction.

TABLE 153. FATTY ACID COMPOSITION OF SERUM LIPIDS OF SELECTED BURMESE SUBJECTS

Subject Number and Location 1/	Percent Fatty Acid in Serum Lipids										Serum Cholesterol (mg/100 ml)
	C_{14}:0	C_{16}:0	C_{16}:1	C_{18}:0	C_{18}:1	C_{18}:2	C_{18}:3	C_{20}:0	C_{20}:4	C_{21}:0 2/	
1. Ba Htoo Myo (Mil.;M) 3/	3.3	20.0	7.9	5.2	26.4	29.7	0.7	1.0	5.9	Trace	75
2. Ba Htoo Myo (Mil.;M)	3.1	20.6	5.4	4.0	26.8	33.2	0.1	0.3	6.3	0.2	85
3. Maymyo (Dep.;F)	3.9	25.6	8.1	6.9	21.5	25.0	0.2	0.3	7.6	0.9	89
4. Chauk (Mil.;M)	2.4	20.4	5.1	7.1	24.7	28.8	0.3	0.4	9.8	1.1	113
5. Chauk (Mil.;M)	3.8	20.0	4.4	5.8	24.0	33.3	0.3	0.3	6.7	1.3	129
6. Ngayan Chaung (Civ.;F)	3.0	23.6	5.0	5.5	22.4	30.7	0.2	0.6	7.6	1.6	144
7. Ngayan Chaung (Civ.;F)	3.4	27.4	7.5	6.5	20.7	22.2	0.4	1.0	8.7	2.0	171
8. Ngayan Chaung (Civ.;M)	2.6	20.9	5.2	7.3	24.3	27.4	0.2	0.6	10.0	1.5	176
9. Ngayan Chaung (Civ.;M)	2.3	22.0	6.4	5.2	21.7	29.2	0.8	0.9	9.3	2.1	198
10. Maymyo (Mil.;M)	2.6	22.7	4.9	5.7	23.3	28.6	0.3	0.8	9.7	1.4	204
11. Maymyo (Dep.;F)	2.4	21.7	4.7	5.3	22.9	32.7	0.8	0.5	7.6	1.8	215
12. Maymyo (Mil.;M)	2.7	20.7	5.1	6.3	22.9	34.4	0.6	0.7	5.9	0.7	248
Average	3.0	22.1	5.8	5.9	23.5	29.6	0.4	0.6	7.9	1.2	---
13. Average, 11 Young Adult U.S.A. Males	4.8	22.0	7.1	7.7	22.8	28.7	---	---	6.9	---	---

1/ Subjects selected on basis of increasing serum cholesterol levels; M = male; F = female; Mil. = military; Dep. = military dependents; Civ. = civilians.

2/ Tentative identification as a C_{21}:0 fatty acid.

3/ Approximately 7 percent of an unknown fatty acid appeared after C_{16}:1 in this sample which was not included in the calculations; compound was possibly a C_{17}:0 or branched fatty acid.

b. Discussion and results

A detailed outline of the analytical method is given on page 163. The results are presented in Table 154.

TABLE 154. ASSAYS OF RED CELL HEMOLYSIS IN BURMESE SUBJECTS

Percent Hemolysis	Males		Females		Children		Total	
	No.	%	No.	%	No.	%	No.	%
<10	131	77	13	56	2	100	146	74
10-20	25	14	5	22	0		30	15
>20	16	9	5	22	0		21	11
Total	172		23		2		197	

The percent of hemolysis of a suspension of red cells following incubation with a 2.4 percent suspension of hydrogen peroxide is considered to be related to the serum tocopherol level as follows:

Percent hemolysis	Serum tocopherol level	
<10	= 0.7 mg/cc or higher	(Normal)
10-20	= 0.5-0.7 mg/cc	(Low)
>20	= 0.5 mg/cc or less	(Deficient)

Prior to this study, plasma tocopherol values have been determined in a total of 1,575 subjects in 18 surveys from five nations (United States, England, Holland, Italy, Hungary) (27). The mean (milligrams per 100 milliliters) $\pm$ S.D. has been found to vary from 0.77 $\pm$ 0.35 (Holland, 122 subjects) to 1.23 $\pm$ 0.31 (New Haven, Connecticut, 23 subjects) with the over-all mean being 1.01 $\pm$ 0.24. Only four of these studies have reported the distribution in detail. These show that 12, 7, 4 and 2 percent respectively of the total subjects in Holland (122 subjects), Rochester, New York (197 subjects), Birmingham, England (70 subjects) and other parts of England (583 subjects) had values in the deficiency range (27). In comparison, 11 percent of the 197 subjects from Mingaladon were found to be deficient, with a particularly high percentage (22 percent) occurring among the 23 female subjects, many of whom were pregnant or lactating.

Thus, it appears that a measurable amount of vitamin E deficiency may be detected in many regions, Mingaladon included. Present knowledge does not, however, justify recommendation of an increased intake of tocopherol. Research to clarify the significance of vitamin E in human nutrition is obviously needed.

c. Method

The procedure for the red cell hemolysis is as follows: Draw approximately 5 milliliters of blood into a heparinized tube. Transfer 0.2 milliliters to a graduated centrifuge tube containing 2.0 milliliters of citrate-saline solution. After centrifugation for 10 minutes at 1,800 rpm, the volume of cells is estimated and the supernatant fluid withdrawn. The cells are then made up to a 2.5 percent suspension in a saline-buffer mixture of equal parts of 0.9 percent saline and phosphate buffer (0.2 M potassium monophosphate,

25.0 milliliters; 0.2 M sodium hydroxide, 19.7 milliliters; distilled water to 100.0 milliliters, pH 7.4) and incubated at 37° C for 15 minutes. After centrifugation and withdrawal of the supernatant, they are resuspended, 5 percent in 0.9 percent saline. Into each of five small round-bottom test tubes 0.25 milliliters of suspension is pipetted after shaking to assure a uniform suspension. Into four of these tubes 0.25 milliliters of 2.4 percent hydrogen peroxide in phosphate buffer is measured (1 cc of 30 percent H_2O_2, superoxal r + 11.5 cc of phosphate buffer). Into the fifth tube 0.25 milliliters of phosphate buffer is pipetted as a control. All tubes are incubated at 37° C for 15 minutes, then gently shaken on a laboratory shaker at room temperature for two and three-quarter hours. At the end of this three-hour period, 4.5 milliliters of saline buffer is added to the control and to three of the tubes to which H_2O_2 has been added. To the fourth tube containing peroxide 4.5 milliliters of distilled water is added. The tubes are mixed by inversion and centrifuged, and the color of the supernatant fluid is read in a photoelectric colorimeter using a 540 millimicron (mμ) filter. The percent of hemolysis caused by peroxide in each tube is calculated from the ratio of the mean reading for the supernatants of tubes containing peroxide and saline buffer to the reading of the supernatant of the tube containing peroxide and distilled water, both values having been corrected by subtracting the reading of the control supernate.

8. Serum vitamin B_{12} and folacin

a. Introduction

Although the normal daily requirements for vitamin B_{12} and folacin are not fully established, reasonable estimates of needs are known (26). Similarly, serum levels of these vitamins reflect dietary intakes. Normal human serum contains vitamin B_{12} in concentrations ranging from 0.000100 to 0.000900 micrograms per milliliter, while folacin is present in concentrations ranging from 0.007 to 0.04 micrograms per milliliter. Daily intakes in the diet of 1 to 2 micrograms of vitamin B_{12} and of 0.5 milligrams of folacin would be expected to cover nutritional needs for these vitamins.

In order to obtain preliminary information concerning the adequacy of vitamin B_{12} and folacin in the nutrition of the Burma population sampled, random serum samples and diet composites were selected, for analysis for these two vitamins. The serum samples were sealed in ampules together with 10-25 milligrams of ascorbic acid and 1-2 milliliters of toluene, frozen and returned by air to the U.S. Army Medical Research and Nutrition Laboratory, Denver, Colorado.

For folacin analyses, thawed aliquots of the serum samples were diluted 1 to 10 with phosphate buffer at pH 6.1 to which fresh 0.05 percent ascorbic acid had been added. The serum-buffer solution was incubated at 37° C for 90 minutes and then autoclaved for 10 minutes at a pressure of 16 pounds per square inch. The coagulated proteins were removed by centrifugation and the clear supernatant was used for assay. Sample preparation was similar to that outlined in "Advances in Clinical Chemistry" (28). The samples were then assayed by microbiological procedures, employing Lactobacillus casei No. 7469 (American Type Culture Collection) as the assay organism. Procedures employed were those routinely used by the laboratory, and are similar to those outlined in the Official Methods of the Association of Official Agricultural Chemists (A.O.A.C.) (29).

Vitamin B_{12} was extracted from the serum samples by a procedure essentially that outlined in the A.O.A.C. Official Methods (30). One milliliter of serum was mixed with 9 milliliters of buffer solution containing 1.3 grams of anhydrous Na_2HPO_4, 1.2 grams of

citric acid monohydrate and 50 milligrams of sodium meta-bisulfite per 100 milliters of buffer. The serum samples were autoclaved for 10 minutes at 15 pounds pressure, cooled, centrifuged, and the supernatant collected and adjusted to pH 6.6-6.8 with potassium hydroxide. The extracts were then assayed by microbiologic procedures employing Lactobacillus leichmannii No. 7830 (American Type Culture Collection).

b. Results

Results of the analyses of the serum for vitamin B_{12} and folacin are summarized in Table 155. Serum levels of vitamin B_{12} were normal (average of 0.00038 micrograms per milliliter), except for an occasional subject who was considered low. This probably reflects the adequacy of the dietary intakes of vitamin B_{12}. Dietary analyses indicated intakes of vitamin B_{12} between 1.86 and 2.84 micrograms per person per day, which are considered adequate (see page 65, Table 50 on page 68 and Appendix Tables 3S and 3T).

TABLE 155. FOLACIN AND VITAMIN B_{12} IN THE SERUM OF RANDOMLY SELECTED BURMESE SUBJECTS

Subjects	No.	Folacin 1/ No. Low	B_{12} 2/ No. Low
Military	37	25 (68 percent)	3
Military dependents	25	21 (84 percent)	0
Civilians	17	7 (41 percent)	2
Average serum levels			
Folacin:	0.0072 mcg/ml (79 subjects)		
Vitamin B_{12}:	0.00038 mcg/ml (80 subjects)		

1/ L. casei 7469 assay; serum levels below 0.007 mcg/ml were considered "low."

2/ L. leichmannii 7830 assay; serum levels below 0.00010 mcg/ml were considered "low."

Serum levels for folacin were low, with an average serum concentration of only 0.0072 micrograms per milliliter for 79 subjects. Men in the military and the military dependents appeared to have lower values than the civilian subjects. From the results of the analyses performed on the diet composites, folacin intakes were low, with an average individual intake of 0.103 milligrams per day (see page 65, Table 50 on page 68 and Tables 3S and 3T in the Appendix).

Judging from the results of these limited studies, it would appear that additional investigations should be undertaken with regard to the adequacy of folacin (folic acid) in the diets of Burma and its possible association with certain cases of anemia.

9. Dietary protein and amino acid analyses

a. Introduction

The evaluation of protein nutriture of a population requires consideration of both the quantity and the quality of the protein consumed. In general, this means that the problem of satisfying protein requirement is one of providing those amino acids essential to man in adequate amounts and proportions rather than a mere consideration of the quantity of protein consumed.

Information on the amino acid intakes was obtained on part of the diet composites collected. Aliquots of the diet composites (0.1-0.5 grams) were placed in Pyrex test tubes to which 5 milliliters of 4 N potassium hydroxide (for tryptophan analyses) or 5 milliliters of 4 N hydrochloric acid (for all other amino acid analyses) were added. Tubes were flushed repeatedly in a closed system with nitrogen and then sealed under vacuum. The sealed tubes were then autoclaved for 6-8 hours at 15 pounds per square inch. The hydrolyzed samples were cooled and contents evaporated to dryness in a rotary vacuum drying apparatus. The residue remaining was then dissolved in sodium citrate buffer (pH 2.2) and made to a known volume with the buffer. Following filtering, aliquots of the acid hydrolyzed samples were analyzed with a Beckman/Spinco amino acid analyzer. Tryptophan was analyzed in aliquots of the alkaline hydrolysates by microbiologic procedures employing Pediococcus pentosaciens 911 (31). Values obtained by the analyzer instrument for histidine, phenylalanine, leucine, isoleucine and valine were also checked by microbiologic assays.

b. Results

The results of the amino acid analyses of the diet composites are presented in Table 156. The protein content of the diets and the protein intakes per standard man are also indicated. The amino acid values are expressed as grams of amino acid per 100 grams of protein where protein is expressed as Kjeldahl nitrogen x 6.25. Values for histidine and arginine are included in the table with recognition that these two amino acids are "essential" only for certain animal species, although histidine is essential for the infant human.

In comparison with the FAO "provisional amino acid pattern" (32) the results of the analyses would indicate that the protein of the average Burmese diet is low in tryptophan and possibly borderline in isoleucine content. However, with the observed daily protein intakes, these levels of tryptophan and isoleucine in the protein would furnish the minimum requirements of the adult human being. The needs for the infant or young child probably would not be adequately met at these levels of intake. Nevertheless, the observation that a significant number of the military dependents and civilians examined, including both adults and children, had depressed serum albumin levels would indicate that further studies on protein nutrition in Burma are warranted.

TABLE 156. ESSENTIAL AMINO ACID COMPOSITION OF PROTEINS IN BURMESE DIETS

Source of diet analyzed	Percent protein in diet	Protein intake per standard man per day (grams)	Amino acid content (gm/100 gm of protein as N x 6.25)										
			Isoleucine	Leucine	Lysine	Methionine	Phenylalanine	Tyrosine	Threonine	Tryptophan	Valine	Histidine	Arginine
Military													
Mingaladon	2.15	57	2.77	7.11	3.22	1.93	4.15	3.25	3.42	0.99	4.17	2.08	3.85
Ba Htoo Myo, BANCOS	3.04	95	3.88	8.89	6.88	2.88	5.42	3.47	4.91	0.97	5.38	2.54	6.56
Military Dependents													
Mingaladon, BAMC	2.62	60	2.93	7.25	6.62	2.63	4.45	2.59	4.03	0.84	3.97	2.46	6.93
Toungoo	3.12	55	3.19	6.96	4.66	2.46	5.72	2.11	3.81	1.10	3.99	2.53	6.09
Meiktila	2.22	50	3.59	7.99	5.21	2.36	5.78	3.57	4.19	0.66	4.22	2.51	6.26
Ba Htoo Myo	3.69	37	3.90	8.59	7.37	3.01	5.83	1.78	4.50	0.90	4.69	3.16	7.98
Maymyo	3.23	76	4.58	8.61	6.26	3.06	4.17	3.82	4.32	0.83	6.42	2.16	9.11
Moulmein	2.48	55	4.78	9.28	7.56	2.95	4.69	3.82	4.40	0.86	6.52	2.35	9.67
Civilians													
Zigon	4.95	68	3.45	7.75	7.71	2.88	4.80	2.48	4.51	0.59	4.06	2.28	6.71
Kyee Taw	2.91	63	4.25	7.45	6.55	3.30	5.51	1.70	4.62	0.60	4.29	2.51	6.92
Sé Bauk	3.06	54	3.80	8.37	6.25	2.93	6.10	3.79	4.81	1.09	5.17	2.71	6.42
Ngayan Chaung	1.89	47	3.80	8.72	5.31	2.61	6.27	4.28	4.31	0.50	5.18	2.71	8.17
Wet Wun	2.71	44	3.66	8.52	4.48	2.11	5.01	4.55	3.91	0.83	4.51	2.32	8.85
Average of all diets	2.93	59	3.74	8.11	6.01	2.70	5.22	3.17	4.29	0.83	4.81	2.49	7.19
FAO provisional amino acid pattern			4.2	4.8	4.2	2.2	2.8	2.8	2.8	1.4	4.2	-	-

References

1. Coursin, D.B., Convulsive Seizures in Infants with Pyridoxine-Deficient Diet. J. Am. Med. Assoc. 154: 406, 1954.
2. Snyderman, S.E., R. Carretero, and L.E. Holt, Jr., Pyridoxine Deficiency in the Human Being. Fed. Proc. 9: 371, 1950.
3. Mueller, J.F., and R.W. Vilter. Pyridoxine Deficiency in Human Beings Induced with Desoxypyridoxine. J. Clin. Invest. 29: 193, 1950.
4. Wachstein, M., and A. Gudaitis. Disturbance of Vitamin B_6 Metabolism in Pregnancy. J. Lab. Clin. Med. 40: 550, 1952.
5. Andrus, S.B., S.N. Gershoff, F.F. Faragalla and E.L. Prien. Production of Calcium Oxalate Renal Calculi in Vitamin B_6-Deficient Rats. Lab. Invest. 9: 7, 1960.
6. Vilter, R.W., The Metabolism of Vitamin B_6 in Human Beings. Am. J. Clin. Nutrition 4: 378, 1956.
7. Interdepartmental Committee on Nutrition for National Defense. Manual for Nutrition Surveys. Washington, D.C., 1957.
8. Brown, R.R., and J.M. Price. Quantitative Studies on Metabolites of Tryptophan in the Urine of the Dog, Cat, Rat and Man. J. Biol. Chem. 219: 985, 1955.
9. Brown, R.R. The Isolation and Determination of Urinary Hydroxykynurenine. J. Biol. Chem. 227: 649, 1957.
10. Boyland, E., and D.C. Williams. The Metabolism of Tryptophan: 2. The Metabolism of Tryptophan in Patients Suffering From Cancer of the Bladder. Biochem. J. 64: 578, 1956.
11. Gershoff, S.N., A.L. Mayer, and L.L. Kulczycki. Effect of Pyridoxine Administration on the Urinary Excretion of Oxalic Acid, Pyridoxine and Related Compounds in Mongoloids and Nonmongoloids. Am. J. Clin. Nutrition 7: 76, 1959.
12. Gershoff, S.N., F.F. Faragalla, D.A. Nelson and S.B. Andrus. Vitamin B_6 Deficiency and Oxalate Nephrocalcinosis in the Cat. Am. J. Med. 27: 72, 1959.
13. Gershoff, S.N., and F.F. Faragalla. Endogenous Oxalate Synthesis and Glycine, Serine, Deoxypyridoxine Interrelationships in Vitamin B_6-Deficient Rats. J. Biol. Chem. 234: 2391, 1959.
14. Archer, H.E., A.E. Dormer, E.F. Scowen and R.W.E. Watts. Studies on the Urinary Excretion of Oxalate by Normal Subjects. Clin. Sci. 16: 405, 1957.
15. Ehrmantraut, H.C. Joint Meeting of the Pacific Northwest Society of Pathologists and the Northwest Region, College of American Pathologists, May 2, 1958.
16. Cramer, W. Experimental production of kidney lesions by diet. Lancet 2: 174, 1932.
17. Gershoff, S.N., and S.B. Andrus. Dietary magnesium, calcium and vitamin B_6 and experimental nephropathies in rats: Calcium oxalate calculi, apatite nephrocalcinosis. J. Nutrition 73: 308, 1961.
18. Bunce, G.E., P.G. Reeves, T.S. Oba, and H.E. Sauberlich. The influence of the dietary protein level on the magnesium requirement. J. Nutrition (in press), 1963.
19. O'Dell, B.L., E.R. Morris, and W.O. Regan. Magnesium requirement of guinea pigs and rats. Effect of calcium and phosphorus and symptoms of magnesium deficiency. J. Nutrition 70: 103, 1960.
20. Vitale, J.J., E.E. Hellerstein, D.M. Hegsted, M. Nakamura, and A. Farbman. Studies on the interrelationships between dietary magnesium and calcium in atherogenesis and renal lesions. Am. J. Clin. Nutrition 7: 13, 1959.
21. United States Department of Agriculture. Magnesium in Human Nutrition. Home Economics Research Report No. 19, 1962.
22. Robinson, H.M.C., and J.C. Rathbun. The determination of calcium and magnesium in blood using one indicator. Canad. J. Biochem. Physiol. 37: 225, 1959.

23. Metcalfe, L.D., and A.A. Schmitz. The rapid preparation of fatty acid esters for gas chromatographic analysis. Anal. Chem. 33: 363, 1961.
24. Stoffel, W., F. Chu, and E.H. Ahrens, Jr. Analysis of long-chain fatty acids by gas-liquid chromatography. Micromethod for preparation of methyl esters. Anal. Chem. 31: 307, 1959.
25. Craig, B.M., and N.L. Murty. Quantitative fatty acid analysis of vegetable oils by gas-liquid chromatography. J. Am. Oil Chemists' Society 36: 549, 1959.
26. Recommended Dietary Allowances, Food and Nutrition Board, National Academy of Sciences-National Research Council, Publication 589, Washington, D.C., 1958.
27. Harris, P.L., E.G. Hardenbrook, F.P. Dean, E.R. Cusack, and J.L. Jensen. Blood tocopherol values in normal human adults and incidence of vitamin E deficiency. Proc. Soc. Exp. Biol. Med. 107: 381, 1961.
28. Advances in Clinical Chemistry, vol. 3, p. 277, 1960.
29. Association of Official Agricultural Chemists, Official Methods, 8th edition, p. 830, 1955.
30. Association of Official Agricultural Chemists, Official Methods, 9th edition, p. 665, 1960.
31. Day, E.J., H.D. Alexander, H.E. Sauberlich, and W.D. Salmon. Effects of gamma radiation on certain water-soluble vitamins in raw ground beef. J. Nutrition 62: 27, 1957.
32. Food and Agriculture Organization. Protein Requirements, FAO Nutritional Studies No. 16, Rome, 1957.

APPENDIX

		Page
1	Procedures	182
2	Agriculture and Food Processing	201
3	The Military Survey	210
4	The Military Dependents	256
5	The Civilian Survey	269
6	Correlation of Results	285

APPENDIX 1

APPENDIX TABLE 1A. CLINICAL EXAMINATIONS, BURMA POPULATION SAMPLE, BY LOCATION AND EXAMINER

Military

Location	ARMY									
	Mingaladon	Indaing	Toungoo	Meiktila	Ba Htoo Myo	Chauk	Maymyo	Moulmein	Army Boys	Total
	Abbreviated Examinations									
Total No. Examined	812	297	366	357	769	213	899	370	50	4,133
	Percent Examined									
Examiner No.										
1	10.7			22.1		25.4		21.6		7.2
2	9.4		26.2	3.4	15.9		2.6	9.4		8.8
3	13.8	14.8		35.0	13.9					9.4
4	14.9	7.7	6.0	1.1	20.7	38.5		6.8	50.0	9.2
5	35.7	49.8	38.8	3.4	30.0	33.3	47.3	25.1	50.0	35.0
6	15.3	27.6	29.0	35.0	19.5		39.8			24.6
7	0.2									0.0
8						2.8	10.3	20.0		4.2
9								17.0		1.5
	Detailed Examinations									
Total No. Examined	269	99	91	89	205	54	224	93	17	1,141
	Percent Examined									
Examiner No.										
1	6.7	37.4	3.3	2.2	45.8		10.3			15.5
2	40.1	62.6	9.9	42.7		48.1	28.6	47.3	52.9	31.6
3	16.4		34.1		24.9	1.8		52.7	47.1	16.1
4	30.5		52.7	55.0	29.3	50.0	61.2			35.3
6	6.3									1.5

APPENDIX TABLE 1A (Continued)

NAVY			AIR FORCE			
Seik Kyi	Ratanabon	Total	Mingaladon	Meiktila	Total	Combined Services
		Abbreviated Examinations				
126	102	228	130	472	602	4,963
		Percent Examined				
		--		23.9	18.8	8.3
	34.3	15.4		4.9	3.8	8.5
		--	30.8		6.6	8.6
42.8		23.7	30.0		6.5	9.5
42.1	34.3	38.6	36.9	39.2	38.7	35.6
15.1	31.4	22.4	2.3	32.0	25.6	24.6
		--			--	0.0
		--			--	3.5
		--			--	1.3
		Detailed Examinations				
42	34	76	41	117	158	1,375
		Percent Examined				
33.3	2.9	19.7	22.0	5.1	9.5	15.0
66.7		36.8	65.8		17.1	30.2
	35.3	15.8		41.9	31.0	17.8
	61.8	27.6	12.2	53.0	42.4	35.7
		--			--	1.2

APPENDIX TABLE 1A (Continued) CLINICAL EXAMINATIONS, BURMA POPULATION SAMPLE, BY LOCATION AND EXAMINER

Military Dependents, Total Sample

Location	ARMY								NAVY	AIR FORCE	
	Mingaladon	Indaing	Toungoo	Meiktila	Ba Htoo Myo	Chauk	Maymyo	Moulmein	(Seik Kyi (Ratanabon Total	(Mingaladon (Meiktila Total	Total
Total No. Examined	224	340	291	208	162	162	120	380	96	121	2,104
	Percent Examined										
Examiner No.											
1	10.7	19.4				24.7			2.1		6.3
2		43.8		3.4					20.8	38.8	10.6
3	15.2							24.2			6.0
4		0.6	43.6		38.3			2.6	17.7		10.4
5	44.2	24.4	35.4	45.2	32.1	30.9	39.2	36.8	33.3	35.5	35.3
6	29.9	11.8	21.0	39.9	29.6	30.9	37.5	11.0	26.0	25.6	23.4
7				11.5							1.1
8						13.6	23.3	17.9			5.6
9								7.4			1.3

Civilians, Total Sample

Location	Zigon	Indagaw	Kyee Taw	Shwe Daung	Lauk Sauk	Sé Bauk	Ngayan Chaung	Wet Wun	Chauk	Total
Total No. Examined	246	151	300	328	251	259	174	273	21	2,003
	Percent Examined									
Examiner No.										
1	20.3			5.2					33.3	3.7
2						26.2				3.4
3	11.4		33.3							6.4
4				30.5	40.2			21.2		12.9
5	35.4	60.9	41.0	35.4	33.9	33.6	46.6	29.7	42.8	38.0
6	32.9	39.1	25.7	29.0	25.9	25.5	29.9	26.7		28.4
7										--
8						14.7	23.6	22.3	23.8	7.2
9										--

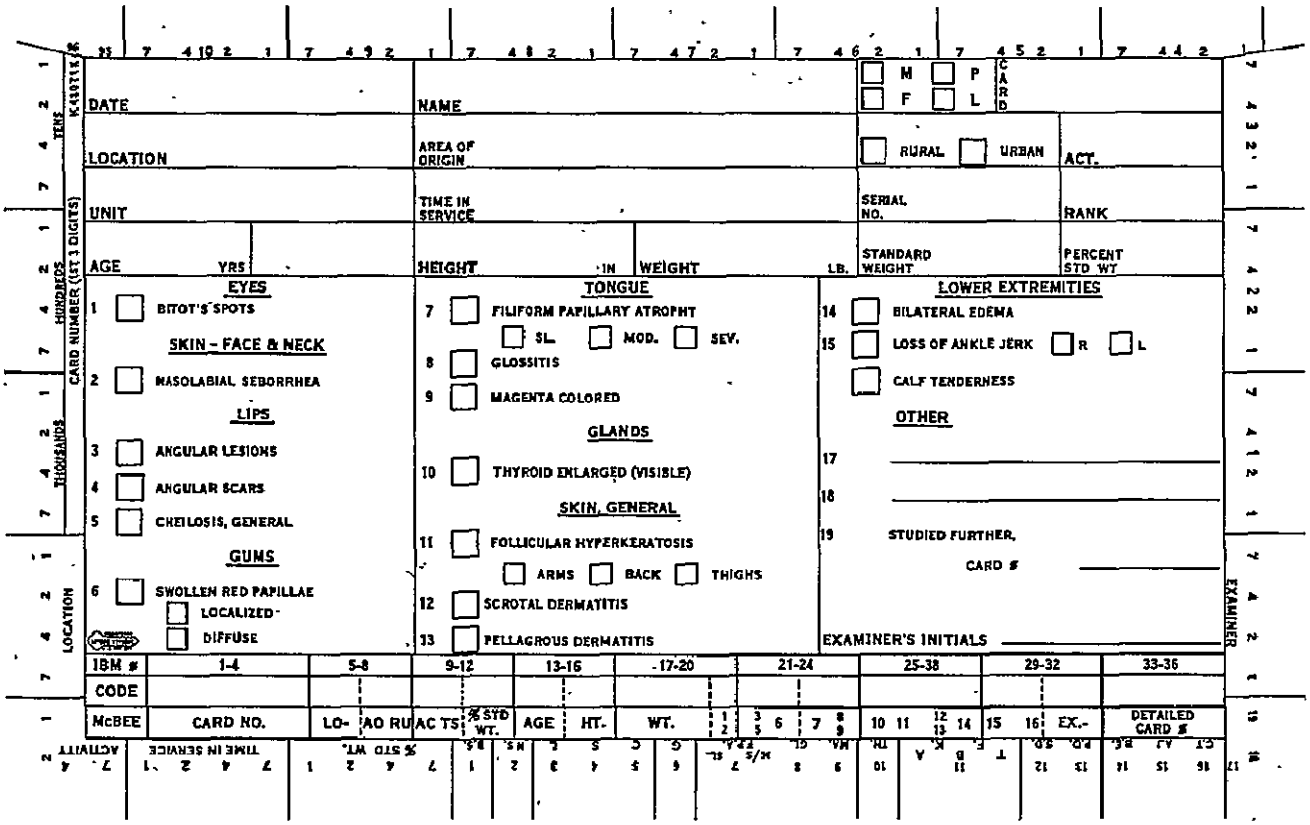


FIGURE 1A - CLINICAL EXAMINATION CARD. ABBREVIATED FORM.

DATE | NAME | ☐ M ☐ F ☐ P ☐ L | CARD

LOCATION | AREA OF ORIGIN | ☐ Rural ☐ Urban | ACT.

UNIT | TIME IN SERVICE | SERIAL No. | RANK

AGE yrs. | HEIGHT in | WEIGHT lb | STANDARD WEIGHT | PERCENT STD. WT.

RECENT HISTORY OF DISEASE

a ☐ Malaria b ☐ Trachoma c ☐ TBC d ☐ Diarrhea e ☐ _____ f ☐ _____

HAIR

1 ☐ Depigmentation

EYES

2 ☐ Thickened opaque bulbar conjunctiva
3 ☐ Xerosis conjunctiva
4 ☐ Pinguecular
5 ☐ Bitot's spots
6 ☐ Circumcorneal injection (bilateral)
7 ☐ Conjunctival injection (bilateral)
8 ☐ Blepharitis

SKIN – FACE & NECK

9 ☐ Nasolabial seborrhea
10 ☐ Other seborrhea
11 ☐ Pigmentation (malar)

LIPS

12 ☐ Angular lesions
13 ☐ Angular scars
14 ☐ Cheilosis

GUMS

15 a ☐ Marginal redness
15 b ☐ Marginal swelling
16 a ☐ Atrophy of papillae
16 b ☐ Recession of gums
17 ☐ Swollen red papillae ☐ Localized ☐ Diffuse
18 ☐ Bleeding gums

TEETH

19 ☐ Carious teeth ☐ 1-4 ☐ 5+
20 ☐ Worn teeth
21 ☐ Missing teeth ☐ 1-4 ☐ 5-16 ☐ 17-31
22 ☐ No teeth ☐ Plates ☐ No plates
23 ☐ Fluorosis
24 ☐ Malposition
25 ☐ Debris or calculus

TONGUE

26 ☐ Papillary atrophy – filiform
☐ Slight ☐ Moderate ☐ Severe
27 ☐ Papillary atrophy – fungiform
☐ Slight ☐ Moderate or Severe
28 ☐ Papillary hypertrophy or hyperemia
☐ Slight ☐ Moderate or Severe
29 ☐ Geographic
☐ Furrows or scrotal appearance
30 ☐ Fissures, erosions, or ulcers
31 ☐ Serrations or swellings
32 ☐ Red, tip and/or lateral margins only
33 ☐ Red, scarlet, beefy (glossitis)
34 ☐ Magenta colored

GLANDS

35 ☐ Parotid enlarged ☐ Bilateral
36 ☐ Thyroid enlarged (visible)

M17216X

OTHER:
37 ☐ _____
38 ☐ _____

REMARKS:

IBM#	1-4	5-8	9-12	13-16	17-20	21-24	25-28	29-32	33-36
CODE									
McBEE	CARD NO.	LO - AO RU	AC TS STD WT	AGE	HT.	WT.	HIST. D a c 6 f	1 3 4 2 5 8	9 12 15a 16b 11 14 15b 18
McBEE	19 21 23 20 22 25	26	27 29 32 28 31 34	35 36					

LIPS 12 13 14 15 16 17 18 GUMS 19 20 21 22 23 24 25 TEETH 26 27 28 29 30 31 32 33 34 TONGUE 35 36 GLANDS 37 38 39 40 41 42 OTHER 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 SKIN – GENERAL SKIN FACE & NECK EYES HAIR % STD. WT. TIME IN SERVICE ACTIVITY LOCATION CARD NUMBER (LST 3 DIGITS) HUNDREDS THOUSANDS TENS

FIGURE 1B - CLINICAL EXAMINATION CARD_ DETAILED FORM, FRONT.

82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112
		T.P.P.	7	4	2	1	7	4	2	1	7	4	2	1	7	4	2	1	7	4	2	1	7	4	2	1				
			HEMOGLOBIN				M.C.H.C.				SERUM VIT. C.				SERUM VIT. A				SERUM CAROTENE											

NICOTINAMIDE | RIBOFLAVIN | THIAMINE | BLOOD FECES | URINE | T.T. | B.P. | SKELETAL | LOWER EXTREMITIES | ABDOMEN | EXAMINER | SKIN – GENERAL

SKIN – GENERAL

Follicular hyperkeratosis

39 ☐ Arms ☐ Slight ☐ M/S

40 a ☐ Back ☐ Slight ☐ M/S

40 b ☐ Chest ☐ Slight ☐ M/S

41 a ☐ Thighs ☐ Slight ☐ M/S

41 b ☐ Buttocks ☐ Slight ☐ M/S

42 ☐ Perifolliculosis

43 ☐ Dry or scaling skin (Xerosis)

44 ☐ Crackled skin

45 ☐ Acneform eruption

46 ☐ Thickened pressure points (other than elbow and knees)

47 ☐ Purpura or petechia

48 ☐ Hyperpigmentation of the hands

49 ☐ Pellagrous dermatitis

☐ Neck ☐ Hands ☐ Other

50 ☐ Scrotal dermatitis

SKIN THICKNESS

Arm _____ mm Scapula _____ mm

51–53 EXAMINER'S INITIALS _____

ABDOMEN

CARD

54 ☐ Hepatomegalia

55 ☐ Splenomegaly

LOWER EXTREMITIES

56 ☐ Bilateral edema

57 ☐ Loss of ankle jerk ☐ R ☐ L

58 ☐ Calf tenderness

59 ☐ Loss of knee jerk ☐ R ☐ L

60 ☐ Loss of vibratory sense, Malleoli ☐ R ☐ L

61 ☐ Motor weakness

SKELETAL

62 ☐ Costochondrial beading

63 ☐ Epiphyseal enlargement

☐ Bowlegs

CARDIOVASCULAR

64 ☐ Blood Pressure _____ (>150/100)

☐ Pulse Rate _____ (>100)

☐ Murmur _____

65 ☐ Tourniquet Test ☐ positive

CARDIOVASCULAR EXAMINER'S INITIALS _____

66 ☐ Urine Sample # _____

67 ☐ Blood Sample # _____

68 ☐ Feces Sample # _____

URINE ANALYSES

69–72 Thiamine _____ _____

73–76 Riboflavin _____ _____

77–80 N'methylnicotinamide _____ _____

Creatinine _____

Urine volume _____ ml

Time of sample _____ hrs

BLOOD ANALYSES

81–84 Total Plasma Protein _____ (gm/100 ml) _____

Albumin _____ (gm/100 ml) _____

85–88 Hemoglobin _____ (%) _____

Hematocrit _____ (%) _____

89–92 MCHC = $\frac{\text{Hemoglobin}}{\text{Hematocrit}} \times 100$ _____ (%) _____

93–96 Serum Vitamin C _____ (mg/100 ml) _____

97–100 Serum Vitamin A _____ (mcg/100 ml) _____

101–104 Serum Carotene _____ (mcg/100 ml) _____

105–108 _____ _____ _____

OTHER:

109 ☐ _____

110 ☐ _____

111 ☐ PHOTOGRAPH _____

REMARKS:

IBM#	37-40	41-44	45-48	49-52	53-56	57-60	61-64	65-68	69-72	73-76	77-80
CODE											
McBEE	39 40b 41b 43 / 40a 41a 42 43	46 49 54 57 / 48 50 56 59	— —	BLOOD PRESSURE	PULSE ARM	SCAP EX —	TRN EXCRETION —	TPP Hgb	PCV MCHC	C A	CAROT. — —

FIGURE IC - CLINICAL EXAMINATION CARD_ DETAILED FORM, BACK.

APPENDIX 1B. FOOD COMPOSITION VALUES USED IN BURMA SURVEY[1/]

per 100 grams

Name Burmese; English	Botanical Name	Moisture gm	Calories	Protein gm	Fat gm
Leafy vegetables					
Kinbon thee	Cephandra indica	93.64	23.56	0.69	--
Khawei thee; ridge gourd	Luffa acutangula	93.6	23.76	0.79	--
Yonpadi thee; lady's finger	Hibiscus ascultatus	90.0	37.24	1.24	--
Hmyit; bamboo shoots		93.2	25.48	2.23	--
Datchinbaung; roselle	Hibiscus sabdariffa	86.25	51.4	2.41	--
Gorakha thee; chocho	Sechium edule	96.78	11.52	0.7	--
Pelay Hnyin		92.6	25.96	2.4	--
Shan nan-nan; coriander	Coriandrum sativum	89.3	38.88	1.5	--
Magyi thee (tender); tamarind	Tamarindus indica	77.71	85.56	2.5	--
Pepazun ywet; lablab bean	Dolichos lablab	97.2	9.28	0.6	--
Yeyo ywet; Indian mulberry	Morinda angustifolia	77.8	84.88	4.02	--
Mezali ywet; Siamese senna	Cassia siamea	73.5	100.04	7.07	--
Lebadu ywet	Asteracantha longifolia	82.2	67.6	4.06	--
Dant Gwye ywet; horseradish tree	Moringa oleifera	85.6	52.4	6.12	--
Pesaun-ya ywet; goa-bean	Psophocarpus tetra-gonolopa	86.0	54.4	0.9	--
Pepin pauk; sprouted green gram	Phaseolus radiatus	94.6	--	6.21	--
Dantdalun ywet (leaves); drumstick	Moringa oleifera	73.33	--	10.03	--
Zeephyu thee; gooseberry	Phyllanthus emblica	85	--	0.73	--
Gwecho thee	Spondias dulcis	87.8	--	tr.	--
Nannan pin; coriander	Coriandrum sativum	89.6	31.2	2.51	--
Yay-htikayon; sensitive plant	Mimosa pudica	93	26	1.37	--
Ka-nyut ywet (Le-ka-nyut)	Ammannia baccifera	90.89	32.6	6.65	--
Zaung-ya thee	Averrhoa carambola	93.4	25.2	0.22	--
Tayoke saga pwyint	Plumeria acutifolia	86.3	50.4	1.6	--
Bu ywet; gourd	Lagenaria vulgaris	90.1	36.84	5.09	--
Thinbaw ywet; papaya leaves (tender)	Carica papaya	79.6	75.2	6.13	--
Peinne thee nu; jackfruit (tender)	Artocarpus integrifolia	82.8	64.64	2.84	--
Yindaik ywet	Dalbergia cultrata	74.4	95.6	5.51	--
Peinne ywet nu; jackfruit leaves (tender)	Artocarpus integrifolia	75.5	90	4.99	--

1/ Values taken from Food Composition Tables, Nutrition Project, Burma, 15 September 1959.

APPENDIX 1B (Continued)

Carbohydrate gm	Fiber gm	Ash gm	Calcium mg	Phosphorus mg	Iron mg	Thiamine mcg	Riboflavin mcg	Vitamin C mg
5.2	--	0.47	24.6	25.0	0.6	tr.	tr.	81.0
5.15	--	0.46	20.2	25.0	0.76	tr.	tr.	6.57
8.07	--	0.69	95.0	8.2	1.2	--	--	6.45
4.14	--	0.45	25.0	8.0	0.1	--	--	--
10.44	--	0.90	82.0	36.7	2.0	--	--	50.37
2.18	--	0.34	18.0	20.0	0.2	--	--	8.4
4.09	--	0.91	43.2	41.4	1.2	--	--	9.16
8.22	--	0.98	99.9	36.9	13.0	--	--	20.15
18.89	--	0.90	61.2	38.68	0.8	--	--	tr.
1.72	--	0.48	8.0	36.0	23.0	--	--	4.5
17.2	--	0.98	36.59	30.0	32.5	--	--	100.75
17.94	--	1.49	44.14	120.0	17.0	--	--	100.5
12.84	--	0.9	54.81	75.0	13.0	--	--	100.1
6.98	--	1.3	58.5	51	11.4	--	--	201
12.7	--	0.4	44.55	71	15.1	--	--	44.8
--	--	--	57.6	85.1	0.85	62.5	48	20.6
--	--	--	336	5.38	6.4	59.9	254	240
--	--	--	60	12	0.85	42.6	287	960
--	--	--	102	67.13	0.22	33.6	--	162
5.29	--	2.6	146	50	13.6	48	96	128
5.13	--	0.5	35	53.0	1.4	115.2	48	18.5
4.51	--	0.95	60	68.2	6.4	72.0	49	52.8
6.08	--	0.3	100	45.0	0.8	76.8	48	100.6
11	--	1.1	69.3	60.3	12	--	--	224.5
4.12	--	0.69	56	140	115	--	--	95.4
12.67	--	1.6	335	220	25	--	--	264
13.22	--	1.1	53.4	35	10	--	--	27.16
18.39	--	1.7	28	78	25	--	--	26.41
17.51	--	2	170	60	17.5	--	--	70.4

APPENDIX 1B (Continued) FOOD COMPOSITION VALUES USED IN BURMA SURVEY

per 100 grams

Name Burmese; English	Botanical	Moisture gm	Calories	Protein gm	Fat gm
Dawai hmaing ywet	Quisqualis indica	75.4	91.6	4.83	--
Magyi ywet nu; tamarind leaves (tender)	Tamarindus indica	74.3	--	5.4	--
Gwechin thee	Spondias mangifera = S. pinnata	89.6	--	0.88	--
Hinnu-nwe; spinach	Amaranthus blitum	86.2	--	--	--
Kazun-u; sweet potato	Ipomoea batatas	66.55	131.8	1.11	--
Mayan thee nu; marian	Bouea burmanica	--	--	0.98	--
Mayan thee; marian (big)	do	--	--	0.97	--
Thayet thee nu; mango (tender)	Mangifera indica	83.45	--	0.68	--
Thayet ywet nu; mango leaves (tender)	do	77.6	--	3.6	--
Thayet phu nu; mango buds	do	72.4	--	3.4	--
Seasonal fruits					
Thayet-bingala; mango	Mangifera indica	82	69.95	0.3	0.07
Thayet-waso; mango	do	86	53.85	0.94	0.05
Thayet phyu; mango	do	84	60.95	0.71	0.03
Thayet panswe; mango	do	79.75	78.44	0.66	0.2
Thayet machitsu; mango	do	83	65.1	0.7	0.06
Thayet ingu; mango	do	81	74.43	0.59	0.11
Thayet sinmon; mango	do	79	80.54	0.93	0.10
Thayet gaunggyaw; mango	do	80	75.5	0.68	0.06
Duyin thee; durian	Durio zibethinus	74	101.8	2.28	0.2
Peinne thee; jackfruit (ripe)	Artocarpus integrifolia	61	152.1	1.87	0.6
Yakhine ngetpyaw; banana (plantain)	Musa paradisiaca	67.7	124.2	0.87	0.08
Pheegyan ngetpyaw; banana (ripe)	do	70.25	107.58	0.76	0.06
Htawbat ngetpyaw; banana (ripe)	do	66.5	130.78	1.16	0.3
Thakwar thee; cucumber (ripe)	Cucumis sativus	94.3	20.4	0.15	--
Rice and rice products					
Shwewa san; rice (polished)	Oryza sativa	7.7	381.4	7.17	3
Sabanet san; rice (polished)	do	8.2	380.34	7.13	3.1
Mandalay san; rice (polished)	do	6.8	380.8	6.87	2
Ngasein san; rice (polished)	do	6.1	381.5	6.86	1.7
Kamakyi san; rice (polished)	do	8.8	371.6	6.7	2
San kwe (Zakwe); broken rice	do	0.9	398.3	5.82	1.1
Phwenu; rice bran I, first polishing	do	11	--	5.25	--

Have protein from another book

APPENDIX 1B (Continued)

Carbohydrate gm	Fiber gm	Ash gm	Calcium mg	Phosphorus mg	Iron mg	Thiamine mcg	Riboflavin mcg	Vitamin C mg
18.07	--	1.7	103.5	97	40	--	--	70.2
--	--	0.4	6	32	2.7	19.2	30.4	--
--	--	0.7	250	36.3	2.5	--	--	27.8
--	--	2.5	192	95.23	3.8	52.8	290	21.9
31.84	--	0.5	144	64.21	1.9	67.2	48	3.2
--	--	0.2	98.6	54	0.4	tr.	--	22.63
--	--	0.2	82.8	54.5	0.6	19.2	--	26.33
14.92	--	0.95	51	32.86	3.9	52.8	48	220
--	--	0.9	15.3	71.36	3.4	45.6	96	220
--	--	0.9	86	71.4	2.8	57.6	48	251
17.03	--	0.6	12	60	0.4	--	--	6.2
12.41	--	0.6	10.8	62.2	0.3	--	--	14.67
14.46	--	0.8	9.9	60.8	0.2	--	--	10.2
18.5	--	0.89	10	70	0.18	--	--	14.7
15.44	--	0.8	10	70.6	0.2	--	--	12.57
17.77	--	0.53	12	70.6	0.2	--	--	12
18.98	--	1	12	69.8	0.2	--	--	17.6
18.06	--	1.2	13	69.8	0.2	--	--	22
22.72	--	0.8	12.6	66.6	0.8	--	--	29.34
34.8	0.8	0.8	14.4	71	0.4	--	--	7.2
30	0.4	0.89	19	28	0.5	--	--	9.6
26	0.5	1.1	20	51	0.25	--	--	7.04
30.86	0.2	0.9	22.5	37.5	0.6	--	--	10.6
4.95	--	0.6	40	55.2	0.8	72	96	45
81.43	--	0.7	11	98	9	--	--	--
80.98	--	0.5	10.6	102	8.2	--	--	--
83.83	--	0.7	10.9	105	10	--	--	--
84.69	--	0.63	9.7	100	10	--	--	--
81.7	--	0.71	7.2	140	6.7	--	--	--
91.28	--	0.9	--	--	--	--	--	--
--	--	15.2	--	208	80.8	105.6	96	--

APPENDIX 1B (Continued) FOOD COMPOSITION VALUES USED IN BURMA SURVEY

per 100 grams

Name Burmese; English	Botanical Name	Moisture gm	Calories	Protein gm	Fat gm
Phwenu; rice bran II	Oryza sativa	14	--	13.13	16.9
Phwenu; rice bran III	do	14	--	13.12	17.1
Phwenu; rice bran, old sample	do	16.2	283.9	14	3.1
Sapar (Zabar); paddy, raw	do	7.7	316.22	2.02	2.3
Phwenu; rice bran, old sample	do	16.8	--	4.9	6.1
Fish and fish products					
Ngamyin-yin ngapi; salt fish		--	--	28	--
Ngatha lauk ngapi; salt fish		--	--	25.2	--
Ngakhu ngapi; salt fish		--	--	30	--
Ngapoke chauk; dried fish		--	--	79.84	--
Arbye chauk; dried fish		--	--	73.34	--
Ngayant chauk; dried fish		--	--	77.63	--
Ngathaledo chauk; dried fish		--	--	76.82	--
Ye-gyo ngapi; fish paste, salt		53.75	--	22.89	--
Seinza ngapi; shrimp paste		44.26	--	18.12	2.25
do		44.31	--	23.46	1.5
do		46.09	--	17.54	2.64
do		44.06	--	19.47	3.3
do		43.07	--	13.08	3.01
do		46.82	--	21.26	3.1
Nganpya-ye; fish sauce		--	--	3.64	--
do		--	--	4.56	--
do		--	--	9.28	--
do		--	--	14.68	--
do		--	--	14.28	--
Pazunchauk; dried prawns		22.5	--	78.18	--
do		18.5	--	78.74	--
do		21	--	73.5	--
Nga-hmont; fish flour with bones		10.5	--	62.61	4.35
Peas, beans and their products					
Pekyer	Phaseolus lunatus	8.6	379.4	20.13	5.8
Pebizat	Dolichos biflorus	9	367.2	28.9	4.1
Pelun; cowpea	Vigna catjang	10	--	26.5	--
Peboke	Glycine hispida	13.4	--	39.91	--
Pegadipa; lablab bean	Dolichos lablab	12.6	--	--	--
Penauk; green gram	Phaseolus radiatus Vigna radiata	8.6	--	--	--

APPENDIX 1B (Continued)

Carbohydrate gm	Fiber gm	Ash gm	Calcium mg	Phosphorus mg	Iron mg	Thiamine mcg	Riboflavin mcg	Vitamin C mg
--	--	11.2	--	905	43.2	306.8	120	--
--	--	8.8	--	1,040	36	383.6	120	--
50	6.9	9.8	--	--	--	--	--	--
71.86	10.42	5.9	--	--	--	--	--	--
--	7.6	6.1	--	--	--	--	--	--
--	--	--	--	--	--	55.2	--	--
--	--	--	--	--	--	60	--	--
--	--	--	--	--	--	67.2	--	--
--	--	--	--	--	--	158.4	--	--
--	--	--	--	--	--	124.8	156	--
--	--	--	--	--	--	120	132	--
--	--	--	--	--	--	129.6	156	--
--	--	--	--	--	--	100.32	--	--
--	--	--	100	--	--	136.8	--	--
--	--	--	170.3	--	--	117.6	--	--
--	--	--	79.2	--	--	110.4	--	--
--	--	--	217.68	--	--	124.32	--	--
--	--	--	--	--	--	125.28	--	--
--	--	--	--	--	--	109.92	--	--
--	--	--	--	--	--	84.2	--	--
--	--	--	--	--	--	108.8	--	--
--	--	--	--	--	--	96	--	--
--	--	--	--	--	--	68	--	--
--	--	--	--	--	--	120	--	--
--	--	8.9	160	742	10	62	192	--
--	--	9	365	828	26	52.8	96	--
--	--	7.9	190	701.7	26	91.2	480	--
--	--	1.33	505	207	50	33.6	376	--
61.67	--	3.8	156	--	9.3	--	--	--
53.8	--	4.2	294	--	8.2	--	--	--
--	--	3.5	180	--	7.7	--	--	--
--	--	5.2	254	--	11.2	--	--	--
--	--	4	144	--	10	--	--	--
--	--	4.98	228.4	--	4.4	--	--	--

687462 O - 63 - 14

APPENDIX 1B (Continued) FOOD COMPOSITION VALUES USED IN BURMA SURVEY

per 100 grams

Name Burmese; English	Botanical Name	Moisture gm	Calories	Protein gm	Fat gm
Pehmont; Bengal gram flour	Cicer arietinum	13.3	365.2	11.4	5.6
Peseinngon; dhal	Cajanus indica	8.9	336.5	20.83	1.5
Myepefat; oil cake, groundnut	Arachis hypogaea	9.4	359.9	48.1	6.3
Mushrooms (Hmo)					
Taungbo hmo; mushroom		84.2	69.1	3.36	1.9
Kaukyo hmo; mushroom		90	45.8	3.65	1.8
Hmo chaytanshi; mushroom		81	--	6.19	1.14
Tin provision, Burma Army products					
Amebu; meat (tin provision) (Army produced)		56.05	267	21	20
Amehinbu; meat mixed with vegetables (tin provision)		75	159.7	4	13.5
Khayanchinthee-chet; tomato paste (tin provision)		68.8	221.2	4.63	20
Kyet U; egg, fertilized (hen)		72.25	165.7	12.49	12.78
Kyet U; egg, nonfertilized (hen)		71.7	174.3	13.58	13.3
Some Burmese snacks					
Myaype hlaw; roasted groundnut	Arachis hypogaea	4	--	21.72	47.95
Pegyi hlaw; roasted peas		7.4	--	25.56	15.6
Pe pyoke; boiled peas		63.83	--	10.56	0.73
Htanmyit pyoke; boiled root of palm seed		50.3	--	4.33	0.83
Laphet thoke (ngale chauk)		10.4	--	46.36	--
Phwenu-mont; sweet bran cake		23	--	5.69	--
Miscellaneous foodstuffs					
Paung-mont; bread, enriched		28.95	296.8	7.9	3.4
Paung-mont; bread, local		37.2	260.6	12.16	2.6
Lunzansi; lunzan seed		3.14	553.2	2.73	35.55
Pyaungbu; corn	Zea mays	11.25	356.7	9.39	3.3
Gyon-phwenu; wheat bran	Triticum vulgare	11	327.7	12.51	2.3
Bedabin; water hyacinth	Eichhorina crassipes	89.8	22.7	0.54	--
Daniyay; Nipal palm juice		--	--	--	--
Curries					
Pesein-ngon hin (Kyaw chet)		33	--	13.3	--
Pesein-ngon hin		79	--	8	--
Pe-hin (+ ngagle chauk); dhal curry		70.08	--	10.95	--
Penilay hin		82	--	6.57	--
Pewa-hin (Pesan); Bengal gram curry		85.4	--	5.95	--
Kyethingathee hin; bitter gourd curry with fish flour		--	--	16.66	--

APPENDIX 1B (Continued)

Carbohydrate gm	Fiber gm	Ash gm	Calcium mg	Phosphorus mg	Iron mg	Thiamine mcg	Riboflavin mcg	Vitamin C mg
67.3	--	2.4	15.3	298.7	2.4	--	--	--
59.93	4.74	4.3	--	--	--	--	--	--
27.68	2.9	5.6	--	--	--	--	--	--
9.64	--	0.9	tr.	--	--	64.8	--	--
3.75	--	0.8	--	--	--	52.8	--	--
--	--	1.5	--	--	6.5	172.8	--	--
0.75	--	2	10	143.5	35.2	52.79	24	--
5.55	--	1.95	7.5	60.5	1	71.99	43.2	--
3.17	--	3.4	30	100.7	15.4	81.58	71	--
0.18	--	1.6	--	--	--	--	--	--
0.07	--	1.35	--	--	--	--	--	--
--	--	--	32.3	--	10.3	74.4	274.6	--
--	--	--	10.9	--	8.3	84.1	268.8	--
--	--	--	25.2	--	0.83	72.48	153.6	--
--	--	6.82	--	--	--	146.8	40.8	--
--	--	6.6	592	817.7	6	57.6	53.6	--
--	--	1	106.5	80	6.8	--	--	--
58.65	--	1.1	30	120	20	--	--	--
47.14	--	0.9	25	105	11.6	--	--	--
55.58	--	3.11	--	--	--	--	--	--
72.35	1.97	1.75	--	--	--	--	--	--
64.25	6.11	3.8	--	--	--	--	--	--
5.13	2.43	2.1	--	--	--	--	--	--
--	--	2.78	246	7.58	260	19.2	23	--
--	--	2.8	192	174.3	2.6	62.4	--	--
--	--	1.2	360	79.59	1.6	52.8	--	--
--	--	3.5	264	152.5	0.8	40.8	--	--
--	--	1.6	275	87	2.2	72	48	--
--	--	2.1	308	101.2	1.6	60	48	--
--	--	5	524.6	368	5.6	108	123.6	--

APPENDIX 1C

Questionnaire Form

NUTRITION PROJECT, BURMA

Village_____ District_____

Name of Surveyor_____ House No._____

Name of Head of Family_____ Age Head Family_____Years

1. Income of the family per year_____kyats.

2. Name of the members of the family —

Names (1)	Age (2)	Sex (3)	Relationship to Head of Family (4)	Occupation (5)	Remarks including pregnancy and lactation (6)
(a)					
(b)					
(c)					
(d)					
(e)					
(f)					
(g)					

3. Children who have died —

Names	Age at time of death	Sex	Cause and date of death
(a)			
(b)			
(c)			
(d)			

4. Sanitary facilities —
Storage of drinking water.
Water supply.
Whether drinking water is boiled.

5. Foods —

Home produced	Amount used by Family	Amount sold
Rice		
Vegetables (mention kinds). . . .		
Fruits (mention kinds).		
Eggs (mention kinds).		

6. Rice (in condensed milk tins) —

Amount prepared per day	Amount eaten by family	Amount otherwise used	How milked	Washing and cooking of rice: how many times washing_____ much cooking water yes no

7. Marketing for the rest of the food —
How many times per week_____ per month_____ costs per time K_____

8. Kinds of other foods. Please give kinds and quantities vegetables, describe kinds

	Viss	Kilogr.	per day p.h.
Sugar, brown or white			
Meat, pork, beef, or chicken.			
Fish, fresh			
Fish, tinned, ngapi			
Eggs			
Fruits			
Oil			
Salt			
Milk (fresh or condensed) how many tins per week			

9. Feeding of infants, do they get other special foods or not. Describe the normal food for infants which is used.

10. Diet of nursing or expectant mothers, do they get special food or do they eat the normal diet of the family.

Are there any foods they do not eat during pregnancy.

Are the babies breast fed or bottle fed.

Describe the weaning diet of very young children.

11. Bowel movements of mother and children —

Diarrhea. Constipation.

12. Deficiency symptoms observed —

Members of family	Deficiency symptoms
(a)	
(b)	
(c)	
(d)	
(e)	
(f)	
(g)	
(h)	

APPENDIX TABLE 1D. STANDARD MAN VALUE[1/]

CHILDREN	
Younger than 1 year	0.25
1-3 years	0.35
4-6 years	0.50
7-9 years	0.65
10-12 years	0.75
Boys: 13-15 years	1.00
Girls: 13-15 years	0.75
Boys: 16-19 years	1.20
Girls: 16-19 years	0.70
MEN	
20-59 years	1.00
60 years and older	0.75
WOMEN	
20-59 years	0.80
60 years and older	0.55
Pregnant or lactating	1.00

1/ As percent of standard man.

APPENDIX 1E

METHODS AND CRITERIA USED IN THE DENTAL EXAMINATIONS, BURMA

The procedures and criteria used for assessment of oral health during the Burma survey are described below. They are essentially the same as those that have been ordinarily used by dentists in other ICNND surveys.

Dental caries. Each tooth in the mouth was recorded as free of dental caries, or decayed, or missing, or filled. Obvious cavitation was required before a lesion was recorded as carious. A tooth with a crown so destroyed by dental caries that restoration was impracticable was recorded as indicated for extraction and tabulated as a missing tooth. Any missing tooth was considered lost as a result of dental caries except in instances where there was good reason to suspect that a permanent tooth had not yet erupted.

Findings are presented as the mean numbers of decayed, missing, or filled (DMF) teeth per person.

Periodontal index (1). The condition of the supporting tissues (periodontium) of each tooth was evaluated according to the following scale:

Score	Observation
0	Supporting tissues negative for specified signs
1	Presence of an overt area of inflammation not circumscribing the tooth
2	Presence of an overt area of inflammation circumscribing the tooth
6	Clinical evidence of a periodontal (not gingival) pocket, indicating involvement of alveolar bone and loss of periodontal support
8	Tissue destruction advanced to the point that tooth function is impaired and increased mobility is present

Findings are presented as the mean score per person for teeth remaining in the mouth.

A numerical score is useful in epidemiological studies if it has a relation to the severity of the disease to which it is applied, and if the criteria of assessment represented by the score can be applied uniformly. Information in the following table[1/] is included to illustrate the relationship between mean periodontal index scores and clinical evaluation of periodontal involvement somewhat in terms of the classic clinical descriptions of mild, moderate and severe.

Clinical Evaluation	Usual Range of PI Scores	
Essentially normal	0	.2
Gingivitis	.3	.9
Severe gingivitis to incipient periodontal disease	.7	1.9
Established periodontal disease	1.5	5.0
Advanced periodontal disease	4.0	8.0

1/ Adapted from reference 1, p. 200.

Gingival recession. The recession score is based on a count of teeth around which the gingiva has receded apically to the cemento-enamel junction. It is expressed as the mean percent of teeth involved.

Oral hygiene index (2). The following teeth and surfaces are scored for oral debris and calculus:

Maxillary right and left first molars — labial surfaces
Maxillary right central incisor — labial surface
Mandibular right and left first molars — lingual surfaces
Mandibular left central incisor — labial surface

Debris was scored as follows:

0 No debris
1 Debris confined to gingival 1/3 of surface
2 Debris present on more than 1/3 but not more than 2/3 of surface
3 Debris present on more than 2/3 of surface

Calculus was scored as follows:

0 No detectable calculus
1 Supragingival calculus confined to gingival 1/3 of surface
2 Supragingival calculus present on more than 1/3 but not more than 2/3 of surface and/or flecks of subgingival calculus
3 Supragingival calculus present on more than 2/3 of surface and/or a continuous band of subgingival calculus

These findings are presented as the mean score per person for the teeth examined. The oral hygiene index is the sum of the debris and calculus scores.

References

1. Russell, A.L. A System of Classification and Scoring for Prevalence Surveys of Periodontal Disease. J. Dent. Research 35: 350, 1956.

2. Greene, J.C., and J.R. Vermillion. The Oral Hygiene Index: A Method for Classifying Oral Hygiene Status. J. Am. Dent. Assn. 61: 172, 1960.

APPENDIX 2A

Basic Reference Library

A food science laboratory will need a small reference library which should include, as a bare minimum, books as follows:

Author	Title	Publisher	Price[1/]
Matz	Bakery Technology and Engineering	Avi Publishing Co.	$16.00
Matz	Chemistry and Technology of Cereals	Avi Publishing Co.	16.00
Jacobs	Chemistry and Technology of Foods (2nd Edition)	Interscience Publishers	13.50
Cruess	Commercial Fruit and Vegetable Products	McGraw-Hill	16.00
Frandsen	Dairy Handbook and Dictionary	Avi Publishing Co.	10.50
Parker	Elements of Food Engineering (3 vols.)	Reinhold	24.00
Kirschenbauer	Fats and Oils: Chemistry and Technology	Avi Publishing Co.	7.00
Schultz	Food Enzymes	Avi Publishing Co.	7.50
Merory	Food Flavorings	Avi Publishing Co.	13.50
Frazier	Food Microbiology	McGraw-Hill	9.50
Herrick	Food Regulation and Compliance	Revere Publishing Co.	10.00
Prescott and Proctor	Food Technology	McGraw-Hill	10.50
Tressler and Evers	Freezing Preservation of Foods (2 vols.)	Avi Publishing Co.	30.00
Tressler and Joslyn	Fruit and Vegetable Juice Production	Avi Publishing Co.	16.00
Frobisher	Fundamentals of Bacteriology	W. B. Saunders Publ. Co.	4.00
Soc. Amer. Bacteriologists	Manual of Microbiological Methods		5.75
Association of Vitamin Chemists	Methods of Vitamin Assay	Interscience Publishers	6.00
Tanner	Microbiology of Foods	Garrard Press	12.50
Assn. of Official Agric. Chemists	Official Methods of Analysis	Geo. Banta Publ. Co.	18.00
Gortner and Gortner	Outlines of Biochemistry	John Wiley & Sons	9.75
Barail	Packaging Engineering	Avi Publishing Co.	9.50
Altchul	Processed Plant Protein Feedstuffs	Academic Press, Inc.	12.00
American Meat Institute	Science of Meat and Meat Products	Avi Publishing Co.	9.60
Markley	Soybeans and Soybean Products (2 vols.)	Interscience Publishers	31.00
American Public Health Association	Standard Methods for Examination of Milk Analysis	Amer. Pub. Health Assn.	7.50
American Public Health Association	Standard Methods for Examination of Water and Sewage	Amer. Pub. Health Assn.	7.50
Burrows	Textbook of Bacteriology	W. B. Saunders Publ. Co.	10.00
Decrosier	Technology of Food Preservation	Avi Publishing Co.	13.40

1/ Approximate price in U.S. dollars.

Basic Reference Library (Continued)

In addition the following journals should be available:

	Subscription per year
Applied Microbiology	$ 14.00
Food Engineering	10.00
Journal of Food Science	10.00
Food Technology	14.00
Journal of the Association of Official Agricultural Chemists	10.50
Journal of Nutrition	24.00
Total for first year	$439.00

APPENDIX 2B

EDIBLE BURMESE PLANTS

Name		
Scientific	English	Burmese
Nigella sativa, Linn.	Small fennel or black cumin	Sămon-net
Ranunculus sceleratus, Linn.	Celery-leaved crowfoot	Tă-nga Ngăyok
Anona muricata, Linn.	Soursop	Duyin-awza
Anona reticulata, Linn.	Bullock's heart, custard apple of the West Indies	Thinbaw-awza
Anona squamosa, Linn.	Sweetsop, custard apple of Anglo-Indians	Awza
Nelumbium speciosum, Willd.	Sacred lotus, sacred bean or water bean	Pădomma Kya
Nymphaea lotus, Linn.	Water lily	Kya
Nymphaea stellata	Water lily	Kya
Argemone mexicana, Linn.	Mexican or prickly poppy	Khăya
Papaver rhoeas, Linn.	Red or corn poppy	Bein-ni
Brassica alba	White mustard	Mon-hnyin-byu
Brassica campestris, Linn. Sub-sp. Campestris	Colza or Swedish turnip	--
Brassica campestris, Linn. Sub-sp. Napus	Rape	Mon-hnyin
Brassica campestris, Linn. Sub-sp. Rapa	Turnip	Kăbu-byu
Brassica juncea	Rai or Indian mustard	Mon-hnyin-ni
Brassica nigra, Koch	Black or true mustard	Mon-hnyin
Brassica oleracea, Linn. Sub-sp. Capitata	Cabbage	Kobi-dok; Mon-la-dok
Brassica oleracea, Linn. Sub-sp. Caulorapa	Kohlrabi	Kăbu
Brassica oleracea, Linn. Sub-sp. Botrytis	Cauliflower	Kobi-pwin; Pan Monla
Lepidium sativum, Linn.	Garden cress	Sămon-ni
Raphanus sativus, Linn.	Radish	Mon-la
Cleome viscosa, Linn.	Wild mustard	Hingăla
Bixa orellana, Linn.	Anatto	Thidin
Aberia gardneri, Hoch.	Ceylon plum; gooseberry	Naywè
Flacourtia ramontchi, L'Herit	Madagascar plum	Naywè
Portulaca oleracea, Linn.	Purslane (Indian)	Mya-byit
Calophyllum inophyllum, Linn.	Alexandrian laurel	Pon-nyet
Garcinia mangostana	Mangosteen	Mingut
Camellia theifera	Tea plant	Letpet
Durio zibethinus	Durian	Duyin
Hibiscus esculentus, Linn.	Okra, ochro or lady's finger plant	Yompădi
Hibiscus mutibilis, Linn.	Changeable hibiscus	Thon-ban-hla
Hibiscus sabdariffa, Linn.	Roselle	Chinbaung-ni; Bilat Chinbaung
Citrus aurantium	Orange tree	Lein-maw; Kăbăla
Citrus decumana, Linn.	Pomelo shaddock tree	Kywe-gaw; Shaukpan; Shaukton; Shauk waing
Citrus medica, Linn.	Citron	Shauk-Thăkhwa

EDIBLE BURMESE PLANTS (Continued)

Name		
Scientific	English	Burmese
Citrus medica, Linn., var. acida	Sour lime	Thanbaya
Citrus medica, Linn., var. limetta	Sweet lime tree	Shauk-cho; Thanbaya-cho
Citrus medica, Linn., var. limonum	Lemon tree	Shauk; Shauk-chin
Citrus medica, Linn., var. limonum	Maltese lemon	Thanbayo
Citrus medica, Linn., var. lumia	Sweet lemon	Shauk-cho
Vitis vinifera, Linn.	Grapevine	Thăbyit
Nephelium litchi, Camb.	Litchi tree	Kyet-mauk
Nephelium longana, Camb.	Longan tree	Taw Kyet-mauk
Anacardium occidentale, Linn.	Cashew-nut tree	Thiho Thăyet
Bouea burmanica, Griff. Syn. Bouea oppositifolia, Meissn.	Marian tree	Măyan; Măyin
Mangifera indica, Linn.	Mango tree	Thăyet
Spondias dulcis, Willd.	Hog plum or Olaheite apple tree	Thinbaw Gwe; Gwe-cho
Spondias mangifera, Willd.	Indian hog plum tree	Gwe
Abrus precatorius, Linn.	Indian or wild licorice	Ywe-găle
Arachis hypogaea, Linn.	Groundnut	Mye Pè
Cajanus indicus, Spreng	Pigeon pea	Pè-sin-ngon; Pè-yin-chaung
Canavalia ensiformis	Sword or jack bean	Pè-dălet; Pè-dăma
Cicer arientinum, Linn.	Gram or chick pea	Kălă Pè; Singaung Pè
Cyamopis tetragonoloba, Taub	Cluster bean	Pè-wăli
Dolichos biflorus, Linn.	Horse gram	Pè-bizat
Dolichos lablab, Linn.	Indian lablab bean	Nwè-pè; Pè-păzun
Glycine soja, Sieb.	Soya bean	Pè-ngăpi; Pè-kyat-pyin
Lens esculenta, Moench	Lentil	Pè-yaza; Pè-san-ban
Mucuna nivea	White-flowered velvet bean	Gwe-nge-pè; Pè-det-net; Khwe-li-pè
Pachyrhizus angulatus, Rich-C	Goa bean, Chinese potato	Pè-sein-sa; Sein-sa; Mrauk-u; Mah-pra
Phaseolus calcaratus, Roxb.	Lobia or Indian rice bean	Pè-yin; Kăchin Pè
Phaseolus lunatus, Linn.	Lima or duffin bean	Pè-gya; Pè-byu-găle
Phaseolus lunatus, Linn.	Madagascar bean	Pè-byu-gyi; Pè-wot-kyeik-lein
Phaseolus mungo, Linn.	Black pulse	Mat-pè; Mat-chwè
Phaseolus radiatus, Linn.	Green gram, mung	Pè-di-sein; Pè-di; Pè-nauk; Pè-nauk-sein
Phaseolus vulgaris, Linn.	Kidney, haricot bean	Bo-sa-pè; Tălă-pè; Pè-byin
Pisum arvense, Linn.	Field pea	Sădaw-pè; Pè-si-lon; Pè-leik-pya

Edible Burmese Plants
Scientific Names

EDIBLE BURMESE PLANTS (Continued)

Name		
ientific	English	Burmese
m sativum, Linn.	Common or garden pea	Sadaw-pè; Pè-daw; Pè-leik-pya
hocarpus tetragonolobus	Kaffir bean	Pè-myit; Pè-zaung-ya
Dania aculeata, Poir	Daincha	Nyan; Nyan-bauk
ia faba, Linn.	Broad bean	Tayok Pè; Pè-let-ma; Bo-sa-pè
gna catjang, Walp., Syn. Vigna catiang, Endl.	Cowpea	Pè-lun; Pè-ngashan; Pè-akyan; Tala-pè; Nadaw-pè; Pè-daung-lat; Wa-gaung-pè; Pè-daung-to; Pè-myin-sa-yaung; Tazaung-mon-pè; Pè-shwe-wa; Pè-mè; Pè-mi-go; Khawtoon-pè; Pè-byu-shaw; Pè-mi-shaw; Pè-let-nyo
Vigna catjang, Walp., var. sinensis	Chowli or asparagus bean	Pè-thi-daung; Pè-ngat-kya; Pè-gaung-baung; Pè-kyaung-ma; Pè-tit-ti-du; Pè-daung-she; Tala-pè; Pè-daung; Taing-daung-pè; Pè-paw-ni; Pè-wet-taung; Pè-shauk-kan; Thon-la-pè; Tawtalin-pè; Thon-daung-gyaw-pè
Tamarindus indicus, Linn.	Tamarind tree	Magyi
Mimosa pudica, Linn.	Sensitive plant	Htikayon
Pithecolobium dulce, Benth., Syn. Inga dulcis, Willd.	Manila tamarind	Thinbaw Magyi
Eriobotrya japonica, Lindl.	Loquat tree	Tayok Hninthi
Fragaria elatior, Ehrh.	Strawberry	Shan
Prunus armeniaca, Linn.	Apricot	Bingala Zi; Kala Zi; Tayok Zi
Prunus avium, Linn.	Cherry	Cheli
Prunus communis, Hud.	Plum	Mè-man
Prunus persica, Benth. & Hook.f	Nectarine and peach	Mè-man; Shan Zi
Pyrus communis, Linn.	Pear	Thit-taw
Pyrus malus, Linn.	Apple	Hnin-thi
Eugenia jambolana	Black plum	Thabye-byu
Eugenia jambos, Linn., Syn. Jambosa vulgaris	Rose apple	Thabyu Thabye

EDIBLE BURMESE PLANTS (Continued)

Name		
Scientific	English	Burmese
Psidium guyava, Linn., Syn. Psidium guajava, Linn.	Guava tree	Ma-ka-la; Man-ka-la; Ma-la-ka
Punica granatum, Linn.	Pomegranate	Thălè
Passiflora laurifolia, Linn.	Passion flower	Suka-ban; Nwè-ni-nat-pan
Passiflora quadrangularis, Linn.	Granadilla	Suka-thi-nwè; A-kaw-wădi
Carica papaya, Linn.	Papaw, papaya tree	Thinbaw-bin
Benincasa cerifera, Savi.	White gourd-melon	Kyauk Hpăyon
Citrullus vulgaris, Schrad.	Watermelon	Hpăyè
Cucumis melo, Linn., var. momordica	Sweet melon	Thăkhwa-hmwe
Cucumis melo, Linn., var. utilissima	Cucumber melon	Thăkhwa-hmwe
Cucumis sativus, Linn.	Cucumber	Thăkhwa
Cucurbita maxima, Duch.	Red gourd, squash gourd or melon-pumpkin	Shwe Hpăyon; Hpăyon
Cucurbita moschata, Duch.	Musk melon	Hpăyon
Cucurbita pepo	Pumpkin	Bu Thăkhwa
Lagenaria vulgaris, Ser.	White gourd, bottle gourd, prophet's gourd	Bu; Bu-thăbeik; Bu-sin-swe; Bungan
Momordica charantia, Linn.	Bitter gourd	Kyet-hin-ga
Sechium edule, Swartz	Chico, chocho, chayote	Gurăkha-bin
Trichosanthes anguina, Linn.	Snake gourd	Pèlinmwe
Opuntia oxyacantha	Prickly pear	Shăzaung-let-wa
Anethum sowa, Roxb.	Dill	Săneik
Apium graveolens, Linn.	Celery	Tăyok Nan-nan
Carum carui, Linn.	Caraway	Kărawe (Kălawe)
Carum petroselinum, Benth. & Hook.f.	Parsley	Tăyok Nan-nan
Coriandrum sativum, Linn.	Coriander	Nan-nan
Daucus carota, Linn.	Carrot	Mon-la-ni; Găgyè
Peucedanum sativum, Benth. & Hook.	Parsnip	--
Coffea arabica, Linn.	Arabian coffee	Ka-pi; Ka-hpi
Coffea liberica, Hiern.	Liberian coffee	Ka-pi; Ka-hpi
Achras sapota, Linn.	Sapota or sapodilla plum	Thagya-thi-bin
Chrysophyllum cainto, Linn.	Star apple of the West Indies	Thagya-thi-bin
Chrysophyllum roxburghii, G. Don.	Star apple	Thagya-thi-bin
Diospypros kaki, Linn.	Persimmon, Chinese date, Chinese fig	Tè; Tayok-Tè
Impomaea batatas, Poir	Sweet potato	Kăzun; Kăzun-u-nwè
Impomaea purpurea, Roth	Morning glory	Pan-kăzun-nwè
Capsicum annum, Linn.	Chilli or red pepper	Ngăyok
Capsicum frutescens, Linn.	Chilli or red pepper	Ngăyok
Capsicum grossum, Willd.	Bell pepper	Thinbaw Ngăyok
Capsicum minimum, Roxb.	Bird's eye chilli	Mo-hmyaw Ngăyok; Ngăyok-nok-myan

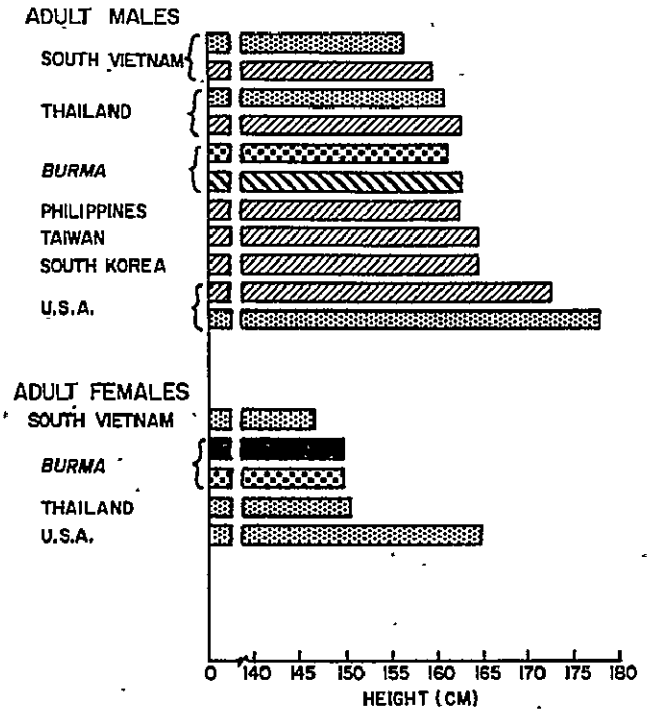
EDIBLE BURMESE PLANTS (Continued)

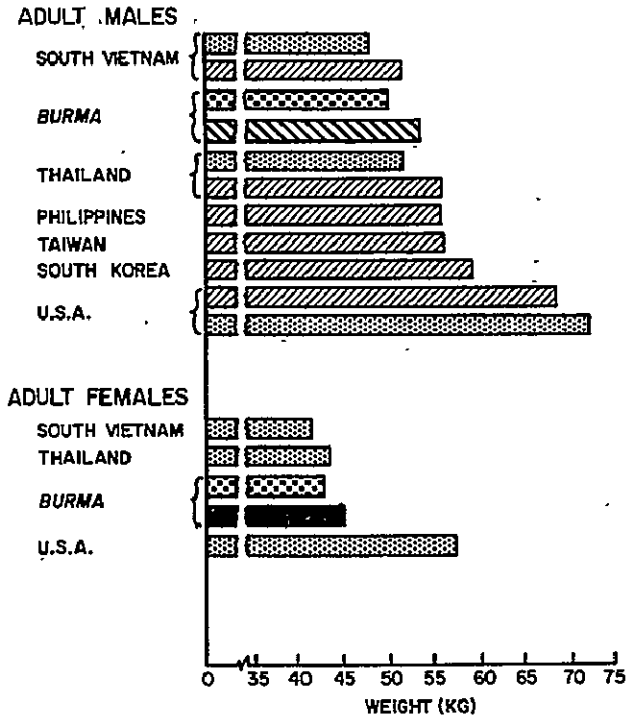
Name		
Scientific	English	Burmese
Lycopersicon esculentum	Tomato	Khǎyan-gyin
Physalis peruvianum, Linn.	Cape gooseberry	Tipari
Solanum melongena, Linn.	Brinjal or egg plant	Khǎyan
Solanum tuberosum, Linn.	Potato	Alu
Sesamum indicum	Sesame, sesamum	Hnan
Stachys tuberifera, Nand.	Chinese artichoke	Pèpodi
Basella rubra, Linn.	Indian spinach	Ginbeik
Fagopyrum esculentum, Moench	Buckwheat	Shari-mam
Piper betle, Linn., Syn. Chavica betle, Miq.	Betel vine	Kun
Piper nigrum, Linn.	Black pepper	Ngǎyok-kaung
Cinnamomum zeylanicum, Breyn	True cinnamon	Thinbaw Thit-clyabo; Lulen-gyaw; Nǎlin-gyaw
Manihot utilissima, Pohl	Cassava or tapioca plant	Palo-pinan-u-bin
Artocarpus incisa, Linn. f.	Breadfruit tree	Paung-mo-thi-bin
Artocarpus integrifolia, Linn.	Jackfruit tree	Pein-hnè
Ficus carica, Linn.	Fig tree	Thǎhpan; Thinbaw Thǎhpan
Ficus palmata, Forsk.	Indian fig tree	Thǎhpan
Morus indica, Linn.	Indian mulberry tree	Po-za
Juglans regia, Linn.	Walnut tree	Thit-kya
Musa chinensis, Sweet., Syn. Musa cavendishii, Lambert	Chinese dwarf banana	Wet-mǎ-lut
Musa paradisiaca, Linn., var. rubra	Red plantain	Shwe Hnget-pyaw
Maranta arundinacea, Linn.	West Indian arrowroot	Adalut; Pwinbwa-bin
Curcuma angustifolia, Roxb.	East Indian arrowroot	Adalut
Curcuma longa, Linn.	Turmeric	Sǎ-nwin; Nǎ-nwin
Zingiber officinale, Rose.	Ginger	Gyin; Gyin-sein
Ananas sativa, Linn.	Pineapple	Nanat
Zephyranthes carinata, Herb.	Rose amaryllis	Hnin-ban-ni
Dioscorea aculeata, Linn.	Prickly-stemmed yam	Tǎdwe-bin; Wet-ka
Dioscorea alata, Linn.	Wing-stemmed yam	Myauk-u-bin; Myauk-hpyu; Myauk gyin; Myauk-chwe gyo
Dioscorea atropurpurea, Roxb.	Dark-purple yam	Myauk-u-bin; Myauk-u-ni
Dioscorea fasciculata, Roxb.	Kidney yam	Kǎdwe (Tǎdwe)-bin
Dioscorea glabra, Roxb.	Chinese yam	Myauk-nwè; Kat-kǎtè
Dioscorea pentaphylla, Linn.	Kawan yam of Fiji	Pwa-sa-bin; Put-sa-bin
Dioscorea purpurea, Roxb.	Purple yam	Myauk-u-ni-bin
Dioscorea sativa, Linn.	Common yam	Myauk-u-bin
Allium ampeloprasum, Linn.	Leek	Htan Kyet-thun
Allium ascalonicum, Linn.	Shallot	Kyet-thun-ni; Kyet-thun-gǎle; Kyet-thun-ni-gǎle

EDIBLE BURMESE PLANTS (Continued)

Name		
Scientific	English	Burmese
Allium cepa, Linn.	Onion	Kyet-thun-u-gyi; Kăla Kyet-thun
Allium tuberosum, Roxb.	Indian leek	Gyu-myit
Allium sativum, Linn.	Garlic	Kyet-thun-byu
Eichhornia crassipes, Solms.	Water hyacinth	Beda-bin; Ye Pŭdauk
Areca catechu, Linn.	Areca nut or betel-nut palm	Kun-thi-bin
Arenga saccharifera, Labill.	Sago palm of Malaya	Taw (Taung) On
Cocos nucifera, Linn.	Coconut palm	On
Phoenix sylvestris, Roxb.	Wild date palm	Sun-bă-lun
Colocasia antiquorum, Schott.	Egyptian arum, taro, eddoes or coco	Pein-u; Măhuya
Coix lachryma-jobi, Linn.	Job's tears grass	Kyeik; Kăleik; Kălein
Cymbopogon citratus, Stapi.	Culinary lemon grass	Sŭbălin
Cymbopogon nardus, Rendle. Syn. Andropogon nardus, Linn.	Citronella grass	Sŭbălin-hmwe; Myet-hmwe
Oryza sativa, Linn.	Rice	Sŭba
Panicum miliaceum, Linn.	Common millet	Lu
Paspalum scrobiculatum, Linn.	Kodo millet	--
Pennisetum typhoideum, Rich.	Bulrush millet or spike millet	Kăla Sŭt
Saccharum officinarum, Linn.	Sugar cane	Kyan
Sorghum vulgare, Pers. Syn. Andropogon	Great Indian millet, Guinea corn	Pyaung; Kon Pyaung; San Pyaung
Zea mays, Linn.	Maize or Indian corn	Pyaung-bu
Avena sativa, Linn.	Oat	Ok-gyon
Eleusine coracana, Gaertn.	Ragi millet	Sŭt-ni
Hordeum vulgare, Linn.	Barley	Byit Gyon
Triticum durum, Desf.	Macaroni wheat	Syon; Tŭmă gauk Syon
Triticum vulgare, Vill.	Common wheat	Gyon

COMPARISON OF AVERAGE HEIGHTS AND WEIGHTS OF BURMESE ADULTS WITH AVERAGES FROM OTHER COUNTRIES





CIVILIANS
MILITARY
BURMESE CIVILIANS
BURMESE MILITARY DEPENDENTS
BURMESE MILITARY

FIGURE 3A

APPENDIX 3

APPENDIX TABLE 3A. HEIGHT, WEIGHT, PERCENT "STANDARD WEIGHT" AND AGE BY RANK, BURMA, MILITARY

Mean Values

	ARMY				NAVY			
	Enlisted Men	NCO	Officers	Total	Enlisted Men	NCO	Officers	Total
Number	3,138	882	108	4,128	194	6	28	228
Height, cm	162.6	163.3	165.3	162.8	164.2	162.0	165.0	164.3
Weight, kg	53.0	53.1	58.1	53.1	52.4	52.0	54.2	52.6
Number	3,138	882	108	4,128	194	6	28	228
% "Standard Weight"	88.7	87.4	93.4	88.6	87.7	86.5	88.1	87.7
Number	3,143	882	108	4,133	194	6	28	228
Age (Years)	25.9	30.4	33.5	27.0	21.8	31.2	25.1	22.5

APPENDIX TABLE 3A (Continued)

AIR FORCE				COMBINED SERVICES			
Enlisted Men	NCO	Officers	Total	Enlisted Men	NCO	Officers	Total
469	104	27	600	3,801	992	163	4,956
162.8	164.8	164.2	163.2	162.7	163.4	165.1	163.0
51.0	53.6	55.1	51.6	52.7	53.2	56.9	52.9
468	104	27	599	3,800	992	163	4,955
85.7	86.6	90.7	86.1	88.3	87.3	92.0	88.2
471	104	27	602	3,808	992	163	4,963
23.1	29.2	24.6	24.2	25.3	30.3	30.6	26.5

APPENDIX TABLE 3B. CLINICAL FINDINGS BY LOCATION AND SERVICE, BURMA, MILITARY

(Abbreviated Examinations)

Location	ARMY									
	Mingaladon	Indaing	Toungoo	Meiktila	Ba Htoo Myo	Chauk	Maymyo	Moulmein	Army Boys	Total
Number Examined	812	297	366	357	769	213	899	370	50	4,133
	Percent Prevalence									
Eyes										
Bitot's spots				0.3	0.1		0.1	0.3		0.1
Skin, Face and Neck										
Nasolabial seborrhea	4.3	11.1	11.2	10.6	6.6	6.6	5.1	3.5		6.6
Lips										
Angular lesions	5.8	8.4	7.4	2.5	3.6	3.3	4.6	1.9	18.0	4.8
Angular scars		2.7	1.4	2.5	3.4	1.4	4.3	0.8		2.2
Cheilosis	0.1				0.1					0.04
Gums										
Swollen red papillae										
Localized	2.8	3.4		1.7	0.6	0.5	0.6	0.8		1.3
Diffuse	2.7	3.0	0.8	0.8	0.6		0.4	0.8	2.0	1.2
Tongue										
Filiform papillary atrophy - Slight	1.0	0.3	1.6	0.6	0.3	0.9	1.8	0.5		0.9
Moderate	0.4	0.3		0.3	0.4		1.3			0.5
Glossitis	0.1	1.0	0.3	0.3	0.1		0.6		2.0	0.3
Glands										
Thyroid enlarged										
Grade I	1.7	1.3	1.4	1.4	1.6	1.4	2.3	4.6		2.0
Grade II								0.3		0.0
Skin, General										
Follicular hyperkeratosis										
Anywhere	5.4	6.1	4.4	1.7	1.6	1.4	0.6		2.0	2.5
Arms	0.1				0.3	0.9	0.4			0.2
Back	4.9	6.1	4.4	1.7	1.3	1.4	0.3		2.0	2.3
Thighs	0.6					0.9				0.2
Scrotal dermatitis	0.5									0.1
Lower Extremities										
Bilateral edema				0.3			0.2	0.3		0.1
Loss of ankle jerk										
Unilateral	0.4	0.7		0.8	0.5		0.3	0.5		0.4
Bilateral	0.2	1.0		0.8	0.1		0.2	1.4		0.4
Side not given		2.0	0.8	1.1	1.2	1.4	2.9			1.2
Calf tenderness				0.3			0.1			0.0
Other										
Pterygium	4.8	4.0	2.7	3.1	2.3	1.9	2.1	2.4		3.0
Thickened bulbar conjunctivae	36.6	57.6	66.4	74.2	64.1	68.5	35.9	65.4	6.0	52.8

APPENDIX TABLE 3B (Continued)

NAVY			AIR FORCE			
Seik Kyi	Ratanabon	Total	Mingaladon	Meiktila	Total	Combined Services
126	102	228	130	472	602	4,963
		Percent Prevalence				
		--		0.2	0.2	0.1
2.4	3.9	3.1		7.8	6.1	6.3
4.0	6.9	5.3	6.2	1.9	2.8	4.6
1.6	1.0	1.3		2.3	1.8	2.2
		--			--	0.0
2.4	2.0	2.2	0.8	0.4	0.5	1.2
2.4	1.0	1.8	0.8	0.2	0.3	1.1
0.8	2.9	1.8	0.8	0.6	0.7	0.9
0.8		0.4		0.4	0.3	0.5
		--	1.5	0.2	0.5	0.3
1.6	2.9	2.2	2.3	0.8	1.2	1.9
		--			--	0.0
10.3	19.6	14.5	3.8	4.7	4.5	3.3
2.4	2.9	2.6		0.2	0.2	0.3
10.3	19.6	14.5	1.5	4.7	4.0	3.1
1.6		0.9	2.3		0.5	0.2
1.6		0.9	0.8		0.2	0.1
		--			--	0.1
		--			--	0.3
0.8		0.4			--	0.3
0.8	1.0	0.9			--	1.1
		--			--	0.0
	2.0	0.9	2.3	0.2	0.7	2.6
25.4	48.0	35.5	9.2	65.2	53.2	52.1

APPENDIX TABLE 3C. CLINICAL FINDINGS BY PERCENT "STANDARD WEIGHT," BURMA, MILITARY

(Abbreviated Examinations)

	ARMY							
Percent "Standard Weight"	60-69	70-79	80-89	90-99	100-109	110-119	120-139	Total
Number Examined	34	591	1,744	1,307	362	69	21	4,128
	Percent Prevalence							
Eyes								
Bitot's spots			0.1		0.6			0.1
Skin, Face and Neck								
Nasolabial seborrhea	5.9	5.6	7.3	6.4	5.0	7.2	9.5	6.6
Lips								
Angular lesions		5.1	4.5	4.7	6.9	2.9	14.3	4.8
Angular scars		1.5	1.9	2.8	3.6	2.9		2.2
Cheilosis		0.2		0.1				0.0
Gums								
Swollen red papillae								
Localized	5.9	2.2	1.0	1.1	1.4		4.8	1.3
Diffuse		2.4	1.2	0.9	0.6		4.8	1.2
Tongue								
Filiform papillary atrophy								
Slight	2.9	0.5	1.2	0.8	0.8	1.4		0.9
Moderate		0.7	0.3	0.4	0.6	1.4	4.8	0.5
Glossitis		0.3	0.4	0.2				0.3
Glands								
Thyroid enlarged - Grade I		2.2	1.7	2.3	2.5			2.0
Grade II		0.2						0.0
Skin, General								
Follicular hyperkeratosis								
Anywhere	2.9	2.2	1.8	2.9	4.7	4.3	4.8	2.5
Arms		0.2	0.0	0.4	0.6			0.2
Back	2.9	1.9	1.7	2.8	4.4	4.3	4.8	2.3
Thighs		0.5	0.1	0.1	0.3			0.2
Scrotal dermatitis			0.2		0.3			0.1
Lower Extremities								
Bilateral edema				0.2		1.4		0.1
Loss of ankle jerk								
Unilateral		0.5	0.2	0.6	0.3			0.4
Bilateral		0.5	0.4	0.3		2.9		0.4
Side not given		1.2	0.9	1.7	1.1	2.9		1.2
Calf tenderness				0.2				0.0
Other								
Pterygium	5.9	3.2	3.2	2.4	2.5	1.4	9.5	3.0
Thickened bulbar conjunctivae	64.7	53.1	53.3	51.0	52.8	66.7	47.6	52.8

APPENDIX TABLE 3C (Continued)

NAVY					AIR FORCE						
60-79	80-89	90-99	100-119	Total	60-69	70-79	80-89	90-99	100-109	110-139	Total
29	106	79	14	228	8	127	272	155	28	9	599
	Percent Prevalence						Percent Prevalence				
				--				0.6			0.2
	3.8	3.8		3.1		3.9	5.9	7.7	3.6	33.3	6.1
6.9	4.7	5.1	7.1	5.3		3.9	2.2	2.6	3.6	11.1	2.8
	0.9	2.5		1.3		1.6	1.8	2.6			1.8
				--							--
6.9	0.9	2.5		2.2			1.1				0.5
	1.9	1.3	7.1	1.8			0.4	0.6			0.3
3.4	2.8			1.8			1.5				0.7
	0.9			0.4			0.4	0.6			0.3
				--	12.5		0.4	0.6			0.5
3.4	2.8	1.3		2.2			1.5	0.6	7.1		1.2
				--							--
20.7	12.3	15.2	14.3	14.5		3.1	4.0	5.2	10.7	11.1	4.5
6.9		3.8	7.1	2.6			0.4				0.2
20.7	12.3	15.2	14.3	14.5		2.4	3.7	4.5	10.7	11.1	4.0
3.4	0.9			0.9		0.8	0.4	0.6			0.5
	1.9			0.9		0.8					0.2
				--							--
				--							--
		1.3		0.4							--
	1.9			0.9							--
				--							--
		2.5		0.9		0.8		1.3	3.6		0.7
41.4	36.8	30.4	42.8	35.5	25.0	43.3	58.8	54.2	50.0	44.4	53.2

APPENDIX TABLE 3D. CLINICAL FINDINGS AND MESSING PRACTICE BY RANK, BURMA, MILITARY

(Abbreviated Examinations)

	ARMY				NAVY			
	Enlisted Men	NCO	Officers	Total	Enlisted Men	NCO	Officers	Total
Number	3,143	882	108	4,133	194	6	28	228
				Percent Prevalence				
Eyes								
Bitot's spots	0.1	0.2		0.1				--
Skin, Face and Neck								
Nasolabial seborrhea	6.6	6.1	7.4	6.6	3.1	16.7		3.1
Lips								
Angular lesions	5.5	2.6	2.8	4.8	6.2			5.3
Angular scars	2.7	0.8	0.9	2.2	1.5			1.3
Cheilosis	0.1			0.04				--
Gums								
Swollen red papillae								
Localized	1.1	1.8	0.9	1.3	2.6			2.2
Diffuse	1.1	1.6		1.2	1.5		3.6	1.8
Tongue								
Filiform papillary atrophy								
Slight	1.0	0.8		0.9	2.1			1.8
Moderate	0.4	0.6	0.9	0.5			3.6	0.4
Glossitis	0.3	0.3		0.3				--
Glands								
Thyroid enlarged								
Grade I	1.8	2.4	1.8	2.0	2.1	16.7		2.2
Grade II	0.03			0.02				--
Skin, General								
Follicular hyperkeratosis								
Anywhere	2.6	2.4	1.8	2.5	15.5	33.3	3.6	14.5
Arms	0.2	0.1		0.2	3.1			2.6
Back	2.4	2.3	0.9	2.3	15.5	33.3	3.6	14.5
Thighs	0.2	0.1	0.9	0.2	1.0			0.9
Scrotal dermatitis	0.1		0.9	0.1	1.0			0.9
Lower Extremities								
Bilateral edema	0.1		0.9	0.1				--
Loss of ankle jerk								
Unilateral	0.4	0.4		0.4				--
Bilateral	0.3	0.4	0.9	0.4			3.6	0.4
Not given	1.2	1.2	0.9	1.2	1.0			0.9
Calf tenderness	0.1			0.04				--
Other								
Pterygium	2.9	3.4	0.9	3.0	1.0			0.9
Thickened bulbar conjunctivae	51.7	55.6	62.0	52.8	36.1	33.3	32.1	35.5
				Percent Distribution				
Messing Practice								
Eat at home	43.4	57.9	50.9	46.7	17.0	83.3		16.7
Eat on base	50.2	36.5	48.1	47.2	83.0	16.7	100.0	83.3
Unknown	6.3	5.6	0.9	6.0				--

APPENDIX TABLE 3D (Continued)

AIR FORCE				COMBINED SERVICES			
Enlisted Men	NCO	Officers	Total	Enlisted Men	NCO	Officers	Total
471	104	27	102	3,808	992	163	4,963
			Percent Prevalence				
	1.0		0.2	0.05	0.3		0.1
5.7	8.6	3.7	6.1	6.4	6.4	5.5	6.3
3.4	1.0		2.8	5.3	2.4	1.8	4.6
1.9	1.9		1.8	2.5	0.9	0.6	2.2
			--	0.05			0.04
0.6			0.5	1.2	1.6	0.6	1.2
0.4			0.3	1.1	1.4	0.6	1.1
0.8			0.7	1.0	0.7		0.9
0.2	1.0		0.3	0.4	0.6	1.2	0.5
0.2	1.9		0.5	0.3	0.5		0.3
1.1	1.9		1.2	1.8	2.4	1.2	1.9
			--	0.02			0.02
5.1	1.9	3.7	4.5	3.6	2.5	2.4	3.3
0.2			0.2	0.4	0.1		0.3
4.4	1.9	3.7	4.0	3.3	2.4	1.8	3.1
0.6			0.5	0.3	0.1	0.6	0.2
0.2			0.2	0.2		0.6	0.1
			--	0.1		0.6	0.1
			--	0.3	0.4		0.3
			--	0.3	0.4	1.2	0.3
			--	1.1	1.1	0.6	1.1
			--	0.05			0.04
0.6	1.0		0.7	2.5	3.1	0.6	2.6
52.9	55.8	48.1	53.2	51.1	55.4	54.6	52.1
			Percent Distribution				
35.9	76.9	18.5	42.2	41.2	60.1	36.8	44.8
64.1	23.1	81.5	57.8	53.6	35.0	62.6	50.2
			--	5.2	4.9	0.6	5.0

APPENDIX TABLE 3E. CLINICAL FINDINGS BY LOCATION AND SERVICE, BURMA, MILITARY

(Detailed Examinations)

	ARMY									
Location	Mingaladon	Indaing	Toungoo	Meiktila	Ba Htoo Myo	Chauk	Maymyo	Moulmein	Army Boys	Total
Number Examined	269	99	91	89	205	54	224	93	17	1,141
	Percent Prevalence									
History of:										
Malaria	12.6	8.1	27.5	18.0	10.2	35.2	12.5	12.9	5.9	14.4
Trachoma			2.2	1.1	1.5	3.7	2.2			1.1
Tuberculosis	0.4							3.2		0.4
Diarrhea	1.1	3.0	3.3	1.1	0.5	3.7	2.2	4.3	11.8	1.8
Taking vitamins		13.1	11.0	4.5	13.6	3.7	8.0	9.7		7.4
Eyes										
Pingueculae	1.1	4.0								0.6
Conjunctival injection (bilateral)	0.4		5.5		0.5					0.6
Skin, Face and Neck										
Other seborrhea	2.2	1.0			2.0					1.0
Pigmentation (malar)					0.5	1.8		7.5		0.8
Gums										
Marginal redness	6.3	3.0	4.4	6.7	1.5	3.7	2.2	5.4		3.9
Marginal swelling	3.0	3.0	1.1	2.2		1.8				1.3
Recession	13.0	7.1	7.7	23.6	5.4		2.2			7.5
Tongue										
Geographic	0.7						0.4			0.3
Furrows	4.5	5.0		1.1		1.8	0.9	2.2		2.0
Serrations	0.4									0.1
Red tip or lateral margins	0.4									0.1
Glands										
Parotid enlarged										--
Skin, General										
Follicular hyperkeratosis										
Back - Slight	7.1	5.0	2.2	3.4	2.0		0.4		11.8	3.2
Moderate/Severe	1.1	3.0								0.5
Chest - Slight	1.8	6.1	3.3							1.2
Moderate/Severe	0.7	1.0								0.3
Buttocks - Slight	1.5	2.0								0.5
Moderate/Severe										--
Perifolliculosis	1.1	3.0	3.3							0.8
Xerosis		1.0								0.1
Acneform eruption	3.0	3.0	1.1	2.2	0.5		1.3	1.1		1.7
Abdomen										
Hepatomegalia	0.7	1.0	1.1	1.1	2.0	1.8		1.1		1.0
Splenomegalia	0.4	1.0	1.1	1.1	0.5		0.4			0.5
Lower Extremities										
Bilateral loss of knee jerk	0.4	7.1	3.3		0.5		0.9	2.2		1.4
Other										
Arcus senilis	3.0	7.1		5.6	0.5	1.8	1.3			2.2

APPENDIX TABLE 3E (Continued)

NAVY			AIR FORCE			
Seik Kyi	Ratanabon	Total	Mingaladon	Meiktila	Total	Combined Services
42	34	76	41	117	158	1,375
		Percent Prevalence				
	11.8	5.3		4.3	3.2	12.6
		--	2.4	1.7	1.9	1.2
		--			--	0.3
	2.9	1.3		1.7	1.3	1.7
		--		3.4	2.5	6.4
		--			--	0.5
	5.9	2.6	2.4	0.8	1.3	0.8
2.4		1.3		3.4	2.5	1.2
		--			--	0.6
11.9	14.7	13.2	2.4	6.0	5.1	4.6
7.1		3.9	2.4		0.6	1.4
2.4	2.9	2.6	7.3	6.8	7.0	7.2
		--		0.8	0.6	0.3
2.4	5.9	3.9	4.9	4.3	4.4	2.4
		--			--	0.1
		--			--	0.1
		--		0.8	0.6	0.1
7.1	14.7	10.5	2.4	7.7	6.3	3.9
		--		1.7	1.3	0.6
2.4		1.3			--	1.1
		--			--	0.2
4.8		2.6	7.3		1.9	0.8
2.4		1.3			--	0.1
4.8	2.9	3.9	4.9		1.3	1.0
		--			--	0.1
4.8		2.6	7.3	0.8	2.5	1.8
	2.9	1.3			--	0.9
		--			--	0.4
2.4		1.3		0.8	0.6	1.3
2.4		1.3			--	1.9

APPENDIX TABLE 3F. CLINICAL FINDINGS BY TIME IN SERVICE, BURMA, MILITARY

(Abbreviated Examinations)

	Time in Service							
	<1 mo.	1-3 mo.	3-5 mo.	6 mo.-5 yr.	6-10 yr.	11-15 yr.	16+ yrs.	Total
Number	23	86	486	1,727	1,448	985	208	4,963
	Percent Prevalence							
Eyes								
Bitot's spots				0.2	0.1		0.5	0.1
Skin, Face and Neck								
Nasolabial seborrhea	4.3		3.5	6.5	6.8	7.5	6.2	6.3
Lips								
Angular lesions	17.4	2.3	8.6	4.5	3.4	4.7	3.8	4.6
Angular scars		1.2	4.9	2.5	1.6	1.4		2.2
Cheilosis				0.05		0.1		0.04
Gums								
Swollen red papillae								
Localized			1.6	0.9	1.3	1.2	2.9	1.2
Diffuse			0.8	0.9	1.2	1.7	1.0	1.1
Tongue								
Filiform papillary atrophy								
Slight			1.8	0.8	0.8	1.3	0.5	0.9
Moderate			0.8	0.4	0.3	0.4	1.4	0.5
Glossitis			0.4	0.3	0.3	0.3	0.5	0.3
Glands								
Thyroid enlarged								
Grade I			2.0	1.8	2.0	2.0	1.4	1.9
Grade II						0.1		0.02
Skin, General								
Follicular hyperkeratosis								
Anywhere	26.1	9.3	3.7	4.0	3.1	1.7	1.0	3.3
Arms			0.8	0.4	0.3			0.3
Back	26.1	7.0	3.7	3.7	3.0	1.6	0.5	3.1
Thighs		2.3	0.4	0.2	0.1	0.1	0.5	0.2
Scrotal dermatitis			0.4	0.2	0.1	0.1		0.1
Lower Extremities								
Bilateral edema			0.2	0.05		0.1	0.5	0.1
Loss of ankle jerk								
Unilateral			0.4	0.3	0.4	0.3	0.5	0.3
Bilateral			0.4	0.2	0.3	0.4	1.9	0.3
Not given			3.5	0.7	1.0	0.9	0.5	1.1
Calf tenderness			0.2	0.05				0.04
Other								
Pterygium	4.3	1.2	1.0	1.6	3.0	3.8	5.8	2.6
Thickened bulbar conjunctivae	34.8	26.7	28.6	42.0	59.2	69.4	70.2	52.1

APPENDIX TABLE 3G. SUGGESTED GUIDE TO INTERPRETATION OF BIOCHEMICAL DATA[1/]

	Deficient	Low	Acceptable	High
BLOOD				
Total serum protein (gm/100 ml)	<6.0	6.0-6.4	6.5-6.9	>6.9
Serum albumin (gm/100 ml)	<2.5	2.5-3.4	3.5-5.0	>5.0
Serum globulin (gm/100 ml)	<1.0	1.0-1.9	2.0-2.9	3.0-3.5[2/]
Hemoglobin (gm/100 ml)	<12.0	12.0-13.9	14.0-14.9	>14.9
Hematocrit (percent)	<36	36-41	42-45	>45
Serum vitamin A (mcg/100 ml)	<10	10-19	20-49	>49
Serum carotene (mcg/100 ml)	<20[3/]	20-39	40-99	>99
Serum vitamin C (mg/100 ml)	<0.10	0.10-0.19	0.20-0.39	>0.39
URINE				
Thiamine (mcg/gm creatinine)	<27	27-65	66-129	>129
Riboflavin (mcg/gm creatinine)	<27	27-79	80-269	>269
N^1-Methylnicotinamide (mg/gm creatinine)	<0.50	0.50-1.59	1.60-4.29	>4.29

1/ Standards except for serum albumin and globulin based on those used for ICNND Survey of Thailand (see reference 2, p. 81).
2/ Values >3.5 gm/100 ml interpreted as "very high," clearly indicating hyperglobulinemia.
3/ A deficient range for carotene is not well established.

APPENDIX TABLE 3H. BIOCHEMICAL FINDINGS BY LOCATION, BURMA, MILITARY

Location	ARMY									
	Mingaladon	Indaing	Toungoo	Meiktila	Ba Htoo Myo	Chauk	Maymyo	Moulmein	Army Boys	Total
BLOOD										
Total Serum Protein (gm/100 ml)										
No. of subjects	59	23	25	24	48	14	56	24	4	277
Mean	7.6	7.8	7.7	7.8	7.2	7.8	7.4	7.6	7.3	7.5
S.E. 1/	.07	.11	.14	.10	.08	.16	.11	.10	.10	.04
					Percent Distribution					
<6.0					2.1		1.8			0.7
6.0-6.39					2.1		5.4			1.4
6.4-6.99	13.6	8.7	16.0	4.2	41.7	7.1	28.6	12.5		19.8
≥7.0	86.4	91.3	84.0	95.8	54.2	92.8	64.3	87.5	100.0	78.0
Serum Albumin (gm/100 ml)										
No. of subjects	59	23	25	24	48	14	56	24	4	277
Mean	4.2	4.1	4.2	4.2	4.2	3.9	4.0	4.0	4.1	4.1
S.E.	.05	.10	.07	.06	.05	.09	.04	.06	.48	.02
					Percent Distribution					
<2.5										--
2.5-3.4	3.4	4.3					1.8			1.4
3.5-4.9	94.9	91.3	96.0	100.0	100.0	100.0	98.2	100.0	75.0	97.1
≥5.0	1.7	4.3	4.0						25.0	1.4
Serum Globulin (gm/100 ml)										
No. of subjects	59	23	25	24	48	14	56	24	4	277
Mean	3.4	3.7	3.5	3.6	3.0	3.8	3.4	3.6	3.2	3.4
S.E.	.07	.13	.13	.10	.08	.16	.11	.13	.48	.04
					Percent Distribution					
1.0-1.9									25.0	0.4
2.0-2.9	15.2	8.7	24.0	12.5	56.2		37.5	16.7		26.0
3.0-3.5	39.0	30.4	28.0	41.7	29.2	42.8	26.8	45.8	50.0	34.3
>3.5	45.8	60.9	48.0	45.8	14.6	57.1	35.7	37.5	25.0	39.4

1/ S.E. = Standard error.

APPENDIX TABLE 3H (Continued)

NAVY			AIR FORCE			
Seik Kyi	Ratanabon	Total	Mingaladon	Meiktila	Total	Combined Services
18	15	33	8	31	39	349
7.6	7.5	7.5	7.8	8.1	8.0	7.6
.13	.15	.10	.28	.10	.10	.04
		Percent Distribution				
		--			--	0.6
		--	12.5		2.6	1.4
5.6	20.0	12.1		3.2	2.6	17.2
94.4	80.0	87.9	87.5	96.8	94.9	80.8
18	15	33	8	31	39	349
4.0	4.1	4.1	4.3	4.1	4.1	4.1
.11	.08	.07	.19	.06	.06	.02
		Percent Distribution				
		--			--	--
5.6		3.0			--	1.4
88.9	100.0	93.9	87.5	100.0	97.4	96.8
5.6		3.0	12.5		2.5	1.7
18	15	33	8	31	39	349
3.6	3.4	3.5	3.5	4.0	3.9	3.5
.18	.18	.12	.16	.12	.10	.04
		Percent Distribution				
5.6		3.0			--	0.6
5.6	46.7	24.2	12.5	3.2	5.1	23.5
38.9	13.3	27.3	37.5	29.0	30.8	33.2
50.0	40.0	45.4	50.0	67.7	64.1	42.7

APPENDIX TABLE 3H (Continued) BIOCHEMICAL FINDINGS BY LOCATION, BURMA, MILITARY

Location	ARMY									
	Mingaladon	Indaing	Toungoo	Meiktila	Ba Htoo Myo	Chauk	Maymyo	Moulmein	Army Boys	Total
Albumin/Globulin Ratio										
No. of subjects	59	23	25	24	48	14	56	24	4	277
Mean	1.24	1.14	1.24	1.18	1.46	1.06	1.28	1.16	1.54	1.26
S.E.	.04	.06	.05	.04	.05	.06	.04	.05	.08	.02
	Percent Distribution									
0.5-0.9	16.9	26.1	28.0	20.8	6.2	42.8	23.2	25.0	25.0	20.6
1.0-1.4	71.2	56.5	60.0	70.8	45.8	50.0	51.8	66.7	50.0	58.8
1.5-1.9	8.5	17.4	12.0	8.3	43.8	7.1	21.4	8.3		18.0
≥2.0	3.4				4.2		3.6		25.0	2.5
Hemoglobin (gm/100 ml)										
No. of subjects	57	24	25	25	46	15	63	24	5	284
Mean	13.8	13.7	13.9	14.2	14.6	14.1	14.2	13.9	11.7	14.0
S.E.	.18	.24	.31	.24	.20	.38	.17	.23	.86	.08
	Percent Distribution									
<12.0	7.0	4.2	8.0		2.2	6.7	1.6	4.2	60.0	4.9
12.0-13.9	54.4	54.2	48.0	44.0	26.1	40.0	38.1	50.0	20.0	43.0
14.0-14.9	19.3	29.2	20.0	32.0	34.8	20.0	33.0	29.2	20.0	27.8
≥15.0	19.3	12.5	24.0	24.0	37.0	33.3	27.0	16.7		24.3
Hematocrit (percent)										
No. of subjects	59	24	27	25	48	15	63	24	5	290
Mean	47.5	45.5	46.8	45.8	47.2	45.9	46.6	45.8	44.8	46.6
S.E.	.43	.67	.75	.62	.53	.85	.38	.80	1.34	.20
	Percent Distribution									
<36								4.2		0.3
36-41		8.3	7.4	4.0	6.2	6.7	6.3	8.3	20.0	5.5
42-44	16.9	33.3	18.5	36.0	16.7	26.7	17.5	25.0	20.0	21.4
≥45	83.0	58.3	74.1	60.0	77.1	66.7	76.2	62.5	60.0	72.8
Mean Corpuscular Hemoglobin Concentration (percent)										
No. of subjects	57	24	25	25	46	15	63	24	5	284
Mean	29.0	30.4	30.0	31.4	31.2	30.4	30.6	30.8	26.2	30.2
S.E.	.31	.57	.57	.59	.41	.53	.36	.53	1.46	.17
	Percent Distribution									
<28.0	35.1	12.5	32.0	12.0	8.7	6.7	17.5	4.2	80.0	19.4
28.0-29.9	31.6	33.3	12.0	24.0	13.0	40.0	25.4	33.3		25.0
30.0-31.9	21.0	20.8	32.0	28.0	50.0	26.7	23.8	50.0	20.0	30.6
≥32.0	12.3	33.3	24.0	36.0	28.3	26.7	33.3	12.5		25.0

APPENDIX TABLE 3H (Continued)

NAVY			AIR FORCE			
Seik Kyi	Ratanabon	Total	Mingaladon	Meiktila	Total	Combined Services
18	15	33	8	31	39	349
1.24	1.26	1.26	1.24	1.04	1.08	1.24
.15	.07	.09	.06	.04	.04	.02
		Percent Distribution				
33.3	20.0	27.3	12.5	48.4	41.0	23.5
55.6	60.0	57.6	75.0	51.6	56.4	58.4
5.6	20.0	12.1	12.5		2.5	15.8
5.6		3.0			--	2.3
19	7	26	8	32	40	350
13.9	14.1	14.0	11.9	14.6	14.1	14.0
.26	.42	.22	.76	.23	.30	.08
		Percent Distribution				
		--	37.5		7.5	4.8
52.6	42.8	50.0	50.0	28.1	32.5	42.3
31.6	28.6	30.8	12.5	37.5	32.5	28.6
15.8	28.6	19.2		34.4	27.5	24.3
19	17	36	8	32	40	366
42.0	46.2	44.0	46.5	46.2	46.3	46.3
1.15	.78	.78	1.24	.62	.55	.19
		Percent Distribution				
5.3		2.8			--	0.5
36.8	5.9	22.2	12.5	6.2	7.5	7.4
26.3	29.4	27.8		34.4	27.5	22.7
31.6	64.7	47.2	87.5	59.4	65.0	69.4
18	7	25	8	32	40	349
33.6	30.2	32.6	25.6	31.8	30.4	30.4
1.14	.28	.88	1.16	.40	.56	.16
		Percent Distribution				
5.6		4.0	87.5		17.5	18.0
5.6	42.8	16.0		18.8	15.0	23.2
38.9	57.1	44.0	12.5	46.9	40.0	32.7
50.0		36.0		34.4	27.5	26.1

687462 O - 63 - 16

APPENDIX TABLE 3H (Continued) BIOCHEMICAL FINDINGS BY LOCATION, BURMA, MILITARY

Location	ARMY									
	Mingaladon	Indaing	Toungoo	Meiktila	Ba Htoo Myo	Chauk	Maymyo	Moulmein	Army Boys	Total
Serum Vitamin A (mcg/100 ml)										
No. of subjects	46	24	27	25	47	15	63	24	5	276
Mean	42.6	38.2	37.8	43.5	40.8	34.2	34.3	36.1	31.6	38.4
S.E.	1.4	1.9	2.2	1.5	1.6	2.1	1.4	1.6	2.0	0.6
					Percent Distribution					
<10							1.6			0.4
10-19			7.4		4.2	6.7	7.9			3.6
20-49	69.6	91.7	77.8	80.0	72.3	93.3	87.3	95.8	100.0	81.9
≥50	30.4	8.3	14.8	20.0	23.4		3.2	4.2		14.1
Serum Carotene (mcg/100 ml)										
No. of subjects	56	24	27	25	48	15	63	24	5	287
Mean	86	93	83	108	94	82	88	80	63	89
S.E.	4	7	7	8	5	6	4	4	7	2
					Percent Distribution					
20-39	3.6	8.3	3.7		4.2		4.8			3.5
40-99	64.3	50.0	66.7	48.0	64.6	80.0	65.1	91.7	100.0	65.8
≥100	32.1	41.7	29.6	52.0	31.2	20.0	30.2	8.3		30.7
Serum Vitamin C (mg/100 ml)										
No. of subjects	56	24	25	25	47	15	63	24	5	284
Mean	.50	.34	.30	.50	.50	.46	.52	.37	.54	.46
S.E.	.03	.01	.02	.03	.04	.04	.02	.03	.08	.01
					Percent Distribution					
<.10					2.1					0.4
.10-.19	1.8	4.2		4.0	6.4					2.1
.20-.39	35.7	83.3	84.0	12.0	36.2	26.7	20.6	70.8	20.0	40.8
≥.40	62.5	12.5	16.0	84.0	55.3	73.3	79.4	29.2	80.0	56.7
Serum Cholesterol										
No. of subjects	58	24	27	25	48	15	63	23	5	288
Mean	159	145	159	160	165	181	172	173	113	163
S.E.	4	5	5	9	6	8	4	7	18	2
					Percent Distribution					
50-99				4.0	8.3				40.0	2.4
100-149	36.2	54.2	37.0	40.0	27.1	13.3	27.0	26.1	40.0	32.6
150-199	58.6	45.8	59.2	36.0	45.8	60.0	52.4	60.9	20.0	51.7
≥200	5.2		3.7	20.0	18.8	26.7	20.6	13.0		13.2

APPENDIX TABLE 3H (Continued)

NAVY			AIR FORCE			
Seik Kyi	Ratanabon	Total	Mingaladon	Meiktila	Total	Combined Services
19	16	35	8	30	38	349
34.5	40.9	37.4	41.9	35.5	36.8	38.1
1.9	2.6	1.7	6.9	1.6	1.9	0.6
		Percent Distribution				
		--			--	0.3
		--			--	2.9
94.7	87.5	91.4	75.0	93.3	89.5	83.7
5.3	12.5	8.6	25.0	6.7	10.5	13.2
19	17	36	8	32	40	363
71	76	73	95	86	88	87
5	4	3	4	5	4	2
		Percent Distribution				
15.8		8.3			--	3.6
73.7	88.2	80.6	87.5	75.0	77.5	68.6
10.5	11.8	11.1	12.5	25.0	22.5	27.8
19	16	35	7	13	20	339
.39	.52	.45	.62	.32	.42	.46
.04	.06	.03	.06	.07	.06	.01
		Percent Distribution				
		--			--	0.3
		--		30.8	20.0	2.9
73.7	31.2	54.3		53.8	35.0	41.9
26.3	68.8	45.7	100.0	15.4	45.0	54.9
19	17	36	8	32	40	364
142	165	153	171	152	156	161
6	6	4	11	6	5	2
		Percent Distribution				
5.3		2.8		3.1	2.5	2.5
52.6	23.5	38.9	37.5	40.6	40.0	34.1
42.1	70.6	55.6	37.5	40.6	40.0	50.8
	5.9	2.8	25.0	15.6	17.5	12.6

APPENDIX TABLE 3H (Continued) BIOCHEMICAL FINDINGS BY LOCATION, BURMA, MILITARY

Location	ARMY									
	Mingaladon	Indaing	Toungoo	Meiktila	Ba Htoo Myo	Chauk	Maymyo	Moulmein	Army Boys	Total
URINE										
Thiamine Excretion (mcg/gm Creatinine)										
No. of subjects	57	23	25	22	48	11	62	21	5	274
Median	21	19	12	48	38	46	44	26	56	30
					Percent Distribution					
<27	59.6	69.6	92.0	27.3	37.5	18.2	27.4	52.4	20.0	46.7
27-65	22.8	17.4	8.0	40.9	43.8	63.6	50.0	33.3	40.0	35.0
66-129	10.5	4.3		18.2	12.5	9.1	16.1	9.5		10.9
≥130	7.0	8.7		13.6	6.2	9.1	6.4	4.8	40.0	7.3
Riboflavin Excretion (mcg/gm Creatinine)										
No. of subjects	58	24	25	22	48	10	63	20	5	275
Median	56	40	55	90	63	44	53	77	174	60
					Percent Distribution					
<27	5.2	33.3	8.0	13.6	6.2	20.0	14.3			10.9
27-79	62.1	54.2	68.0	27.3	56.2	60.0	55.6	50.0	20.0	54.9
80-269	25.9	12.5	20.0	36.4	27.1	20.0	25.4	50.0	80.0	27.6
≥270	6.9		4.0	22.7	10.4		4.8			6.5
N^1-Methylnicotinamide Excretion (mg/gm Creatinine)										
No. of subjects	27	10	13	10	25	1	33	10	1	130
Median	2.6	1.9	3.2	4.9	3.2	2/	2.7	3.4	2/	2.8
					Percent Distribution					
<0.5										--
0.5-1.59	25.9	40.0	23.1		8.0		12.1	10.0		16.2
1.6-4.29	63.0	60.0	53.8	40.0	56.0		75.8	60.0	100.0	61.5
≥4.3	11.1		23.1	60.0	36.0	100.0	12.1	30.0		22.3

2/ Only one value at this location.

APPENDIX TABLE 3H (Continued)

NAVY			AIR FORCE			
Seik Kyi	Raintanabon	Total	Mingaladon	Meiktila	Total	Combined Services
15	16	31	8	32	40	345
44	46	45	20	53	46	34
		Percent Distribution				
20.0	31.2	25.8	75.0	15.6	27.5	42.6
66.7	37.5	51.6	25.0	50.0	45.0	37.7
13.3	6.2	9.7		18.8	15.0	11.3
	25.0	12.9		15.6	12.5	8.4
17	17	34	8	32	40	349
44	52	46	64	96	90	61
		Percent Distribution				
5.9	23.5	14.7	12.5	6.2	7.5	10.9
70.6	52.9	61.8	50.0	31.2	35.0	53.3
23.5	17.6	20.6	25.0	53.1	47.5	29.2
	5.9	2.9	12.5	9.4	10.0	6.6
8	4	12	4	11	15	157
3.3	3.0	3.2	3.0	5.1	4.5	3.0
		Percent Distribution				
		--			--	--
12.5	25.0	16.7	25.0	9.1	13.3	15.9
75.0	75.0	75.0	50.0	27.3	33.3	59.9
12.5		8.3	25.0	63.6	53.3	24.2

APPENDIX TABLE 3I. BIOCHEMICAL FINDINGS BY TIME IN SERVICE AND PERCENT "STANDARD WEIGHT," BURMA, MILITARY

	Time in Service							
	<1 mo.	1-3 mos.	3-5 mos.	6 mos.-5 yrs.	6-10 yrs.	11-15 yrs.	16+ yrs.	Total
BLOOD								
Total Serum Protein (gm/100 ml)								
No. of subjects	3	4	43	123	94	71	11	349
Mean	7.4	8.0	7.7	7.6	7.5	7.5	7.6	7.6
				Percent Distribution				
<6.0				0.8		1.4		0.6
6.0-6.39				1.6	2.1	1.4		1.4
6.4-6.99			11.6	18.7	18.1	19.7	9.1	17.2
≥7.0	100.0	100.0	88.4	78.9	78.7	77.5	90.9	80.8
Serum Albumin (gm/100 ml)								
No. of subjects	3	4	43	123	94	71	11	349
Mean	3.8	4.2	4.0	4.1	4.1	4.1	4.1	4.1
				Percent Distribution				
<2.5								--
2.5-3.4			2.3	2.4	1.1			1.4
3.5-4.9	100.0	75.0	93.0	96.7	96.8	100.0	100.0	96.8
≥5.0		25.0	4.6	0.8	2.1			1.7
Serum Globulin (gm/100 ml)								
No. of subjects	3	4	43	123	94	71	11	349
Mean	3.6	3.7	3.7	3.5	3.4	3.4	3.4	3.5
				Percent Distribution				
<2.0			2.3	0.8				0.6
2.0-2.9		25.0	11.6	23.6	25.5	28.2	27.3	23.5
3.0-3.5	33.3		27.9	32.5	36.2	35.2	36.4	33.2
>3.5	66.7	75.0	58.1	43.1	38.3	36.6	36.4	42.7
Albumin/Globulin Ratio								
No. of subjects	3	4	43	123	94	71	11	349
Mean	1.08	1.26	1.16	1.24	1.28	1.24	1.26	1.65
				Percent Distribution				
<0.5								--
0.5-0.9	33.3	50.0	41.9	25.2	18.1	16.9	9.1	23.5
1.0-1.4	66.7	25.0	46.5	56.1	60.6	67.6	63.6	58.4
1.5-1.9			9.3	16.3	18.1	15.5	27.3	15.8
≥2.0		25.0	2.3	2.4	3.2			2.3
Hemoglobin (gm/100 ml)								
No. of subjects	--	4	43	124	95	73	11	350
Mean		13.5	13.5	13.9	14.2	14.3	14.3	14.0
				Percent Distribution				
<12.0			4.6	8.1	3.2	2.7		4.8
12.0-13.9		75.0	55.8	43.5	38.9	35.6	36.4	42.3
14.0-14.9			30.2	26.6	30.5	27.4	45.4	28.6
≥15.0		25.0	9.3	21.8	27.4	34.2	18.2	24.3

APPENDIX TABLE 3I (Continued)

Percent "Standard Weight"					
60-69	70-79	80-89	90-99	100-109	110-119
5	56	159	102	21	6
7.5	7.7	7.6	7.4	7.8	7.3
		Percent Distribution			
		0.6	1.0		
	3.6	0.6	2.0		
20.0	10.7	15.7	22.5	9.5	50.0
80.0	85.7	83.0	74.5	90.5	50.0
5	56	159	102	21	6
4.2	4.2	4.1	4.1	4.1	4.1
		Percent Distribution			
	1.8	1.9			16.7
100.0	94.6	96.8	99.0	95.2	83.3
	3.6	1.2	1.0	4.8	
5	56	159	102	21	6
3.4	3.5	3.5	3.3	3.7	3.2
		Percent Distribution			
		1.2			
	26.8	22.6	23.5	14.3	66.7
80.0	28.6	30.2	40.2	28.6	16.7
20.0	44.6	45.9	36.3	57.1	16.7
5	56	159	102	21	6
1.24	1.26	1.22	1.28	1.14	1.32
		Percent Distribution			
	3.6	27.7	18.6	28.6	16.7
100.0	61.5	55.3	62.7	61.9	33.3
	19.6	14.5	15.7	9.5	50.0
	1.8	2.5	2.9		
5	52	165	103	19	6
14.1	13.7	14.0	14.3	14.1	14.4
		Percent Distribution			
	5.8	7.3	1.9		
40.0	57.7	42.4	33.0	52.6	33.3
60.0	13.5	27.3	36.9	31.6	16.7
	23.1	23.0	28.2	15.8	50.0

APPENDIX TABLE 3I (Continued) BIOCHEMICAL FINDINGS BY TIME IN SERVICE AND PERCENT "STANDARD WEIGHT," BURMA, MILITARY

	Time in Service							
	<1 mo.	1-3 mos.	3-5 mos.	6 mos.-5 yrs.	6-10 yrs.	11-15 yrs.	16+ yrs.	Total
Hematocrit (percent)								
No. of subjects	4	4	44	128	101	74	11	366
Mean	44.2	45.0	43.8	46.7	46.9	46.7	46.1	46.3
				Percent Distribution				
<36			2.3		1.0			0.5
36-41			22.7	6.2	5.9	2.7	9.1	7.4
42-44	75.0	25.0	29.5	17.2	22.8	25.7	18.2	22.7
≥45	25.0	75.0	45.4	76.6	70.3	71.6	72.7	69.4
Mean Corpuscular Hemoglobin Concentration								
No. of subjects	--	4	42	124	95	73	11	349
Mean		30.4	31.2	29.8	30.6	30.8	31.0	30.4
				Percent Distribution				
<28.0		25.0	19.0	21.8	22.1	8.2		18.0
28.0-29.9		25.0	23.8	24.2	16.8	27.4	36.4	23.2
30.0-31.9		25.0	23.8	35.5	32.6	31.5	45.4	32.7
≥32.0		25.0	33.3	18.5	28.4	32.9	18.2	26.1
Serum Vitamin A (mcg/100 ml)								
No. of subjects	4	4	44	121	96	70	10	349
Mean	38.2	49.2	34.7	37.1	39.0	40.0	40.0	38.1
				Percent Distribution				
<10			2.3					0.3
10-19			2.3	3.3	3.1	1.4	10.0	2.9
20-49	100.0	50.0	90.9	84.3	83.3	81.4	70.0	83.7
≥50		50.0	4.5	12.4	13.5	17.1	20.0	13.2
Serum Carotene (mcg/100 ml)								
No. of subjects	4	4	44	126	101	73	11	363
Mean	72	90	76	84	89	96	94	87
				Percent Distribution				
20-39			9.1	1.6	4.0	4.1		3.6
40-99	100.0	75.0	75.0	76.2	66.3	54.8	54.5	68.6
≥100		25.0	15.9	22.2	29.7	41.1	45.4	27.8
Serum Vitamin C (mg/100 ml)								
No. of subjects	4	3	43	115	94	69	11	339
Mean	.54	.28	.45	.47	.47	.42	.45	.46
				Percent Distribution				
<.10						1.4		0.3
.10-.19		33.3		3.5	2.1	4.3		2.9
.20-.39	50.0	66.7	46.5	40.9	40.4	40.6	45.4	41.9
≥.40	50.0		53.5	55.7	57.4	53.6	54.5	54.9

APPENDIX TABLE 3I (Continued)

Percent "Standard Weight"					
60-69	70-79	80-89	90-99	100-109	110-119
5	58	169	107	21	6
48.2	46.5	46.3	46.2	46.1	47.2
		Percent Distribution			
			1.9		
	5.2	8.9	6.5	4.8	16.7
20.0	27.6	21.3	21.5	33.3	
80.0	67.2	69.8	70.1	61.9	83.3
5	52	165	102	19	6
29.8	29.6	30.4	31.0	31.0	31.4
		Percent Distribution			
20.0	25.0	18.8	13.7	15.8	16.7
40.0	30.8	24.2	20.6	10.5	
40.0	25.0	33.9	33.3	36.8	33.3
	19.2	23.0	32.4	36.8	50.0
5	55	157	105	21	6
37.8	38.6	37.8	37.5	40.3	46.7
		Percent Distribution			
			1.0		
		3.8	2.8	4.8	
80.0	85.4	83.4	84.8	81.0	66.7
20.0	14.5	12.7	11.4	14.3	33.3
5	58	166	107	21	6
97	89	86	87	88	98
		Percent Distribution			
	3.4	3.6	3.7		16.7
60.0	70.7	69.3	68.2	71.4	33.3
40.0	25.9	27.1	28.0	28.6	50.0
5	52	153	103	20	6
.46	.45	.46	.47	.42	.43
		Percent Distribution			
			1.0		
	3.8	3.3	2.9		
40.0	34.6	45.1	36.9	60.0	50.0
60.0	61.5	51.6	59.2	40.0	50.0

APPENDIX TABLE 3I (Continued) BIOCHEMICAL FINDINGS BY TIME IN SERVICE AND PERCENT "STANDARD WEIGHT," BURMA, MILITARY

	Time in Service							
	<1 mo.	1-3 mos.	3-5 mos.	6 mos.-5 yrs.	6-10 yrs.	11-15 yrs.	16+ yrs.	Total
Serum Cholesterol (mg/100 ml)								
No. of subjects	4	3	44	128	101	73	11	364
Mean	145	175	154	161	160	168	165	161
				Percent Distribution				
50-99			2.3	2.3	4.0	1.4		2.5
100-149	50.0		45.4	35.9	32.7	28.8	18.2	34.1
150-199	50.0	100.0	40.9	49.2	52.5	50.7	81.8	50.8
≥200			11.4	13.3	10.9	19.2		12.6
URINE								
Thiamine Excretion (mcg/gm creatinine)								
No. of subjects	4	4	39	122	98	70	8	345
Median	72	52	40	32	34	26	46	34
				Percent Distribution				
<27	25.0		30.8	45.1	41.8	51.4	25.0	42.6
27-65	25.0	75.0	53.8	35.2	39.8	27.1	50.0	37.7
66-129	25.0	25.0	10.2	9.8	10.2	14.3	12.5	11.3
≥130	25.0		5.1	9.8	8.2	7.1	12.5	8.4
Riboflavin Excretion (mcg/gm creatinine)								
No. of subjects	4	4	41	125	96	71	8	349
Median	51	51	46	68	54	64	70	61
				Percent Distribution				
<27	25.0		9.8	9.6	12.5	12.7		10.9
27-79	50.0	75.0	58.5	49.6	56.2	50.7	62.5	53.3
80-269		25.0	24.4	33.6	24.0	33.8	25.0	29.2
≥270	25.0		7.3	7.2	7.3	2.8	12.5	6.6
N¹-Methylnicotinamide Excretion (mg/gm creatinine)								
No. of subjects	2	2	21	49	44	33	6	157
Median	1/	1/	3.2	3.2	3.3	2.5	4.4	3.0
				Percent Distribution				
<0.5								--
0.5-1.59	50.0	50.0	4.8	14.3	18.2	18.2	16.7	15.9
1.6-4.29	50.0	50.0	81.0	55.1	54.5	66.7	33.3	59.9
≥4.3			14.3	30.6	27.3	15.2	50.0	24.2

1/ Too few samples for statistical analysis.

APPENDIX TABLE 31 (Continued)

Percent "Standard Weight"					
60-69	70-79	80-89	90-99	100-109	110-119
5	58	167	107	21	6
179	161	157	164	176	180
		Percent Distribution			
		2.4	4.7		
20.0	37.9	38.9	26.2	23.8	50.0
60.0	55.2	50.9	49.5	52.4	16.7
20.0	6.9	7.8	19.6	23.8	33.3
4	53	158	105	19	6
30	36	36	32	21	36
		Percent Distribution			
50.0	39.6	41.1	44.8	52.6	33.3
25.0	41.5	34.8	39.0	36.8	66.7
25.0	7.5	13.3	10.5	10.5	
	11.3	10.8	5.7		
4	53	163	104	19	6
81	62	66	54	54	77
		Percent Distribution			
	7.5	11.0	13.5	10.5	
50.0	54.7	49.7	58.6	52.6	50.0
25.0	30.2	31.9	22.1	36.8	50.0
25.0	7.5	7.4	5.8		
3	19	78	47	8	2
3.3	3.1	3.3	2.6	3.6	1/
		Percent Distribution			
	21.0	17.9	12.8	12.5	
100.0	52.6	51.3	74.5	62.5	50.0
	26.3	30.8	12.8	25.0	50.0

APPENDIX TABLE 3J. BIOCHEMICAL FINDINGS BY AGE, RURAL-URBAN ORIGIN AND ACTIVITY, BURMA, MILITARY

	Age (Years)						
	16-19	20-24	25-29	30-34	35-39	40+	Total
BLOOD							
Total Serum Protein (gm/100 ml)							
No. of subjects	35	133	81	63	26	11	349
Mean	7.5	7.6	7.5	7.6	7.4	7.6	7.6
			Percent Distribution				
<6.0		0.8		1.6			0.6
6.0-6.39		2.2	1.2	1.6			1.4
6.4-6.99	11.4	15.8	21.0	15.9	26.9	9.1	17.2
≥7.0	88.6	81.2	77.8	81.0	73.1	90.9	80.8
Serum Albumin (gm/100 ml)							
No. of subjects	35	133	81	63	26	11	349
Mean	4.0	4.1	4.1	4.1	4.1	4.0	4.1
			Percent Distribution				
<2.5							--
2.5-3.4		2.2	1.2			9.1	1.4
3.5-4.9	97.1	94.7	97.5	100.0	100.0	90.9	96.8
≥5.0	2.8	3.0	1.2				1.7
Serum Globulin (gm/100 ml)							
No. of subjects	35	133	81	63	26	11	349
Mean	3.6	3.5	3.4	3.4	3.3	3.7	3.5
			Percent Distribution				
1.0-1.9	2.8	0.8					0.6
2.0-2.9	11.4	24.8	24.7	27.0	26.9	9.1	23.5
3.0-3.5	37.1	27.8	37.0	28.6	46.2	54.5	33.2
>3.5	48.6	46.6	38.3	44.4	26.9	36.4	42.7
Albumin/Globulin Ratio							
No. of subjects	35	133	81	63	26	11	349
Mean	1.18	1.26	1.24	1.24	1.28	1.12	1.65
			Percent Distribution				
<0.5							--
0.5-0.9	28.6	29.3	16.0	19.0	15.4	36.4	23.5
1.0-1.4	65.7	48.9	66.7	61.9	65.4	54.5	58.4
1.5-1.9	2.8	18.0	16.0	19.0	15.4	9.1	15.8
≥2.0	2.8	3.8	1.2		3.8		2.3
Hemoglobin (gm/100 ml)							
No. of subjects	34	135	83	61	26	11	350
Mean	13.1	14.0	14.2	14.3	14.4	13.8	14.0
			Percent Distribution				
<12.0	17.6	3.7	1.2	1.6	15.4		4.8
12.0-13.9	58.8	40.0	47.0	36.1	26.9	54.5	42.3
14.0-14.9	17.6	33.3	26.5	31.1	15.4	36.4	28.6
≥15.0	5.9	23.0	25.3	31.1	42.3	9.1	24.3

APPENDIX TABLE 3J (Continued)

Area of Origin		Activity		
Rural	Urban	Active Training	Garrison Duty	Clerical Duty
143	206	66	272	11
7.6	7.6	7.6	7.6	7.7
Percent Distribution				
0.7	0.5	1.5	0.4	
2.1	1.0		1.8	
16.1	18.0	15.2	18.0	9.1
81.1	80.6	83.3	79.8	90.9
143	206	66	272	11
4.1	4.1	4.0	4.1	3.8
Percent Distribution				
0.7	1.9	1.5	0.7	18.2
97.9	96.1	93.9	98.2	81.8
1.4	1.9	4.5	1.1	
143	206	66	272	11
3.5	3.5	3.6	3.4	3.8
Percent Distribution				
	1.0	3.0		
21.7	24.8	16.7	26.1	
35.7	31.6	31.8	33.4	36.4
42.6	42.7	48.5	40.4	63.6
143	206	66	272	11
1.24	1.24	1.22	1.26	1.04
Percent Distribution				
23.8	23.3	36.4	19.8	36.4
58.7	58.2	45.4	61.4	63.6
15.4	16.0	13.6	16.9	
2.1	2.4	4.5	1.8	
140	210	66	273	11
13.9	14.1	13.8	14.1	13.8
Percent Distribution				
5.7	4.3	6.1	4.8	
44.3	41.0	48.5	39.6	72.7
28.6	28.6	28.8	28.9	18.2
21.4	26.2	16.7	26.7	9.1

APPENDIX TABLE 3J (Continued) BIOCHEMICAL FINDINGS BY AGE, RURAL-URBAN ORIGIN AND ACTIVITY, BURMA, MILITARY

	Age (Years)						
	16-19	20-24	25-29	30-34	35-39	40+	Total
Hematocrit (percent)							
No. of subjects	37	141	86	64	27	11	366
Mean	43.7	46.5	46.8	46.9	46.4	45.8	46.3
			Percent Distribution				
<36	2.7	0.7					0.5
36-41	24.3	5.0	7.0	3.1	7.4	9.1	7.4
42-44	27.0	22.0	17.4	26.6	25.9	27.3	22.7
≥45	45.9	72.3	75.6	70.3	66.7	63.6	69.4
Mean Corpuscular Hemoglobin Concentration							
No. of subjects	34	134	83	61	26	11	349
Mean	30.4	30.2	30.4	30.8	31.2	30.4	30.4
			Percent Distribution				
<28.0	32.4	17.2	21.7	13.1	7.7	9.1	18.0
28.0-29.9	20.6	24.6	21.7	19.7	26.9	36.4	23.2
30.0-31.9	20.6	35.8	27.7	39.3	30.8	36.4	32.7
≥32.0	26.5	22.4	28.9	27.9	34.6	18.2	26.1
Serum Vitamin A (mcg/100 ml)							
No. of subjects	37	137	79	60	25	11	349
Mean	36.4	37.5	39.0	40.1	38.6	34.1	38.1
			Percent Distribution				
<10	2.7						0.3
10-19		3.6	2.5	1.7		18.2	2.9
20-49	91.9	85.4	78.5	81.7	88.0	72.7	83.7
≥50	5.4	10.9	19.0	16.7	12.0	9.1	13.2
Serum Carotene (mcg/100 ml)							
No. of subjects	37	140	85	63	27	11	363
Mean	71	84	92	93	95	92	87
			Percent Distribution				
20-39	5.4	3.6	3.5	4.8			3.6
40-99	89.2	73.6	62.4	57.1	59.2	72.7	68.6
≥100	5.4	22.8	34.1	38.1	40.7	27.3	27.8
Serum Vitamin C (mg/100 ml)							
No. of subjects	36	130	77	59	26	11	339
Mean	.45	.49	.45	.42	.44	.36	.46
			Percent Distribution				
<.10					3.8		0.3
.10-.19		3.1	5.2	3.4			2.9
.20-.39	50.0	34.6	44.2	47.4	38.5	63.6	41.9
≥.40	50.0	62.3	50.6	49.2	57.7	36.4	54.9

APPENDIX TABLE 3J (Continued)

Area of Origin		Activity		
Rural	Urban	Active Training	Garrison Duty	Clerical Duty
149	217	70	285	11
45.7	46.7	44.7	46.6	48.4
		Percent Distribution		
1.3		1.4	0.4	
10.7	5.1	14.3	6.0	
24.8	21.2	31.4	21.0	9.1
63.1	73.7	52.8	72.6	90.9
139	210	65	273	11
30.8	30.4	31.0	30.4	28.6
		Percent Distribution		
15.8	19.5	16.9	17.9	27.3
24.5	22.4	16.9	23.4	54.5
33.8	31.9	40.0	31.5	18.2
25.9	26.2	26.2	27.1	
142	207	67	273	9
37.7	38.4	38.4	38.7	34.9
		Percent Distribution		
	0.5	1.5		
2.1	3.4		3.7	
85.2	82.6	89.6	82.0	88.9
12.7	13.5	9.0	14.3	11.1
148	215	70	282	11
85	88	79	89	92
		Percent Distribution		
4.0	3.2	5.7	3.2	
67.6	69.3	75.7	67.0	63.6
28.4	27.4	18.6	29.8	36.4
142	197	59	269	11
.45	.46	.45	.46	.42
		Percent Distribution		
0.7		1.7		
1.4	4.1	5.1	2.6	
50.0	36.0	44.1	40.5	63.6
47.9	60.0	49.2	56.9	36.4

APPENDIX TABLE 3J (Continued) BIOCHEMICAL FINDINGS BY AGE, RURAL-URBAN ORIGIN AND ACTIVITY, BURMA, MILITARY

	Age (Years)						
	16-19	20-24	25-29	30-34	35-39	40+	Total
Serum Cholesterol (mg/100 ml)							
No. of subjects	37	140	86	63	27	11	364
Mean	142	161	165	164	165	179	161
			Percent Distribution				
50-99	8.1	2.1		4.8			2.5
100-149	51.4	37.1	29.1	27.0	29.6	27.3	34.1
150-199	35.1	47.1	58.1	52.4	63.0	54.5	50.8
≥200	5.4	13.6	12.8	15.9	7.4	18.2	12.6
URINE							
Thiamine Excretion (mcg/gm creatinine)							
No. of subjects	36	133	83	58	24	11	345
Median	44	40	31	17	23	38	34
			Percent Distribution				
<27	27.8	36.8	45.8	55.2	58.3	36.4	42.6
27-65	50.0	39.1	38.6	31.0	20.8	45.4	37.7
66-129	8.3	15.0	7.2	12.1	8.3	9.1	11.3
≥130	13.9	9.0	8.4	1.7	12.5	9.1	8.4
Riboflavin Excretion (mcg/gm creatinine)							
No. of subjects	37	135	83	59	24	11	349
Median	54	60	60	53	72	84	61
			Percent Distribution				
<27	13.5	11.8	12.0	11.9			10.9
27-79	43.2	54.1	51.8	59.3	58.3	45.4	53.3
80-269	32.4	28.1	27.7	23.7	37.5	54.5	29.2
≥270	10.8	5.9	8.4	5.1	4.2		6.6
N^1-Methylnicotinamide Excretion (mg/gm creatinine)							
No. of subjects	17	61	40	26	9	4	157
Median	2.6	3.3	2.9	3.0	2.6	4.4	3.0
			Percent Distribution				
<0.5							--
0.5-1.59	17.6	11.5	20.0	23.1		25.0	15.9
1.6-4.29	76.5	59.0	57.5	46.2	100.0	25.0	59.9
≥4.3	5.9	29.5	22.5	30.8		50.0	24.2

APPENDIX TABLE 3J (Continued)

Area of Origin		Activity		
Rural	Urban	Active Training	Garrison Duty	Clerical Duty
147	217	69	284	11
162	161	148	165	163
		Percent Distribution		
1.4	3.2	8.7	1.0	
32.6	35.0	40.6	32.7	27.3
56.5	47.0	42.0	52.1	72.7
9.5	14.8	8.7	14.1	
141	204	65	270	10
32	36	49	29	30
		Percent Distribution		
44.7	41.2	20.0	47.8	50.0
37.6	37.7	52.3	34.8	20.0
9.9	12.2	15.4	10.0	20.0
7.8	8.8	12.3	7.4	10.0
141	208	68	270	11
57	64	58	61	68
		Percent Distribution		
11.3	10.6	7.4	12.2	
56.0	51.4	54.4	52.6	63.6
26.2	31.2	30.9	28.5	36.4
6.4	6.7	7.4	6.7	
65	92	24	125	8
3.1	2.9	3.2	3.0	2.3
		Percent Distribution		
16.9	15.2	12.5	16.0	25.0
61.5	58.7	62.5	59.2	62.5
21.5	26.1	25.0	24.8	12.5

687462 O - 63 - 17

APPENDIX 3K

BURMA ARMY (ARMY/NAVY/AIR FORCE) RATION SCALES

(Ordinary)

	Quantity per person	Times per week
Dry ration		
Rice	26 ozs	7
Gram	3 "	7
Cooking oil	2 "	7
Salt	1/2 "	7
Ngapi (salted fish paste)	1/5 "	7
Salted fish sauce	1/8 "	2
Dried shrimp	1/4 "	7
Condiment		
Dried chillie	1/5 "	7
Garlic	1/5 "	7
Tamarind	1/14 "	7
Curry powder	1/26 "	4
Onion	2 "	7
Tea	1/4 "	7
Sugar	1-1/2 "	7
Condensed milk, sweetened	2 "	7
Charcoal	91 "	7
Matches	1 box	1
Toilet paper	8 sheets	7
Fresh ration		
Meat (one of following)		
Beef with bone	7 ozs	3
Pork without bone	4 "	1
Mutton with bone	4 "	1
Fish or prawn or chicken (live)	8 "	1
Dried fish or egg	3 "	1
Vegetables	7 "	7
Potatoes	4 "	7
Ginger	1/14 "	7
Fruits	6 "	7

APPENDIX 3L

VEGETABLES COMMONLY PURCHASED BY BURMA MILITARY

Serial No.	Commodity
1	Ash pumpkin
2	Bamboo shoot
3	Beans, French
4	Beans, long
5	Brinjals (Eggplant)
6	Calabash
7	Carli-flower (Cauliflower)
8	Dhal sprout
9	Snake 'gourd
10	Cabbage
11	Lady's finger (Okra)
12	Radish
13	Roselle leaf
14	Tomatoes
15	Rabbit greens
16	Knol khol (Rabi)
17	Spinach
18	Banana, Phihgyan
19	Banana, Htawbut
20	Banana, Yakhine
21	Banana, Thimwe
22	Mangoes, Nettet
23	Mangoes, Thonelonetadaung
24	Mangoes, Saing
25	Mangoes, Thalaphet
26	Pineapple
27	Watermelon
28	Oranges
29	Sweet lime
30	Pears
31	Custard apple
32	Potatoes, fresh
33	Onions, fresh

APPENDIX 3M

BURMA ARMY (ARMY/NAVY/AIR FORCE) OPERATIONAL RATION SCALES

(A)

	Quantity per person
Dry ration	
Biscuits (service)	10 ozs
Butter	2 "
Canned fish or corned meat	7-1/2 "
Canned peas or vegetables	2 "
Salt	1/2 "
Canned fruit	2 "
Tea	1/4 "
Sugar	1-1/2 "
Condensed milk (sweetened)	2 "
Chocolate	2 "
Chewing gum	1/6 "
Salt tablet, 0.5 gm	1 tablet
Cigarettes	1 tin of 50
Chlorination tablets	1 tablet
Paludrine (0.1; antimalarial)	1 "
Matches	1 box
Toilet paper	8 sheets

(B)

Rice	26 ozs
Canned fish or corned meat	7-1/2 "
Canned peas or vegetables	2 "
Ngapi (fried)	2 "
Pickle	2 "
Salt	2 "
Canned fruit	2 "
Tea	1/4 "
Sugar	1-1/2 "
Condensed milk (sweetened)	2 "
Sweets	1 "
Cigarettes	1 tin of 50
Salt tablets	1 tablet
Chlorination tablets	1 "
Paludrine (0.1; antimalarial)	1 "
Matches	1 box
Toilet paper	8 sheets

BURMA ARMY (ARMY/NAVY/AIR FORCE) PYAUKYA RATION SCALES

Biscuits (service)	10 ozs
Canned fish or corned meat	7-1/2 "
Salt	1/2 "
Tea	1/4 "
Sugar	1-1/2 "
Condensed milk (sweetened)	4 "
Chewing gum	1/6 "
Cigarettes	6
Chlorination tablets	2 tablets
Paludrine (0.1; antimalarial)	1 "
Matches	10 sticks
Toilet paper	8 sheets

APPENDIX 3N

BURMA ARMY (ARMY/NAVY/AIR FORCE) HOSPITAL DIET (1)

	Quantity per person	Times per week
Dry ration		
Rice	20 ozs	7
Gram	3 "	7
Cooking oil	2-1/2 "	7
Salt	3/4 "	7
Ngapi	1/5 "	7
Salted fish sauce	1/8 "	7
Dried shrimp	8 "	7
Baking powder	5/12 "	7
Tea	1/8 "	7
Coffee	1/4 "	7
Horlick	2 "	1
Ovaltine	1/4 "	3
Sugar	2-1/2 "	7
Condensed milk	2-1/2 "	7
Milk	10 "	3
Butter	1/4 "	3
Jam	1/2 "	3
Biscuits (sweetened)	2 "	4
Bread	4 "	3
Condiment		
Dried chillie	1/5 "	7
Garlic	1/5 "	7
Tamarind	1/14 "	7
Curry powder	1/26 "	4
Onion	2-1/2 "	7
Matches	1 box	1
Toilet paper	8 sheets	7
Fresh ration		
Meat		
Beef (without bone)	4 ozs	2
Pork (without bone)	4 "	2
Mutton (with bone)	4 "	2
Chicken (live)	8 "	2
Duck (live)	8-3/4 "	2
Fish	6 "	2
Prawn	6 "	1
Duck egg	2	1
Vegetables	8-3/4 ozs	7
Potatoes	4 "	7
Ginger	1/14 "	7
Fruits	6 "	7
Extra ration		
Liver	2-1/4 "	
Egg (hen)	2	

APPENDIX 3N (Continued)

BURMA ARMY (ARMY/NAVY/AIR FORCE) HOSPITAL DIET (2)

	Quantity per person	Times per week
Dry ration		
Rice	8 ozs	7
Margarine or cooking oil	1-1/4 "	7
Salt	1 "	7
Onion	3/4 "	7
Garlic	1/2 "	7
Custard (1)	1/5 "	6
Tea	1/8 "	7
Coffee	1/4 "	7
Horlick	2 "	7
Ovaltine	1/4 "	7
Sugar	3 "	7
Condensed milk	2-1/2 "	7
Fresh milk	10 "	7
Butter	1/2 "	7
Jams	1/2 "	7
Biscuit (sweetened)	1 "	4
Bread	6 "	7
Matches	1 box	1
Toilet paper	8 sheets	7
Fresh ration		
Meat		
Beef without bone	4 ozs	1
Mutton with bone	5 "	4
Fowl (live)	10 "	3
Duck (live)	12 "	2
Fish	6 "	3
Liver	4 "	1
Egg (hen)	2	7
Vegetables	8 ozs	7
Potatoes	3 "	7
Fruits	6 "	7
Extra ration		
Jelly powder	2 "	
Egg (hen)	2	
Liver	2-1/4 ozs	

APPENDIX 3N (Continued)

BURMA ARMY (ARMY/NAVY/AIR FORCE) HOSPITAL DIET (3)

	Quantity per person	Times per week
Dry ration		
Oatmeal	2 ozs	7
Coffee	1/2 "	7
Horlick	2 "	7
Ovaltine	1/2 "	7
Sugar	4 "	7
Condensed milk	2 "	7
Fresh milk	21 "	7
Chicken (live)	6 "	7
Egg (hen)	2	7
Salt	1/4 ozs	7
Toilet paper	8 sheets	7
Extra ration		
Jelly powder	2 ozs	
Milo	2 "	
Cocoa	2 "	
Egg (hen)	2	
Orange juice	12 ozs	
Lemon barley	12 "	
Lime juice	12 "	

APPENDIX TABLE 3 0. SALT INTAKE BY FOOD COMPOSITE ANALYSIS, BURMA MILITARY

Grams per Man per Day

Mingaladon, BAMC	13.0
Mingaladon, BATD #1	9.6
Indaing, COD	10.3
Indaing, 107th Regt.	17.0
Toungoo, 22nd Buregt.	12.8
Meiktila, Art. Depot	8.7
Ba Htoo Myo, BACFS	6.9
Ba Htoo Myo, BANCOS	13.1
Chauk, 104th Regt.	10.2
Maymyo, BATD #2	11.8
Moulmein, 1st Chin Rfl.	11.5
Ratanabon, Navy	9.6
Meiktila, Air Force	18.3
Average	11.8

APPENDIX TABLE 3P. NUTRIENT INTAKE BY UNIT, BURMA, MILITARY

Location	Mingaladon				Indaing		
Unit	BAMC		BATD #1		COD		107th Regt.
Method	Recipe	Food Composite	Recipe	Food Composite	Recipe	Food Composite	Food Composite
Calories	3,408	2,500	3,842	3,640	3,314	2,450	3,530
Protein, gm	87.1	57.8	97.7	99.0	79.7	60.7	122
Fat, gm	74.2	27.5	73.9	42.0	58.4	22.6	103
Carbohydrate, gm	596	476	704	720	611	502	570
Calcium, mg	327	212	323	396	303	286	1,145
Iron, mg	13.6	27.4	15.8	31.5	11.3	24.4	48.5
Vitamin A, I.U.	1,124	1,160	1,402	3,060	1,464	2,180	2,500
Thiamine, mg	1.47	0.47	1.41	0.58	1.36	0.41	0.54
Riboflavin, mg	0.95	1.16	0.86	1.32	0.81	0.86	2.01
Niacin, mg	17.6	8.1	19.1	9.6	15.0	7.8	15.8
Vitamin C, mg	91	17.2	42	28.4	65.0	18.4	24.3

APPENDIX TABLE 3P (Continued) NUTRIENT INTAKE BY UNIT, BURMA, MILITARY

Location	Chauk	Maymyo		Moulmein		Ratanabon
Unit	104th Regt.	BATD #2		1st Chin Rifles		Navy
Method	Food Composite	Recipe	Food Composite	Recipe	Food Composite	Food Composite
Calories	2,393	3,660	3,318	2,914	2,886	2,170
Protein, gm	85.0	89.2	86.5	71.5	72.5	59.5
Fat, gm	33.0	51.1	29.1	62.7	39.8	61.4
Carbohydrate, gm	525	711	670	517	555	385
Calcium, mg	595	383	500	340	356	324
Iron, mg	32.0	13.2	72.0	13.7	26.8	22.7
Vitamin A, I.U.	1,460	1,691	4,160	4,878	4,180	2,915
Thiamine, mg	0.41	1.53	0.53	1.40	0.60	0.47
Riboflavin, mg	0.87	0.81	0.89	0.95	1.06	0.98
Niacin, mg	9.5	16.7	9.6	13.0	8.5	6.9
Vitamin C, mg	30.1	111	54.0	110	36.8	25.9

APPENDIX TABLE 3P (Continued)

Toungoo		Meiktila			Ba Htoo Myo		
22nd Buregt.		Air Force	Artillery Depot		BACFS		BANCOS
Recipe	Food Composite	Food Composite	Recipe	Food Composite	Recipe	Food Composite	Food Composite
4,039	3,820	3,340	3,416	3,120	3,591	2,620	3,580
98.2	106.5	101.8	83.1	74.5	98.5	63.0	95.5
72.7	52.6	39.4	84.6	55.5	66.1	42.2	123.2
748	701	613	566	594	635	530	607
397	670		341	291	307	395	471
16.2	36.6	34.2	16.1	19	15.4	26.0	45.0
2,234	2,430	2,918	743	5,700	2,021	2,500	1,460
1.58	0.71	0.66	1.44	0.61	1.74	0.51	0.75
1.21	1.32	1.28	1.09	0.94	0.92	0.78	0.87
16.9	12.7	12.9	16.3	10.4	19.8	8.2	7.5
84.0	24.1	39.0	21.5	22.2	65.5	24.6	25.6

APPENDIX TABLE 3Q. SUGGESTED GUIDE TO INTERPRETATION OF NUTRIENT INTAKE DATA[1/]

		Deficient	Low	Acceptable	High
Niacin	mg/day	< 5	5-9	10-14	≥ 15
Riboflavin	mg/day	< .7	0.7-1.1	1.2-1.4	≥ 1.5
Thiamine	mg/1,000 Calories	< .2	0.2-0.29	0.3-0.4	≥ .5
Ascorbic acid	mg/day	< 10	10-29	30-49	≥ 50
Vitamin A	I.U./day	< 2,000	2,000-3,499	3,500-4,999	≥ 5,000
Calcium	gm/day	< .3	0.30-0.39	0.4-0.7	≥ .8
Iron	mg/day	< 6.0	6-8	9-11	≥ 12
Protein	gm/kg body weight	< .5	0.5-0.9	1.0-1.4	≥ 1.5

These guides are intended to apply to 25 year old physically active males 67 inches (170 cm) in height and 143 pounds (65 kg) in weight, living in a temperate climate and consuming a varied diet. The quantities specified should never be considered as inflexible "requirements." In interpreting nutrition surveys of population groups, average values falling in one or another of the above categories conceal the fact that some individuals will receive more and others less than average. In addition, it is known that there is much variability from one individual to another in their requirement for various nutrients. Variations in body size, activity, climate, types of food available and other factors modify requirements and, consequently, interpretation of survey data. The nutrient content of food may be altered materially during food preparation, a fact which must always be considered in evaluating dietary intake data.

1/ Prepared by the Interdepartmental Committee on Nutrition for National Defense.

APPENDIX TABLE 3R. WATER ANALYSIS FOR MINERALS, BURMA

mg/Liter

Source	Iron	Calcium	Fluorine
Toungoo	0.9	0.1	none
Shwe Daung	1.70	11.5	0.92
Sé Bauk	0.05	34.9	0.004
Ba Htoo Myo	0.03	69.3	none
Wet Wun	0.49	74.7	none
Moulmein	0.90	4.47	none

APPENDIX TABLE 3S. MINOR VITAMINS AND MINERALS IN MILITARY DIET, BURMA

Nutrient	Intake per Man per Day	
Vitamin B_6, mg	1.70	(6 locations, 1,052 men)
Vitamin B_{12}, mcg	2.30	(7 locations, 1,590 men)
Folic Acid, mg	.103	(6 locations, 1,492 men)
Pantothenic Acid, mg	.517	(5 locations, 695 men)
Iodine, mg	.148	(13 locations, 2,480 men)
Fluorine, mg	1.80	(3 locations, 720 men)

APPENDIX TABLE 3T. INTAKE OF MINOR NUTRIENTS BY LOCATION PER MAN PER DAY, BURMA MILITARY

Location	Unit	Iodine mg	Fluorine mg	Vitamin B_6 mg	Vitamin B_{12} mcg
Mingaladon	BAMC	.138	1.91	1.82	2.64
Mingaladon	BATD #1	.115	---	---	2.84
Indaing	COD	.070	.83	1.84	1.94
Indaing	107th Regt.	.273	---	---	---
Toungoo	22nd Buregt.	.205	---	---	.32 1/
Meiktila	Art. Depot	.136	---	---	1.86
Ba Htoo Myo	BACFS	.110	---	2.10	2.36
Ba Htoo Myo	BANCOS	.194	---	---	---
Chauk	104th Regt.	.103	---	---	---
Maymyo	BATD #2	.143	---	---	---
Moulmein	1st Chin Rfl.	.130	---	2.10	2.36
Ratanabon	Navy	.110	---	.82	.23 1/
Meiktila	Air Force	.195	2.68	1.75	2.83

1/ Samples exhibited inhibition of test organism at dilutions normally employed.

APPENDIX TABLE 3T (Continued)

Folic Acid mg	Pantothenic Acid mg	Tocopherol mg
.124	.264	3.2
.168	.026	---
---	.776	---
---	---	---
---	---	---
.172	---	---
.052	.595	---
---	---	14.2
---	---	---
---	---	---
.052	.920	---
.022	---	---
.080	---	---

APPENDIX TABLE 3U. DENTAL CARIES AND PERIODONTAL DISEASE FINDINGS FOR POPULATIONS EXAMINED IN BURMA, THAILAND, VIETNAM AND BALTIMORE, MARYLAND, USA

Age (years)	Burma	Thailand (2)	Vietnam (3)	Baltimore (6)1/
		Mean Numbers of DMF2/ Teeth		
5-9	.1	.2	.9	--
10-14	.5	.6	1.9	--
15-19	.7	1.0	1.8	11.9
20-29	.8	.8	1.9	14.0
30-39	1.2	1.0	2.1	15.9
40-49	2.7	2.9	3.3	18.3
50+	9.2	10.6	10.1	22.3
		Periodontal Index Scores		
0-4	.22	--	--	--
5-9	.44	.23	.21	--
10-14	.58	.38	.36	--
15-19	.65	.41	.53	.31
20-29	.86	.72	.66	.36
30-39	1.67	1.97	1.53	.70
40-49	3.30	3.06	2.62	1.29
50+	4.99	5.54	4.59	2.02

1/ Numbers in parentheses are references given on page 76.
2/ DMF = decayed, missing, or filled.

APPENDIX TABLE 3V. DENTAL FINDINGS RELATED TO RESULTS OF BIOCHEMICAL DETERMINATIONS, MILITARY MALES, BURMA

Nutritional Status		Number Examined	Mean Age	Periodontal Disease: Mean Score	Periodontal Disease: Percent with Advanced Disease	Gingival Recession: Mean Score	Gingival Recession: Percent Positive	Dental Caries: Mean DMF 1/	Dental Caries: Percent Positive
				Serum Ascorbic Acid (mcg/100 ml)					
I 2/	<.2	11	24.4	1.0	18	10	55	1.0	36
II 3/	>.2	324	26.2	1.0	34	9	42	.8	32
				Serum Vitamin A (mcg/100 ml)					
I	<20	10	27.9	.8	50	9	60	.3	20
II	>20	337	26.0	1.0	32	8	41	.7	31
				Thiamine (mcg/gm creatinine)					
I	<65	266	26.0	1.0	32	9	39	.7	30
II	≥66	68	26.3	1.1	41	9	47	1.1	37
				Riboflavin (mcg/gm creatinine)					
I	<79	215	25.9	1.0	34	8	40	.7	33
II	≥80	124	26.4	1.1	3	9	42	.9	29
				N'-Methylnicotinamide (mg/gm creatinine)					
I	<1.59	26	26.1	1.0	35	8	50	.9	46
II	≥1.60	128	25.7	.9	38	8	42	.7	36

1/ DMF = decayed, missing, or filled.
2/ I includes "deficient" or "low" levels by ICNND standards.
3/ II includes "acceptable" or "high" levels by ICNND standards.

APPENDIX 4

APPENDIX TABLE 4A. AGE, HEIGHT, WEIGHT AND PERCENT "STANDARD WEIGHT" BY LOCATION, BURMA, DEPENDENTS

(Abbreviated Examinations)

Mean Values

Location	Mingaladon	Seik Kyi and Ratanabon	Indaing	Toungoo	Meiktila (Army)	Meiktila (Air Force)	Ba Htoo Myo	Chauk	Maymyo	Moulmein	Total
Females 15+ years, nonpregnant, nonlactating											
No. Examined	45	9	93	114	65	21	51	70	22	84	574
Age (years)	30.9	27.8	29.6	27.1	26.0	30.3	28.1	26.4	30.4	24.0	27.5
No. Examined	45	9	93	114	65	20	50	70	22	84	572
Height (cm)	150.9	151.7	150.6	150.7	150.5	149.4	149.9	151.5	151.4	150.6	150.7
Weight (kg)	41.2	49.8	45.2	44.1	44.5	43.4	42.8	45.8	46.7	46.4	44.7
Percent "Standard Weight"	78.3	95.0	86.9	84.8	85.7	83.2	82.5	87.2	89.3	89.6	85.8
Females 15+ years, pregnant and lactating											
No. Examined	88	21	138	134	121	70	111	78	43	135	939
Age (years)	26.4	24.8	26.3	24.6	25.4	25.7	25.6	25.6	27.0	23.9	25.4
No. Examined	88	21	136	134	120	70	111	78	43	133	934
Height (cm)	150.3	151.4	150.1	150.8	151.5	149.5	150.5	149.8	150.2	150.4	150.5
Weight (kg)	40.8	44.4	42.5	43.8	44.1	45.8	44.3	44.7	46.8	46.7	44.2
Percent "Standard Weight"	78.2	84.8	81.8	83.9	84.1	88.5	84.9	86.2	90.1	90.0	84.9

APPENDIX TABLE 4B. CLINICAL FINDINGS BY SEX, AGE AND LOCATION, BURMA, DEPENDENTS

(Abbreviated Examinations)

Location	Mingaladon	Seik Kyi and Ratanabon	Indaing	Toungoo	Meiktila (Army)	Meiktila (Air Force)	Ba Htoo Myo	Ghauk	Maymyo	Moulmein	Total
Total Number Examined	224	96	340	291	208	121	162	162	120	380	2,104
Males <15 yrs.1/	52	36	69	26	15	14	--	--	20	74	306
Females <15 yrs.	39	30	40	17	7	16	--	14	35	87	285
Females 15+ yrs., NP, NL2/	45	9	93	114	65	21	51	70	22	84	574
Females 15+ yrs., P, L3/	88	21	138	134	121	70	111	78	43	135	939
					Percent Prevalence						
Nasolabial seborrhea											
Males <15 yrs.		2.8									0.3
Females <15 yrs.											--
Females 15+ yrs., NP, NL	8.9	11.1	15.0	9.6	18.5	4.8	5.9	5.7		3.6	9.2
Females 15+ yrs., P, L	5.7	19.0	10.1	11.2	16.5	17.1	9.9	7.7	9.3	7.4	10.8
Angular lesions											
Males <15 yrs.	7.7	16.7	17.4	7.7		14.3			15.0	6.8	11.1
Females <15 yrs.	5.1	3.3	7.5	5.9		6.2		14.3	14.3	9.2	8.1
Females 15+ yrs., NP, NL	4.4		2.2	2.6	7.7	9.5	2.0	7.1		3.6	4.0
Females 15+ yrs., P, L	9.1		6.5	9.0	6.6	8.6	7.2	6.4	14.0	5.9	7.4
Angular scars											
Males <15 yrs.	3.8	2.8	2.9							1.4	2.0
Females <15 yrs.								7.1	2.8		0.7
Females 15+ yrs., NP, NL	2.2		2.2	4.4	1.5	14.3	2.0	5.7		1.2	3.1
Females 15+ yrs., P, L	1.1		1.4	1.5	0.8	5.7	3.6	2.6	4.6	3.0	2.3
Cheilosis											
Males <15 yrs.											--
Females <15 yrs.											--
Females 15+ yrs., NP, NL											--
Females 15+ yrs., P, L			0.7								0.1
Swollen red papillae - Localized											
Males <15 yrs.		5.6	5.8								2.0
Females <15 yrs.	2.6		2.5							1.1	1.0
Females 15+ yrs., NP, NL	4.4				1.5	4.8		1.4		2.4	1.2
Females 15+ yrs., P, L	2.3	9.5	7.2	2.2	4.1	7.1	0.9			3.0	3.4
Swollen red papillae - Diffuse											
Males <15 yrs.			1.4							1.4	0.6
Females <15 yrs.	2.6								2.8		0.7
Females 15+ yrs., NP, NL			1.1	0.9	4.6					1.2	1.0
Females 15+ yrs., P, L	3.4	4.8	2.2	0.7	3.3	7.1	1.8			0.7	2.1

1/ This group includes 2 15 year olds and 1 16 year old.
2/ NP, NL = Nonpregnant, nonlactating.
3/ P, L = Pregnant, lactating.

APPENDIX TABLE 4B (Continued) CLINICAL FINDINGS BY SEX, AGE AND LOCATION, BURMA, DEPENDENTS

(Abbreviated Examinations)

Location	Mingaladon	Seik Kyi and Ratanabon	Indaing	Toungoo	Meiktila (Army)	Meiktila (Air Force)	Ba Htoo Myo	Chauk	Maymyo	Moulmein	Total
Total Number Examined	224	96	340	291	208	121	162	162	120	380	2,104
Males <15 yrs.	52	36	69	26	15	14	--	--	20	74	306
Females <15 yrs.	39	30	40	17	7	16	--	14	35	87	285
Females 15+ yrs.,NP,NL	45	9	93	114	65	21	51	70	22	84	574
Females 15+ yrs.,P,L	88	21	138	134	121	70	111	78	43	135	939
					Percent Prevalence						
Filiform papillary atrophy - Slight											
Males <15 yrs.	1.9	5.6	1.4			7.1				1.4	2.0
Females <15 yrs.		3.3	2.5							1.1	1.0
Females 15+ yrs.,NP,NL	8.9		2.2	2.6				1.4			1.7
Females 15+ yrs.,P,L	2.3	4.8	5.1	4.5	3.3	5.7	1.8	2.6	7.0	1.5	3.5
Filiform papillary atrophy - Moderate/Severe											
Males <15 yrs.			7.2							1.4	2.0
Females <15 yrs.	2.6		2.5								0.7
Females 15+ yrs.,NP,NL			1.1	2.6	3.1		3.9	4.3			1.9
Females 15+ yrs.,P,L	2.3		2.2	1.5	2.5	2.8	0.9	2.6	7.0	2.2	2.2
Glossitis											
Males <15 yrs.				3.8							0.3
Females <15 yrs.											--
Females 15+ yrs.,NP,NL							2.0				0.2
Females 15+ yrs.,P,L	2.3		0.7	1.5	0.8	2.8					0.8
Thyroid enlarged - Grade I											
Males <15 yrs.											--
Females <15 yrs.								14.3	5.7	5.7	3.2
Females 15+ yrs.,NP,NL	13.3	22.2	4.3	12.3	13.8	9.5	13.7	34.3	31.8	27.4	17.1
Females 15+ yrs.,P,L	10.2	19.0	11.6	11.9	11.6	8.6	27.0	30.8	23.2	34.1	18.6
Thyroid enlarged - Grade II											
Males <15 yrs.											--
Females <15 yrs.											--
Females 15+ yrs.,NP,NL			4.3			4.8					0.9
Females 15+ yrs.,P,L	2.3		2.9	1.5	0.8		0.9	2.6		1.5	1.5
Follicular hyperkeratosis - Anywhere											
Males <15 yrs.	9.6	27.8	2.9	7.7	6.7	7.1					6.9
Females <15 yrs.	2.6	10.0		5.9							1.8
Females 15+ yrs.,NP,NL	8.9			1.8			2.0				1.2
Females 15+ yrs.,P,L	1.1	9.5	0.7	1.5		1.4			2.3	0.7	1.0
Follicular hyperkeratosis - Arms											
Males <15 yrs.	3.8	22.2		7.7							3.9
Females <15 yrs.		10.0		5.9							1.4
Females 15+ yrs.,NP,NL	8.9			0.9							0.9
Females 15+ yrs.,P,L	1.1	4.8							2.3		0.3
Follicular hyperkeratosis - Back											
Males <15 yrs.	9.6	27.8	1.4	7.7	6.7	7.1					6.5
Females <15 yrs.	2.6	10.0		5.9							1.8
Females 15+ yrs.,NP,NL	2.2			1.8			2.0				0.7
Females 15+ yrs.,P,L		9.5	0.7	1.5		1.4				0.7	0.7

APPENDIX TABLE 4B (Continued) CLINICAL FINDINGS BY SEX, AGE AND LOCATION, BURMA, DEPENDENTS

(Abbreviated Examinations)

Location	Mingaladon	Seik Kyi and Ratanabon	Indaing	Toungoo	Meiktila (Army)	Meiktila (Air Force)	Ba Htoo Myo	Chauk	Maymyo	Moulmein	Total
Total Number Examined	224	96	340	291	208	121	162	162	120	380	2,104
Males <15 yrs.	52	36	69	26	15	14	--	--	20	74	306
Females <15 yrs.	39	30	40	17	7	16	--	14	35	87	285
Females 15+ yrs.,NP,NL	45	9	93	114	65	21	51	70	22	84	574
Females 15+ yrs.,P,L	88	21	138	134	121	70	111	78	43	135	939
					Percent Prevalence						
Follicular hyperkeratosis - Thighs											
Males <15 yrs.	3.8	13.9	1.4	3.8							2.9
Females <15 yrs.		3.3		5.9							0.7
Females 15+ yrs.,NP,NL											--
Females 15+ yrs.,P,L									2.3		0.1
Loss of ankle jerk - Unilateral											
Males <15 yrs.			1.4								0.3
Females <15 yrs.	2.6		2.5								0.7
Females 15+ yrs.,NP,NL			1.1					1.4			0.3
Females 15+ yrs.,P,L			2.2			1.4		1.3			0.5
Loss of ankle jerk - Bilateral											
Males <15 yrs.			5.8								1.3
Females <15 yrs.			5.0								0.7
Females 15+ yrs.,NP,NL	4.4		3.2								0.9
Females 15+ yrs.,P,L					0.8						0.1
Loss of ankle jerk - Side not given											
Males <15 yrs.	1.9	2.8	1.4								1.0
Females <15 yrs.									2.8		0.4
Females 15+ yrs.,NP,NL	4.4		1.1	1.8	3.1			2.8			1.6
Females 15+ yrs.,P,L		4.8	2.2	0.7	0.8			2.6	2.3	0.7	1.1
Calf tenderness											
Males <15 yrs.											--
Females <15 yrs.											--
Females 15+ yrs.,NP,NL											--
Females 15+ yrs.,P,L										0.7	0.1
Pterygium											
Males <15 yrs.		2.8									0.3
Females <15 yrs.								7.1			0.4
Females 15+ yrs.,NP,NL	4.4		2.2	3.5	3.1		3.9				2.3
Females 15+ yrs.,P,L	1.1		0.7	2.2	0.8				4.6	0.7	1.0
Thickened bulbar conjunctivae											
Males <15 yrs.									5.0		0.3
Females <15 yrs.										1.1	0.4
Females 15+ yrs.,NP,NL	48.9	44.4	34.4	40.4	36.9	38.1	35.3	38.6	27.3		35.9
Females 15+ yrs.,P,L	29.5	23.8	26.1	26.1	50.4	22.8	38.7	30.8	27.9	30.4	31.8

APPENDIX TABLE 4C. BIOCHEMICAL FINDINGS BY SEX AND AGE, BURMA, MILITARY DEPENDENTS

	MALES	FEMALES					
		Nonpregnant, Nonlactating		Total	Pregnant	Lactating	Total
Age (years)	<15	<15	>15		15-44		
BLOOD							
Total Serum Protein (gm/100 ml)							
No. of subjects	6	4	48	52	24	58	82
Mean	7.5	7.4	7.8	7.8	7.3	7.8	7.6
				Percent Distribution			
6.0-6.39				--	4.2		1.2
6.4-6.9	16.7		6.2	5.8	41.7	12.1	20.7
≥7.0	83.3	100.0	93.8	94.2	54.2	87.9	78.0
Serum Albumin (gm/100 ml)							
No. of subjects	6	4	48	52	24	58	82
Mean	4.1	4.1	4.0	4.0	3.3	3.8	3.7
				Percent Distribution			
<2.5				--	8.3		2.4
2.5-3.4			4.2	3.8	45.8	12.1	22.0
3.5-4.9	100.0	100.0	91.7	92.3	45.8	87.9	75.6
≥5.0			4.2	3.8			--
Serum Globulin (gm/100 ml)							
No. of subjects	6	4	48	52	24	58	82
Mean	3.4	3.4	3.9	3.8	4.1	3.9	4.0
				Percent Distribution			
2.0-2.9	16.7	25.0	4.2	5.8		6.9	4.9
3.0-3.5	50.0	50.0	27.1	28.8	16.7	13.8	14.6
>3.5	33.3	25.0	68.7	65.4	83.3	79.3	80.5
Albumin/Globulin Ratio							
No. of subjects	6	4	48	52	24	58	82
Mean	1.22	1.24	1.06	1.08	.84	1.02	.96
				Percent Distribution			
<0.5				--	4.2		1.2
0.5-0.9			47.9	44.2	79.2	56.9	63.4
1.0-1.4	100.0	75.0	47.9	50.0	16.7	37.9	31.7
1.5-1.9		25.0	4.2	5.8		5.2	3.6
Hemoglobin (gm/100 ml)							
No. of subjects	14	21	47	68	22	49	71
Mean	10.6	11.2	11.6	11.5	10.8	11.3	11.2
				Percent Distribution			
<12.0	71.4	57.1	53.2	54.4	86.4	61.2	69.0
12.0-13.9	28.6	38.1	38.3	38.2	9.1	34.7	26.8
14.0-14.9		4.8	8.5	7.4		4.1	2.8
≥15.0				--	4.5		1.4

APPENDIX TABLE 4C (Continued) BIOCHEMICAL FINDINGS BY SEX AND AGE, BURMA, MILITARY DEPENDENTS

	MALES	FEMALES					
		Nonpregnant, Nonlactating		Total	Pregnant	Lactating	Total
Age (years)	<15	<15	>15		15-44		
Hematocrit (percent)							
No. of subjects	19	22	50	72	24	58	82
Mean	38.0	37.2	39.0	38.4	36.9	39.3	38.6
				Percent Distribution			
<36	36.8	36.4	14.0	20.8	33.3	13.8	19.5
36-41	42.1	59.1	62.0	61.1	54.2	62.1	59.8
42-44	10.5	4.5	16.0	12.5	8.3	15.5	13.4
≥45	10.5		8.0	5.6	4.2	8.6	7.3
Mean Corpuscular Hemoglobin Concentration (percent)							
No. of subjects	14	20	47	67	22	49	71
Mean	27.6	30.0	30.0	30.0	29.2	29.2	29.2
				Percent Distribution			
<28.0	35.7	20.0	25.5	23.9	45.4	26.5	32.4
28.0-29.9	35.7	15.0	31.9	26.9	22.7	32.6	29.6
30.0-31.9	21.4	35.0	12.8	19.4	13.6	20.4	18.3
≥32.0	7.1	30.0	29.8	29.8	18.2	20.4	19.7
Serum Vitamin A (mcg/100 ml)							
No. of subjects	4	5	47	52	24	56	80
Mean	30.0	22.6	29.7	29.0	31.9	32.4	32.2
				Percent Distribution			
<10		20.0		1.9			--
10-19	50.0	20.0	8.5	9.6	4.2	3.6	3.8
20-49	50.0	60.0	91.5	88.5	91.7	91.1	91.2
≥50				--	4.2	5.4	5.0
Serum Carotene (mcg/100 ml)							
No. of subjects	4	5	48	53	24	58	82
Mean	97	67	111	107	113	94	100
				Percent Distribution			
20-39		20.0		1.9		1.7	1.2
40-99	75.0	80.0	52.1	54.7	33.3	60.3	52.4
≥100	25.0		47.9	43.4	66.7	37.9	46.3
Serum Vitamin C (mg/100 ml)							
No. of subjects	2	2	47	49	24	58	82
Mean	.54	.54	.49	.49	.48	.43	.44
				Percent Distribution			
.10-.19			8.5	8.2	4.2	3.4	3.6
.20-.39	50.0	50.0	40.4	40.8	33.3	55.2	48.8
≥.40	50.0	50.0	51.1	51.0	62.5	41.4	47.6

APPENDIX TABLE 4C (Continued) BIOCHEMICAL FINDINGS BY SEX AND AGE, BURMA, MILITARY DEPENDENTS

	MALES	FEMALES					
		Nonpregnant, Nonlactating		Total	Pregnant	Lactating	Total
Age (years)	<15	<15	>15		15-44		
Serum Cholesterol (mg/100 ml)							
No. of subjects	6	5	48	53	24	58	82
Mean	148	157	169	168	181	171	172
				Percent Distribution			
70-99		20.0		1.9			--
100-149	66.7		33.3	30.2	12.5	27.6	23.2
150-199	16.7	80.0	45.8	49.0	62.5	60.3	61.0
≥200	16.7		20.8	18.9	25.0	12.1	15.8
URINE							
Thiamine Excretion (mcg/gm creatinine)							
No. of subjects	9	15	48	63	22	57	79
Median	61	59	40	47	58	60	59
				Percent Distribution			
<27	11.1		39.6	30.2	31.8	15.8	20.2
27-65	44.4	60.0	31.2	38.1	22.7	40.4	35.4
66-129	11.1	20.0	18.8	19.0	31.8	21.0	24.0
≥130	33.3	20.0	10.4	12.7	13.6	22.8	20.2
Riboflavin Excretion (mcg/gm creatinine)							
No. of subjects	9	15	49	64	24	57	81
Median	87	108	59	66	60	66	64
				Percent Distribution			
<27		13.3	16.3	15.6	4.2	7.0	6.2
27-79	33.3	20.0	53.1	45.3	70.8	59.6	63.0
80-269	66.6	60.0	26.5	34.4	20.8	29.8	27.2
≥270		6.7	4.1	4.7	4.2	3.5	3.7
N^1-Methylnicotinamide Excretion (mg/gm creatinine)							
No. of subjects	9	11	23	34	13	35	48
Median	4.8	4.7	3.8	4.0	4.6	3.9	4.0
				Percent Distribution			
0.5-1.59	11.1	18.2	17.4	17.6	7.7	5.7	6.2
1.6-4.29	22.2	27.3	39.1	35.3	38.5	51.4	47.9
≥4.30	66.7	54.5	43.5	47.0	53.8	42.8	45.8

APPENDIX TABLE 4D. BIOCHEMICAL FINDINGS BY LOCATION, BURMA, MILITARY DEPENDENTS

Males and Nonpregnant, Nonlactating Females

Location	Mingaladon	Seik Kyi and Ratanabon	Indaing	Toungoo	Meiktila Army	Meiktila Air Force	Ba Htoo Myo	Chauk	Maymyo	Moulmein	Total
BLOOD											
Total Serum Protein (gm/100 ml)											
No. of subjects	4	8	9	10	6	1	3	1	9	7	58
Mean	7.6	7.5	7.9	8.1	7.8	8.1	8.0	8.1	7.7	7.3	7.8
Percent Distribution											
6.4-6.9		12.5			33.3					14.3	6.9
≥7.0	100.0	87.5	100.0	100.0	56.7	100.0	100.0	100.0	100.0	85.7	93.1
Serum Albumin (gm/100 ml)											
No. of subjects	4	8	9	10	6	1	3	1	9	7	58
Mean	4.4	4.0	4.0	4.1	4.2	3.7	3.3	3.7	4.1	3.8	4.0
Percent Distribution											
2.5-3.4							33.3			14.3	3.4
3-5-4.9	75.0	87.5	100.0	100.0	100.0	100.0	66.7	100.0	100.0	85.7	93.1
≥5.0	25.0	12.5									3.4
Serum Globulin (gm/100 ml)											
No. of subjects	4	8	9	10	6	1	3	1	9	7	58
Mean	3.2	3.5	3.8	4.0	4.4	4.4	4.7	4.4	3.6	3.5	3.8
Percent Distribution											
2.0-2.9	25.0	12.5							11.1	14.3	6.9
3.0-3.5	75.0	50.0	44.4	10.0					33.3	42.8	31.0
>3.5		37.5	55.6	90.0	100.0	100.0	100.0	100.0	55.6	42.8	62.1
Albumin/Globulin Ratio											
No. of subjects	4	8	9	10	6	1	3	1	9	7	58
Mean	1.34	1.20	1.08	1.02	.98	.84	.72	.84	1.20	1.16	1.10
Percent Distribution											
0.5-0.9		12.5	44.4	50.0	66.7	100.0	100.0	100.0	11.1	42.8	39.6
1.0-1.4	100.0	75.0	55.6	50.0	33.3				77.8	42.8	55.2
1.5-1.9		12.5							11.1	14.3	5.2
Hemoglobin (gm/100 ml)											
No. of subjects		14	13	14	8	5	4	2	11	11	82
Mean		11.3	11.1	11.4	10.2	11.3	11.8	11.4	11.7	11.9	11.3
Percent Distribution											
<12.0		71.4	61.5	64.3	75.0	60.0	25.0	50.0	45.4	36.4	57.3
12.0-13.9		21.4	30.8	28.6	25.0	40.0	50.0	50.0	54.5	54.5	36.6
14.0-14.9		7.1	7.7	7.1			25.0			9.1	6.1

APPENDIX TABLE 4D (Continued) BIOCHEMICAL FINDINGS BY LOCATION, BURMA, MILITARY DEPENDENTS

Males and Nonpregnant, Nonlactating Females

Location	Mingaladon	Seik Kyi and Ratanabon	Indaing	Toungoo	Meiktila Army	Meiktila Air Force	Ba Htoo Myo	Chauk	Maymyo	Moulmein	Total
Hematocrit (percent)											
No. of subjects	8	14	13	14	8	5	4	2	11	12	91
Mean	39.2	37.6	39.2	38.0	36.2	37.2	36.2	36.5	41.0	38.7	38.4
					Percent Distribution						
<36	50.0	21.4	15.4	21.4	50.0	20.0	25.0	50.0		25.0	24.2
36-41		71.4	61.5	71.4	50.0	80.0	25.0	50.0	63.6	58.3	57.1
42-44	25.0	7.1	7.7	7.1			50.0		18.2	16.7	12.1
≥45	25.0		15.4						18.2		6.6
Mean Corpuscular Hemoglobin Concentration (percent)											
No. of subjects		13	13	14	8	5	4	2	11	11	81
Mean		30.4	28.4	30.0	28.2	30.2	32.4	31.0	28.8	30.0	29.6
					Percent Distribution						
<28.0		7.7	46.2	28.6	37.5	20.0	25.0		27.3	18.2	25.9
28.0-29.9		38.5	23.1	35.7	37.5	40.0			36.4	9.1	28.4
30.0-31.9		30.8	15.4					100.0	36.4	36.4	19.8
≥32.0		23.1	15.4	35.7	25.0	40.0	75.0			36.4	25.9
Serum Vitamin A (mcg/100 ml)											
No. of subjects	1	8	9	11	6	1	3	1	9	7	56
Mean	22.0	21.9	28.1	31.3	32.8	29.0	40.3	46.0	26.0	29.6	29.1
					Percent Distribution						
<10		12.5									1.8
10-19		50.0	11.1						22.2		12.5
20-49	100.0	37.5	88.9	100.0	100.0	100.0	100.0	100.0	77.8	100.0	85.7
Serum Carotene (mcg/100 ml)											
No. of subjects	2	8	9	11	6	1	3	1	9	7	57
Mean	120	90	127	89	120	135	148	95	107	88	106
					Percent Distribution						
20-39		12.5									1.8
40-99	50.0	62.5	33.3	72.7	50.0		33.3	100.0	66.7	57.1	56.1
≥100	50.0	25.0	66.7	27.3	50.0	100.0	66.7		33.3	42.8	42.1
Serum Vitamin C (mg/100 ml)											
No. of subjects	2	3	8	11	6	1	3	1	9	7	51
Mean	1.10	.34	.42	.32	.34	.14	.64	.44	.77	.50	.49
					Percent Distribution						
.10-.19					50.0	100.0					7.8
.20-.39		100.0	75.0	90.9	16.7					14.3	41.2
≥.40	100.0		25.0	9.1	33.3		100.0	100.0	100.0	85.7	51.0

APPENDIX TABLE 4D (Continued) BIOCHEMICAL FINDINGS BY LOCATION, BURMA, MILITARY DEPENDENTS

Males and Nonpregnant, Nonlactating Females

Location	Mingaladon	Seik Kyi and Ratanabon	Indaing	Toungoo	Meiktila Army	Meiktila Air Force	Ba'Htoo Myo	Chauk	Maymyo	Moulmein	Total
Serum Cholesterol (mg/100 ml)											
No. of subjects	4	8	9	11	6	1	3	1	9	7	59
Mean	143	170	178	175	142	105	145	195	165	181	166
Percent Distribution											
70-99									11.1		1.7
100-149	50.0	25.0	22.2	18.2	83.3	100.0	66.7		22.2	28.6	33.9
150-199	50.0	62.5	44.4	63.6	16.7		33.3	100.0	44.4	28.6	45.8
≥200		12.5	33.3	18.2					22.2	42.8	18.6
URINE											
Thiamine Excretion (mcg/gm creatinine)											
No. of subjects	4	8	13	11	6	3	3	2	10	12	72
Median	131	72	51	11	52	1/	1/	1/	54	49	49
Percent Distribution											
<27	25.0	25.0	30.8	72.7	16.7		66.7			16.7	27.8
27-65		25.0	30.8	18.2	50.0		33.3	100.0	70.0	58.3	38.9
66-129	25.0	25.0	23.1		16.7	33.3			20.0	25.0	18.0
≥130	50.0	25.0	15.4	9.1	16.7	66.7			10.0		15.3
Riboflavin Excretion (mcg/gm creatinine)											
No. of subjects	4	8	13	12	6	3	3	2	10	12	73
Median	70	107	82	22	107	1/	1/	1/	133	70	71
Percent Distribution											
<27		12.5		58.3			33.3	50.0			13.7
27-79	75.0	25.0	46.2	41.7	33.3	33.3	66.7	50.0	30.0	58.3	43.8
80-269	25.0	50.0	46.2		50.0	66.7			70.0	41.7	38.4
≥270		12.5	7.7		16.7						4.1
N'-Methylnicotinamide Excretion (mg/gm creatinine)											
No. of subjects	4	6	9	2	2	1	3	1	8	7	43
Median	3.0	5.1	4.9	1/	1/	1/	1/	1/	6.7	2.1	4.4
Percent Distribution											
0.5-1.59	25.0		11.1	100.0		100.0				28.6	16.3
1.6-4.29	75.0	33.3	11.1		50.0			100.0	25.0	57.1	32.6
≥4.30		66.7	77.8		50.0		100.0		75.0	14.3	51.2

1/ Too few data for statistical analysis.

APPENDIX 4E. NUTRITIONAL REQUIREMENTS IN BURMA

(Prepared by Prof. S. Postmus) (FAO)

Age Groups	Age (Years)	Calories	Protein Vegetable gm	Protein Animal gm	Fat gm	Calcium mg	Iron mg
Children	<1	600	7	16	20	540	3.4
	1-3	900	10	16	27	540	4.7
	4-6	1,200	14	20	34	540	5.4
	7-9	1,500	16	24	40	540	6.6
	10-12	1,800	20	30	50	800	8.0
Boys	13-15	2,400	24	34	66	800	10.0
Girls	13-15	2,000	24	34	54	800	10.0
Boys	16-19	2,400	24	36	84	800	10.0
Girls	16-19	2,000	24	36	50	800	10.0
Men	20-60	2,400	24	24	50	600	8.0
Old men	61+	2,000	24	24	40	660	6.6
Women	20-60	2,000	24	24	48	600	8.0
Old women	61+	1,600	24	24	34	660	6.6
Pregnant women		2,400	25	35	60	1,200	9.0
Lactating mothers		2,600	35	40	65	1,400	9.0

Vitamin A I.U.	Thiamine mg	Riboflavin mg	Niacin mg	Ascorbic Acid mg
750	0.3	0.4	3.0	20
1,000	0.45	0.6	4.0	24
1,400	0.6	0.8	5.4	34
1,800	0.75	1.0	6.6	40
2,200	0.9	1.2	8.0	50
2,600	1.2	1.4	10.0	50
2,600	1.0	1.4	10.0	50
2,600	1.2	1.4	10.0	50
2,600	1.0	1.4	10.0	50
2,600	1.2	1.1	8.0	35
2,600	1.0	1.0	6.6	35
2,600	1.0	1.2	8.0	35
2,600	0.8	1.0	6.6	35
3,600	1.5	2.4	10.0	70
4,000	1.5	2.4	15.0	70

APPENDIX TABLE 4F. PERCENT OF CALORIES FROM PROTEIN, FAT AND CARBOHYDRATE, BURMA

	Dependents 1/	Civilian 1/	Military 2/
Protein	8.8	8.5	10.8
Fat	21.9	16.9	14.9
Carbohydrates	69.3	74.6	74.3

1/ Questionnaire method.
2/ Food composite analysis method.

APPENDIX TABLE 4G. DENTAL FINDINGS RELATED TO RESULTS OF BIOCHEMICAL DETERMINATIONS, MILITARY DEPENDENTS, MALES AND FEMALES, BURMA

Nutritional Status		Number Examined	Mean Age	Mean PI[1] Score	Periodontal Disease: Percent with Advanced Disease	Gingival Recession: Mean Score	Gingival Recession: Percent Positive	Dental Caries: Mean DMF[2]	Dental Caries: Percent Positive
Males									
Serum Ascorbic Acid (mcg/100 ml)									
I[3]	<.2	2	14.5	.8	0	0	0	0	0
II[4]	>.2	4	16.8	.5	0	1	25	1.8	50
Serum Vitamin A (mcg/100 ml)									
I	<20	2	12.0	.5	0	0	0	1.0	50
II	>20	6	14.3	.5	0	1	20	.8	17
Thiamine (mcg/gm creatinine)									
I	<65	7	11.4	.5	0	0	0	1.2	43
II	≥66	7	11.0	.5	0	1	14	1.3	14
Riboflavin (mcg/gm creatinine)									
I	<79	3	9.3	.6	0	0	0	1.0	33
II	≥80	11	11.7	.5	0	1	17	.7	18
N^1-Methylnicotinamide (mg/gm creatinine)									
I	<1.59	1	11.0	.7	0	0	0	3.0	100
II	≥1.60	8	8.2	.4	0	0	0	.3	13
Females									
Serum Ascorbic Acid (mcg/100 ml)									
I	<.2	8	25.9	1.5	38	10	63	2.8	100
II	>.2	125	25.8	1.0	26	12	30	1.6	46
Serum Vitamin A (mcg/100 ml)									
I	<20	11	20.7	.8	10	5	40	.5	20
II	>20	123	25.8	1.0	29	5	30	1.8	50
Thiamine (mcg/gm creatinine)									
I	<65	88	24.1	1.1	25	6	26	1.6	45
II	≥66	54	25.1	.9	26	4	33	1.4	48
Riboflavin (mcg/gm creatinine)									
I	<79	94	24.6	1.0	26	5	29	1.5	46
II	≥80	50	23.8	1.0	26	5	28	1.6	54
N^1-Methylnicotinamide (mg/gm creatinine)									
I	<1.59	9	22.9	.5	11	1	25	.4	11
II	≥1.60	74	24.4	.9	23	5	29	1.1	47

1/ PI = periodontal index.
2/ DMF = decayed, missing, or filled.
3/ I includes "deficient" or "low" levels by ICNND standards.
4/ II includes "acceptable" or "high" levels by ICNND standards.

APPENDIX 5

APPENDIX TABLE 5A. AGE, HEIGHT, WEIGHT AND PERCENT "STANDARD WEIGHT" BY LOCATION, BURMA, CIVILIANS

(Abbreviated Examinations)

Mean Values

Location	Zigon	Indagaw	Kyee Taw	Shwe Daung	Lauk Sauk	Se Bauk	Ngayan Chaung	Wet Wun	Chauk	Total
Males 15+ years										
No. Examined	71	15	176	182	89	109	33	62	21	758
Age (years)	44.7	38.1	35.2	34.6	27.9	42.2	47.0	46.3	34.1	37.5
No. Examined	71	15	176	179	89	107	33	62	21	753
Height (cm)	161.5	162.4	162.1	160.7	161.9	162.1	160.8	161.0	161.6	161.5
Weight (kg)	48.7	50.5	50.2	47.8	50.0	48.5	52.0	49.6	50.1	49.3
Percent "Standard Weight"	81.8	83.8	84.2	82.2	84.9	81.4	88.3	83.7	84.0	83.3
Females 15+ years, nonpregnant, nonlactating										
No. Examined	30	33	88	71	54	42	76	58	--	452
Age (years)	48.9	37.7	40.3	39.3	37.5	46.2	39.6	43.1		41.0
No. Examined	30	32	87	69	54	42	76	58	--	448
Height (cm)	151.8	148.3	152.9	151.1	150.2	149.7	149.7	150.1		150.7
Weight (kg)	44.2	40.4	42.3	41.4	43.0	39.4	46.5	43.1		42.8
Percent "Standard Weight"	83.1	78.8	79.4	79.0	83.4	76.2	89.7	82.6		81.9

APPENDIX TABLE 5B. CLINICAL FINDINGS BY SEX, AGE AND LOCATION, BURMA, CIVILIANS

(Abbreviated Examinations)

Location	Zigon	Indagaw	Kyee Taw	Shwe Daung	Lauk Sauk	Se Bauk	Ngayan Chaung	Wet Wun	Chauk	Total
Total Number Examined	246	151	299	329	251	259	174	273	21	2,003
Males <15 yrs.	54	33	--	27	35	85	20	92	--	346
Males 15+ yrs.	71	15	176	182	89	109	33	62	21	758
Females <15 yrs.	65	24	7	15	54	12	27	37	--	241
Females 15+ yrs.,NP,NL 1/	30	33	88	71	54	42	76	58	--	452
Females 15+ yrs.,P,L 2/	26	46	28	34	19	11	18	24	--	206
				Percent Prevalence						
Bitot's spots										
Males <15 yrs.				3.7		2.4				0.9
Males 15+ yrs.				0.5						0.1
Females <15 yrs.										--
Females 15+ yrs.,NP,NL			1.1							0.2
Females 15+ yrs.,P,L										--
Nasolabial seborrhea										
Males <15 yrs.										--
Males 15+ yrs.			11.4	13.2	4.5	17.4	3.0	8.1	23.8	10.3
Females <15 yrs.					1.8					0.4
Females 15+ yrs.,NP,NL	3.3	9.1	4.5	8.4	5.6	4.8	2.6	8.6		5.8
Females 15+ yrs.,P,L	3.8	4.3		8.8	10.5		5.6			4.4
Angular lesions										
Males <15 yrs.	33.3	21.2		22.2	25.7	17.6	15.0	43.5		28.3
Males 15+ yrs.	15.5		10.2	10.4	9.0	10.1				8.8
Females <15 yrs.	20.0	8.3		26.7	14.8	8.3	14.8	18.9		16.2
Females 15+ yrs.,NP,NL	3.3	6.1	5.7	5.6	3.7	7.1	3.9	5.2		5.1
Females 15+ yrs.,P,L	15.4	19.6	17.8	14.7	5.3	18.2	5.6	20.8		15.5
Angular scars										
Males <15 yrs.	3.7			3.7	11.4	14.1	5.0	15.2		9.8
Males 15+ yrs.	4.2		4.0	4.4	2.2	2.8		4.8	4.8	3.6
Females <15 yrs.	1.5		14.3			8.3	11.1	2.7		2.9
Females 15+ yrs.,NP,NL	3.3		3.4	2.8		2.4	1.3	5.2		2.4
Females 15+ yrs.,P,L	7.7			2.9		9.1	5.6	8.3		3.4
Cheilosis										
Males <15 yrs.					2.8			1.1		0.6
Males 15+ yrs.				1.1						0.3
Females <15 yrs.										--
Females 15+ yrs.,NP,NL										--
Females 15+ yrs.,P,L	3.8			2.9						1.0

1/ NP,NL = Nonpregnant, nonlactating.

2/ P,L = Pregnant, lactating.

APPENDIX TABLE 5B (Continued) CLINICAL FINDINGS BY SEX, AGE AND LOCATION, BURMA, CIVILIANS

(Abbreviated Examinations)

Location	Zigon	Indagaw	Kyee Taw	Shwe Daung	Lauk Sauk	Sé Bauk	Ngayan Chaung	Wet Wun	Chauk	Total
Total Number Examined	246	151	299	329	251	259	174	273	21	2,003
Males <15 yrs.	54	33	--	27	35	85	20	92	--	346
Males 15+ yrs.	71	15	176	182	89	109	33	62	21	758
Females <15 yrs.	65	24	7	15	54	12	27	37	--	241
Females 15+ yrs., NP, NL	30	33	88	71	54	42	76	58	--	452
Females 15+ yrs., P, L	26	46	28	34	19	11	18	24	--	206
				Percent Prevalence						
Swollen red papillae - Localized										
Males <15 yrs.	7.4					3.5		4.3		3.2
Males 15+ yrs.	4.2		2.8	1.1		0.9				1.4
Females <15 yrs.	3.1				1.8					1.2
Females 15+ yrs., NP, NL	6.7			1.4						0.7
Females 15+ yrs., P, L	3.8	2.2					5.6			1.4
Swollen red papillae - Diffuse										
Males <15 yrs.	3.7			3.7	2.8			4.3		2.3
Males 15+ yrs.	12.7			1.1						1.4
Females <15 yrs.		4.2				8.3				0.8
Females 15+ yrs., NP, NL			1.1		1.8					0.4
Females 15+ yrs., P, L	19.2			2.9						2.9
Filiform papillary atrophy - Slight										
Males <15 yrs.	3.7	3.0			2.8	1.2		2.2		2.0
Males 15+ yrs.	2.8	6.7	3.4	1.6	1.1	1.8	3.0			2.1
Females <15 yrs.					3.7					0.8
Females 15+ yrs., NP, NL	6.7	3.0	6.8	1.4	3.7	4.8	2.6	1.7		4.0
Females 15+ yrs., P, L		6.5	14.3	2.9		18.2		16.7		6.8
Filiform papillary atrophy - Moderate/Severe										
Males <15 yrs.		3.0				1.2		1.1		0.9
Males 15+ yrs.			0.6		1.1	0.9				0.4
Females <15 yrs.				13.3			3.7	2.7		1.6
Females 15+ yrs., NP, NL	3.3		8.0				2.6	1.7		2.4
Females 15+ yrs., P, L	3.8	4.3	3.6			9.1		8.3		3.4
Glossitis										
Males <15 yrs.								1.1		0.3
Males 15+ yrs.			0.6							0.1
Females <15 yrs.										--
Females 15+ yrs., NP, NL			2.3				1.3			0.7
Females 15+ yrs., P, L	3.8									0.5
Thyroid enlarged - Grade I										
Males <15 yrs.				3.7	5.7	7.0	25.0	29.3		11.8
Males 15+ yrs.	4.2	6.7	4.0		2.2	1.8	12.1	12.9		3.6
Females <15 yrs.	6.2				24.1	8.3	25.9	18.9		13.3
Females 15+ yrs., NP, NL	20.0	9.1	5.7	4.2	22.2	16.7	34.2	48.3		19.9
Females 15+ yrs., P, L	23.1	17.4	14.3	5.9	36.8	27.3	27.8	58.3		23.8

APPENDIX TABLE 5B (Continued) CLINICAL FINDINGS BY SEX, AGE AND LOCATION, BURMA, CIVILIANS

(Abbreviated Examinations)

Location	Zigon	Indagaw	Kyee Taw	Shwe Daung	Lauk Sauk	Se Bauk	Ngayan Chaung	Wet Wun	Chauk	Total
Total Number Examined	246	151	299	329	251	259	174	273	21	2,003
Males <15 yrs.	54	33	--	27	35	85	20	92	--	346
Males 15+ yrs.	71	15	176	182	89	109	33	62	21	758
Females <15 yrs.	65	24	7	15	54	12	27	37	--	241
Females 15+ yrs.,NP,NL	30	33	88	71	54	42	76	58	--	452
Females 15+ yrs.,P,L	26	46	28	34	19	11	18	24	--	206
					Percent Prevalence					
Thyroid enlarged - Grade II										
Males <15 yrs.										--
Males 15+ yrs.			1.7					1.6		0.5
Females <15 yrs.										--
Females 15+ yrs.,NP,NL					13.0	2.4		6.9		2.6
Females 15+ yrs.,P,L		2.2			15.8		5.6			2.4
Follicular hyperkeratosis - Anywhere										
Males <15 yrs.	5.6			11.1		7.0	10.0	1.1		4.3
Males 15+ yrs.	2.8	6.7	2.8	5.5	3.4	0.9				2.9
Females <15 yrs.	1.5	4.2					3.7	2.7		1.6
Females 15+ yrs.,NP,NL				2.8			1.3			0.7
Females 15+ yrs.,P,L				2.9						0.5
Follicular hyperkeratosis - Arms										
Males <15 yrs.						5.9	10.0	1.1		2.3
Males 15+ yrs.	1.4		0.6	0.5	1.1					0.5
Females <15 yrs.	1.5	4.2					3.7			1.2
Females 15+ yrs.,NP,NL										--
Females 15+ yrs.,P,L										--
Follicular hyperkeratosis - Back										
Males <15 yrs.	5.6			11.1		4.7	10.0			3.5
Males 15+ yrs.	1.4	6.7	2.8	5.5	3.4	0.9				2.8
Females <15 yrs.	1.5	4.2					3.7			1.2
Females 15+ yrs.,NP,NL				2.8			1.3			0.7
Females 15+ yrs.,P,L				2.9						0.5
Follicular hyperkeratosis - Thighs										
Males <15 yrs.						1.2				0.3
Males 15+ yrs.										--
Females <15 yrs.		4.2						2.7		0.8
Females 15+ yrs.,NP,NL										--
Females 15+ yrs.,P,L										--
Scrotal dermatitis										
Males <15 yrs.										--
Males 15+ yrs.			0.6							0.1

APPENDIX TABLE 5B (Continued) CLINICAL FINDINGS BY SEX, AGE AND LOCATION, BURMA, CIVILIANS

(Abbreviated Examinations)

Location	Zigon	Indagaw	Kyee Taw	Shwe Daung	Lauk Sauk	Se Bauk	Ngayan Chaung	Wet Wun	Chauk	Total
Total Number Examined	246	151	299	329	251	259	174	273	21	2,003
Males <15 yrs.	54	33	--	27	35	85	20	92	--	346
Males 15+ yrs.	71	15	176	182	89	109	33	62	21	758
Females <15 yrs.	65	24	7	15	54	12	27	37	--	241
Females 15+ yrs.,NP,NL	30	33	88	71	54	42	76	58	--	452
Females 15+ yrs.,P,L	26	46	28	34	19	11	18	24	--	206
				Percent Prevalence						
Bilateral edema										
Males <15 yrs.										--
Males 15+ yrs.				0.5						0.1
Females <15 yrs.										--
Females 15+ yrs.,NP,NL					1.8					0.2
Females 15+ yrs.,P,L										--
Loss of ankle jerk - Unilateral										
Males <15 yrs.						1.2				0.3
Males 15+ yrs.		6.7	0.6	1.1		0.9				0.6
Females <15 yrs.						8.3				0.4
Females 15+ yrs.,NP,NL	3.3				1.8			3.4		0.9
Females 15+ yrs.,P,L							5.6			0.5
Loss of ankle jerk - Bilateral										
Males <15 yrs.										--
Males 15+ yrs.			2.3	0.5		3.7				1.2
Females <15 yrs.										--
Females 15+ yrs.,NP,NL						4.8	1.3			0.7
Females 15+ yrs.,P,L						9.1				0.5
Loss of ankle jerk - Side not given										
Males <15 yrs.	1.8				2.8					0.6
Males 15+ yrs.	11.3	6.7	2.3	5.5	1.1	3.7	3.0	1.6		4.0
Females <15 yrs.	6.2			6.7	1.8					2.5
Females 15+ yrs.,NP,NL	3.3		1.1	5.6	5.6	4.8	2.6	3.4		3.3
Females 15+ yrs.,P,L		2.2	3.6					4.2		1.4
Calf tenderness										
Males <15 yrs.										--
Males 15+ yrs.				0.5			3.0			0.3
Females <15 yrs.										--
Females 15+ yrs.,NP,NL										--
Females 15+ yrs.,P,L										--

APPENDIX TABLE 5B (Continued) CLINICAL FINDINGS BY SEX, AGE AND LOCATION, BURMA, CIVILIANS

(Abbreviated Examinations)

Location	Zigon	Indagaw	Kyee Taw	Shwe Daung	Lauk Sauk	Se Bauk	Ngayan Chaung	Wet Wun	Chauk	Total
Total Number Examined	246	151	299	329	251	259	174	273	21	2,003
Males <15 yrs.	54	33	--	27	35	85	20	92	--	346
Males 15+ yrs.	71	15	176	182	89	109	33	62	21	758
Females <15 yrs.	65	24	7	15	54	12	27	37	--	241
Females 15+ yrs.,NP,NL	30	33	88	71	54	42	76	58	--	452
Females 15+ yrs.,P,L	26	46	28	34	19	11	18	24	--	206
				Percent Prevalence						
Pterygium										
Males <15 yrs.										--
Males 15+ yrs.	5.6	6.7	4.5	7.1	6.7	9.2	9.1	9.7	4.8	6.9
Females <15 yrs.		4.2								0.4
Females 15+ yrs.,NP,NL	6.7		4.5	9.8	3.7	23.8	7.9	5.2		7.5
Females 15+ yrs.,P,L	3.8	2.2		5.9				4.2		2.4
Thickened bulbar conjunctivae										
Males <15 yrs.	3.7					5.9				2.0
Males 15+ yrs.	63.4	80.0	86.9	74.2	66.3	70.6	57.6	48.4	76.2	72.0
Females <15 yrs.		4.2				8.3				0.8
Females 15+ yrs.,NP,NL	76.7	57.6	73.9	53.5	50.0	42.8	52.6	43.1		56.4
Females 15+ yrs.,P,L	38.5	41.3	64.3	52.9	36.8	45.4	50.0	29.2		45.1

APPENDIX TABLE 5C. BIOCHEMICAL FINDINGS BY SEX AND AGE, BURMA, CIVILIANS

	MALES			FEMALES					
				Nonpregnant, Nonlactating			Pregnant	Lactating	
			Total			Total			Total
Age (years)	<15	>15		<15	>15		15-44		
BLOOD									
Total Serum Protein (gm/100 ml)									
No. of subjects	8	63	71	6	39	45	3	14	17
Mean	7.6	7.6	7.6	7.6	7.5	7.5	7.6	8.0	7.9
				Percent Distribution					
6.0-6.39		4.8	4.2		5.1	4.4	33.3		5.9
6.4-6.9	12.5	12.7	12.7		15.4	13.3			--
≥7.0	87.5	82.5	83.1	100.0	79.5	82.2	66.7	100.0	94.1
Serum Albumin (gm/100 ml)									
No. of subjects	8	63	71	7	39	46	3	14	17
Mean	3.6	4.0	3.9	3.4	3.6	3.6	2.8	3.9	3.7
				Percent Distribution					
<2.5			--	14.3	2.6	4.3			--
2.5-3.4	37.5	11.1	14.1	14.3	25.6	23.9	100.0	14.3	29.4
3.5-4.9	62.5	84.1	81.7	71.4	71.8	71.7		85.7	70.6
≥5.0		4.8	4.2			--			--
Serum Globulin (gm/100 ml)									
No. of subjects	8	63	71	7	39	46	3	14	17
Mean	4.0	3.6	3.7	3.9	3.9	3.9	4.8	4.2	4.3
				Percent Distribution					
1.0-1.9		1.6	1.4			--			--
2.0-2.9	12.5	15.9	15.5		7.7	6.5		7.1	5.9
3.0-3.5	25.0	27.0	26.8	28.6	12.8	15.2		14.3	11.8
≥3.5	62.5	55.6	56.3	71.4	79.5	78.3	100.0	78.6	82.4
Albumin/Globulin Ratio									
No. of subjects	8	63	71	7	39	46	3	14	17
Mean	.96	1.16	1.14	.90	.96	.96	.62	.94	.88
				Percent Distribution					
<0.5			--		2.6	2.2			--
0.5-0.9	37.5	36.5	36.6	71.4	69.2	69.6	100.0	71.4	76.5
1.0-1.4	62.5	49.2	50.7	28.6	25.6	26.1		21.4	17.6
1.5-1.9		11.1	9.8		2.6	2.2		7.1	5.9
≥2.0		3.2	2.8			--			--
Hemoglobin (gm/100 ml)									
No. of subjects	22	63	85	21	41	62	3	14	17
Mean	11.5	13.5	13.0	11.6	12.2	12.0	10.3	11.0	10.9
				Percent Distribution					
<12.0	72.7	12.7	28.2	47.6	34.1	38.7	66.7	71.4	70.6
12.0-13.9	22.7	50.8	43.5	47.6	46.3	46.8	33.3	21.4	23.5
14.0-14.9	4.5	25.4	20.0	4.8	17.1	12.9		7.1	5.9
≥15.0		11.1	8.2		2.4	1.6			--

APPENDIX TABLE 5C (Continued) BIOCHEMICAL FINDINGS BY SEX AND AGE, BURMA, CIVILIANS

	MALES			FEMALES					
			Total	Nonpregnant, Nonlactating		Total	Pregnant	Lactating	Total
Age (years)	<15	>15		<15	>15		15-44		
Hematocrit (percent)									
No. of subjects	25	63	88	21	40	61	3	14	17
Mean	38.5	45.7	43.7	40.8	41.5	41.2	34.7	39.8	38.9
				Percent Distribution					
<36	16.0	1.6	5.7	9.5	10.0	9.8	66.7	14.3	23.5
36-41	64.0	15.9	29.5	47.6	55.0	52.4	33.3	50.0	47.0
42-44	20.0	22.2	21.6	33.3	7.5	16.4		21.4	17.6
≥45		60.3	43.2	9.5	27.5	21.3		14.3	11.8
Mean Corpuscular Hemoglobin Concentration (percent)									
No. of subjects	22	63	85	21	40	61	3	14	17
Mean	30.0	30.0	30.0	28.6	29.8	29.4	30.2	27.6	28.0
				Percent Distribution					
<28.0	27.3	23.8	24.7	38.1	27.5	31.1	33.3	50.0	47.0
28.0-29.9	18.2	28.6	25.9	19.0	25.0	23.0		14.3	11.8
30.0-31.9	31.8	25.4	27.0	23.8	25.0	24.6	66.7	28.6	35.3
≥32.0	22.7	22.2	22.4	19.0	22.5	21.3		7.1	5.9
Serum Vitamin A (mcg/100 ml)									
No. of subjects	7	63	70	2	39	41	3	13	16
Mean	24.8	35.0	34.0	35.0	30.2	30.5	41.7	34.5	35.9
				Percent Distribution					
10-19	28.6	11.1	12.8		12.8	12.2			--
20-49	71.4	76.2	75.7	100.0	82.0	82.9	66.7	84.6	81.2
≥50		12.7	11.4		5.1	4.9	33.3	15.4	18.8
Serum Carotene (mcg/100 ml)									
No. of subjects	7	63	70	2	40	42	3	14	17
Mean	92	101	100	150	111	113	78	91	89
				Percent Distribution					
20-39		3.2	2.8			--		7.1	5.9
40-99	57.1	57.1	57.1		37.5	35.7	66.7	71.4	70.6
≥100	42.8	39.7	40.0	100.0	62.5	64.3	33.3	21.4	23.5
Serum Vitamin C (mg/100 ml)									
No. of subjects	4	62	66	4	40	44	3	14	17
Mean	.57	.56	.56	.67	.56	.57	.78	.73	.74
				Percent Distribution					
.20-.39		24.2	22.7	25.0	25.0	25.0	33.3		5.9
≥.40	100.0	75.8	77.3	75.0	75.0	75.0	66.7	100.0	94.1

APPENDIX TABLE 5C (Continued) BIOCHEMICAL FINDINGS BY SEX AND AGE, BURMA, CIVILIANS

	MALES			FEMALES					
				Nonpregnant, Nonlactating			Pregnant	Lactating	
			Total			Total			Total
Age (years)	<15	>15		<15	>15		15-44		
Serum Cholesterol (mg/100 ml)									
No. of subjects	8	63	71	5	40	45	3	14	17
Mean	137	162	160	155	175	173	178	152	157
				Percent Distribution					
70-99	12.5		1.4			--			--
100-149	62.5	39.7	42.2	60.0	20.0	24.4		42.8	35.3
150-199	25.0	44.4	42.2	20.0	67.5	62.2	100.0	57.1	64.7
≥200		15.9	14.1	20.0	12.5	13.3			--
URINE									
Thiamine Excretion (mcg/gm creatinine)									
No. of subjects	21	62	83	13	35	48	3	8	11
Median	64	46	52	98	42	51	98	36	41
				Percent Distribution					
<27	4.8	33.9	26.5		34.3	25.0	33.3	37.5	36.4
27-65	47.6	32.2	36.1	38.5	40.0	39.6		50.0	36.4
66-129	23.8	16.1	18.1	23.1	11.4	14.6	33.3	12.5	18.2
≥130	23.8	17.7	19.3	38.5	14.3	20.8	33.3		9.1
Riboflavin Excretion (mcg/gm creatinine)									
No. of subjects	22	62	84	13	35	48	3	8	11
Median	64	76	74	68	66	66	32	26	26
				Percent Distribution					
<27	9.1	8.1	8.3	7.7	14.3	12.5	33.3	62.5	54.5
27-79	50.0	45.2	46.4	53.8	54.3	54.2	66.7	12.5	27.3
80-269	22.7	40.3	35.7	38.5	20.0	25.0		25.0	18.2
≥270	18.2	6.4	9.5		11.4	8.3			--
N'-Methylnicotinamide Excretion (mg/gm creatinine)									
No. of subjects	18	33	51	11	20	31	2	10	12
Median	3.9	3.8	3.8	4.5	4.9	4.6	1/	1.7	1.7
				Percent Distribution					
<0.5		3.0	2.0			--		20.0	16.7
0.5-1.59	11.1	9.1	9.8	18.2	25.0	22.6	50.0	30.0	33.3
1.6-4.29	44.4	45.4	45.1	27.3	20.0	22.6		40.0	33.3
≥4.30	44.4	42.4	43.1	54.5	55.0	54.8	50.0	10.0	16.7

1/ Too few subjects for statistical analysis.

APPENDIX TABLE 5D. BIOCHEMICAL FINDINGS BY LOCATION, BURMA, CIVILIANS

Males and Nonpregnant, Nonlactating Females

Location	Zigon	Indagaw	Kyee Taw	Shwe Daung	Lauk Sauk	Sé Bauk	Ngayan Chaung	Wet Wun	Total
BLOOD									
Total Serum Protein (gm/100 ml)									
No. of subjects	19	3	25	22	10	14	13	10	116
Mean	7.6	8.0	8.0	7.4	7.5	7.6	7.3	7.0	7.6
Percent Distribution									
6.0-6.39				4.5		14.3	7.7	10.0	4.3
6.4-6.9	15.8		8.0	13.6		7.1	23.1	30.0	12.9
≥7.0	84.2	100.0	92.0	81.8	100.0	78.6	69.2	60.0	82.8
Serum Albumin (gm/100 ml)									
No. of subjects	19	3	25	22	10	14	14	10	117
Mean	3.7	4.0	4.2	3.9	3.5	3.6	3.4	3.9	3.8
Percent Distribution									
<2.5						7.1	7.1		1.7
2.5-3.4	26.3			13.6	30.0	28.6	42.8		17.9
3.5-3.9	68.4	100.0	92.0	86.4	70.0	64.3	50.0	100.0	77.8
≥5.0	5.3		8.0						2.6
Serum Globulin (gm/100 ml)									
No. of subjects	19	3	25	22	10	14	14	10	117
Mean	3.9	4.1	3.8	3.5	4.0	4.2	3.6	3.1	3.7
Percent Distribution									
1.0-1.9	5.3								0.8
2.0-2.9	5.3		16.0	13.6			14.3	40.0	12.0
3.0-3.5	15.8		12.0	50.0	10.0	7.1	35.7	20.0	22.2
>3.5	73.7	100.0	72.0	36.4	90.0	92.9	50.0	40.0	65.0
Albumin/Globulin Ratio									
No. of subjects	19	3	25	22	10	14	14	10	117
Mean	1.06	.98	1.16	1.14	.90	.86	.98	1.32	1.06
Percent Distribution									
<0.5						7.1			0.8
0.5-0.9	68.4	66.7	36.0	31.8	70.0	78.6	64.3		49.6
1.0-1.4	21.0	33.3	52.0	63.6	30.0	14.3	35.7	60.0	41.0
1.5-1.9	5.3		8.0	4.5				40.0	6.8
≥2.0	5.3		4.0						1.7
Hemoglobin (gm/100 ml)									
No. of subjects	17	10	25	27	15	22	14	17	147
Mean	12.8	11.7	13.2	12.6	12.0	12.5	12.9	12.0	12.6
Percent Distribution									
<12.0	35.3	60.0	20.0	22.2	46.7	36.4	14.3	47.0	32.6
12.0-13.9	35.3	20.0	36.0	59.2	26.7	59.1	71.4	22.2	44.9
14.0-14.9	11.8	20.0	28.0	18.5	26.7		14.3	17.6	17.0
≥15.0	17.6		16.0			4.5			5.4

APPENDIX TABLE 5D (Continued) BIOCHEMICAL FINDINGS BY LOCATION, BURMA, CIVILIANS

Males and Nonpregnant, Nonlactating Females

Location	Zigon	Indagaw	Kyee Taw	Shwe Daung	Lauk Sauk	Sé Bauk	Ngayan Chaung	Wet Wun	Total
Hematocrit (percent)									
No. of subjects	19	10	25	27	16	21	14	17	149
Mean	44.3	40.9	44.4	44.1	40.2	41.4	42.4	41.4	42.7
				Percent Distribution					
<36		20.0	12.0	7.4	12.5			11.8	7.4
36-41	47.4	50.0	16.0	22.2	43.8	61.9	50.0	41.2	38.9
42-44	15.8	10.0	16.0	25.9	25.0	23.8	7.1	23.5	19.5
≥45	36.8	20.0	56.0	44.4	18.8	14.3	42.8	23.5	34.2
Mean Corpuscular Hemoglobin Concentration (percent)									
No. of subjects	17	10	25	27	15	21	14	17	146
Mean	28.8	29.2	30.8	29.2	29.8	30.4	30.6	29.4	29.8
				Percent Distribution					
<28.0	35.3	40.0	20.0	48.1	33.3	9.5	7.1	23.5	27.4
28.0-29.9	11.8	10.0	36.0	18.5	20.0	33.3	28.6	29.4	24.6
30.0-31.9	29.4	10.0	20.0	11.1	26.7	38.1	42.8	35.3	26.0
≥32.0	23.5	40.0	24.0	22.2	20.0	19.0	21.4	11.8	21.9
Serum Vitamin A (mcg/100 ml)									
No. of subjects	15	2	25	22	11	14	12	10	111
Mean	33.1	48.0	30.2	40.3	38.3	31.8	23.9	24.6	32.7
				Percent Distribution					
10-19	13.3		16.0		9.1	14.3	16.7	30.0	12.6
20-49	66.7	100.0	84.0	81.8	72.7	78.6	83.3	70.0	78.4
≥50	20.0			18.2	18.2	7.1			9.0
Serum Carotene (mcg/100 ml)									
No. of subjects	15	3	25	22	11	14	12	10	112
Mean	98	135	101	140	89	105	79	87	105
				Percent Distribution					
20-39	6.7						8.3		1.8
40-99	53.3		60.0	13.6	72.7	57.1	58.3	60.0	49.1
≥100	40.0	100.0	40.0	86.4	27.3	42.8	33.3	40.0	49.1
Serum Vitamin C (mg/100 ml)									
No. of subjects	14	3	24	22	11	14	12	10	110
Mean	.44	.94	.42	.64	.61	.63	.65	.54	.56
				Percent Distribution					
.20-.39	57.1		41.7	13.6	9.1		25.0	10.0	23.6
≥.40	42.8	100.0	58.3	86.4	90.9	100.0	75.0	90.0	76.4

APPENDIX TABLE 5D (Continued) BIOCHEMICAL FINDINGS BY LOCATION, BURMA, CIVILIANS

Males and Nonpregnant, Nonlactating Females

Location	Zigon	Indagaw	Kyee Taw	Shwe Daung	Lauk Sauk	Sé Bauk	Ngayan Chaung	Wet Wun	Total
Serum Cholesterol (mg/100 ml)									
No. of subjects	19	3	25	22	11	14	12	10	116
Mean	157	172	151	174	175	181	162	162	165
				Percent Distribution					
70-99							8.3		0.9
100-149	52.6		48.0	40.9	18.2	14.3	25.0	30.0	35.3
150-199	36.8	100.0	48.0	31.8	63.6	57.1	58.3	70.0	50.0
≥200	10.5		4.0	27.3	18.2	28.6	8.3		13.8
URINE									
Thiamine Excretion (mcg/gm creatinine)									
No. of subjects	16	5	23	26	14	19	12	16	131
Median	32	114	32	90	46	82	46	58	52
				Percent Distribution					
<27	43.8	20.0	43.5	15.4	21.4	10.5	25.0	25.0	26.0
27-65	43.8		43.5	23.1	57.1	36.8	50.0	31.2	37.4
66-129	6.2	40.0		30.8	14.3	10.5	16.7	31.2	16.8
≥130	6.2	40.0	13.0	30.8	7.1	42.1	8.3	12.5	19.8
Riboflavin Excretion (mcg/gm creatinine)									
No. of subjects	17	5	23	26	14	19	12	16	132
Median	31	90	64	120	62	64	74	77	70
				Percent Distribution					
<27	41.2		17.4		7.1	5.3			9.8
27-79	47.0	40.0	39.1	34.6	71.4	63.2	58.3	50.0	49.2
80-269	11.8	60.0	34.8	46.2	21.4	15.8	41.7	37.5	31.8
≥270			8.7	19.2		15.8		12.5	9.1
N^1-Methylnicotinamide Excretion (mg/gm creatinine)									
No. of subjects	17	5	9	12	2	12	9	16	82
Median	1.5	1.3	4.9	3.9	1/	5.4	6.3	5.0	4.1
				Percent Distribution					
<0.5		20.0							1.2
0.5-1.59	52.9	40.0		8.3					14.6
1.6-4.29	29.4	40.0	33.3	50.0	100.0	16.7	44.4	37.5	36.6
≥4.30	17.6		66.7	41.7		83.3	55.6	62.5	47.6

1/ Too few subjects for statistical analysis.

APPENDIX

TABLE 5E. FOOD INTAKE BY FOOD GROUPS, CIVILIANS, BURMA, GRAMS PER STANDARD MAN PER DAY QUESTIONNAIRE

Location	Rice	Vegetables	Sugar		Pulses	Meat	Fish, fresh	Ngapi
			White	Brown				
Indagaw	580	75	6.6	29.2	23	39	91	23
Kyee Taw	525	105	10.7	10.3	13	48	94	24
Shwe Daung	592	169	18	--	29	15	7	7
Lauk Sauk	472	102	4.5	5.7	13	28	13	8
Sé Bauk	473	154	--	22	4	22	--	11
Myaing Gyi	580	184	15.5	17.1	31	39	7	20
Wet Wun	532	149	8.4	10.3	20	32	7	14
Ngayan Chaung	648	146	50	5	61	47	23	2

Location	Eggs	Fruit	Oil	Salt	Milk, tinned	Fish, dry	Fish Paste	Milk, fresh
Indagaw	5	67	30	15	1	7	19	--
Kyee Taw	9	52	32	18	2	8	4	--
Shwe Daung	1	30	30	15	--	9	--	--
Lauk Sauk	4	61	35	14	4	8	3	--
Sé Bauk	4	59	35	14	--	2	--	--
Myaing Gyi	8	56	39	17	1	9	--	50
Wet Wun	9	39	42	20	2	9	--	32
Ngayan Chaung	7	58	49	31	--	--	--	11

APPENDIX TABLE 5F. DENTAL CARIES, PERIODONTAL DISEASE AND GINGIVAL RECESSION, MILITARY, MILITARY DEPENDENT AND CIVILIAN MALES, BURMA

Age (years)	Number Examined	Dental Caries[1/] Mean Number DMF[2/] Teeth	Periodontal Disease Mean Score	Gingival Recession Mean Score
		Military		
<15	--	--	--	--
15-19	192	.6	.52	.4
20-29	1,536	.6	.79	2.4
30-39	595	.9	1.51	10.4
40-49	81	1.9	2.93	30.5
50+	7	2.7	3.91	54.6
		Military Dependents		
<15	90	.2	.35	0
15-19	28	.9	.94	.4
		Civilians		
<15	124	.4	.58	0
15-19	48	.6	1.21	0
20-29	89	.6	1.52	2.9
30-39	76	1.1	2.53	12.8
40-49	62	2.2	3.81	33.7
50+	67	10.9	5.30	60.1

1/ Exclusive of teeth crowned for cosmetic purposes.
2/ DMF = decayed, missing, or filled.

APPENDIX TABLE 5G. DENTAL CARIES, PERIODONTAL DISEASE AND GINGIVAL RECESSION, MILITARY DEPENDENT AND CIVILIAN FEMALES, BURMA

Age (years)	Number Examined	Dental Caries: Mean Number DMF[1/] Teeth	Periodontal Disease: Mean Score	Gingival Recession: Mean Score
		Military Dependents		
0-4	8	--	.24	--
5-9	58	.1	.32	0
10-14	28	.6	.43	0
15-19	81	1.1	.56	.3
20-29	522	1.2	.91	1.9
30-39	180	1.8	1.56	7.7
40-49	34	3.4	2.45	19.3
50+	5	13.0	6.54	68.8
		Civilians		
0-4	1	--	.30	--
5-9	41	.1	.51	0
10-14	80	.7	.61	0
15-19	28	.7	.55	0
20-29	91	1.3	.97	.8
30-39	87	2.1	2.22	6.5
40-49	64	3.8	3.78	29.5
50+	71	8.3	5.04	49.1

1/ DMF = decayed, missing, or filled.

APPENDIX TABLE 5H. DENTAL FINDINGS RELATED TO RESULTS OF BIOCHEMICAL DETERMINATIONS, CIVILIAN MALES AND FEMALES, BURMA

Nutritional Status		Number Examined	Mean Age	Mean PI[1] Score	Periodontal Disease: Percent with Advanced Disease	Gingival Recession: Mean Score	Gingival Recession: Percent Positive	Dental Caries: Mean DMF[2]	Dental Caries: Percent Positive
Males									
Serum Ascorbic Acid (mcg/100 ml)									
I[3]	<.2	0	0	--	--	--	--	--	--
II[4]	>.2	67	34.3	2.5	56	24	53	3.3	46
Serum Vitamin A (mcg/100 ml)									
I	<20	11	29.9	2.4	56	23	53	3.3	46
II	>20	60	33.7	2.0	44	20	42	2.7	41
Thiamine (mcg/gm creatinine)									
I	<65	56	28.8	2.0	44	20	42	2.7	41
II	≥66	30	27.8	2.1	40	22	40	2.7	37
Riboflavin (mcg/gm creatinine)									
I	<79	47	28.5	2.1	40	23	40	3.5	43
II	≥80	40	27.9	1.9	44	17	41	1.7	35
N^1-Methylnicotinamide (mg/gm creatinine)									
I	<1.59	7	25.2	1.7	29	17	29	1.7	43
II	≥1.60	49	27.3	2.0	42	25	72	2.9	37
Females									
Serum Ascorbic Acid (mcg/100 ml)									
I	<.2	0	0	--	--	--	--	--	--
II	>.2	61	37.5	3.0	67	27	65	4.5	59
Serum Vitamin A (mcg/100 ml)									
I	<20	7	45.3	3.7	67	28	67	10.0	57
II	>20	51	37.5	3.0	69	29	67	3.5	59
Thiamine (mcg/gm creatinine)									
I	<65	40	36.5	3.0	65	34	68	4.0	65
II	≥66	18	25.0	1.6	39	14	33	2.1	33
Riboflavin (mcg/gm creatinine)									
I	<79	39	32.8	2.5	56	24	56	2.9	54
II	≥80	19	33.2	2.6	58	29	58	4.7	58
N^1-Methylnicotinamide (mg/gm creatinine)									
I	<1.59	11	33.8	2.1	45	8	55	3.1	55
II	≥1.60	30	29.7	2.3	57	25	50	3.0	47

1/ PI = periodontal index.
2/ DMF = decayed, missing, or filled.
3/ I includes "deficient" or "low" levels by ICNND standards.
4/ II includes "acceptable" or "high" levels by ICNND standards.

APPENDIX 6

APPENDIX

TABLE 6A. NUTRITIONAL STATUS OF BURMESE POPULATION AS DETERMINED BY CLINICAL, BIOCHEMICAL AND DIETARY STUDIES

		Thiamine					
		Clinical		Biochemical		Dietary	
		Bilateral Loss of Ankle Jerk	Ankle Edema	Urinary Thiamine Excretion	Red Blood Cell Transketolase	mg/man/day Chemical	mg/man/day Calculated
		Percent Prevalence		mcg/gm Creatinine	Percent Prevalence of B_1 Insufficiency		
Mingaladon	Army	0.2	0	21	--	.53	1.44
	Dependents	2.2	0	131 (98)	20.0	.33	.72
	Air Force	0	0	20	--	--	--
Zigon	Civilians	5.6	0	32	29.4	.72	
Seik Kyi	Navy	1.6		44	83.3	--	--
	Dependents	2.1	0	72 (--)	12.5	--	.67
Ratanabon	Navy	1.0	0	46	0.0	.47	--
	Dependents	--	--	--	12.5	--	--
Indaing	Army	3.0	0	19	16.7	.47	1.36
	Dependents	4.1	0	51 (62)	54.5	--	.69
Indagaw	Civilians	1.3	0	114	41.7	--	.77
Toungoo	Army	0.8	0	12	13.3	.71	1.58
	Dependents	1.0	0	11 (19)	22.2	.58	.65
Kyee Taw	Civilians	3.3	0	32	27.3	.56	.72
Meiktila	Army	1.9	0	48	28.6	.61	1.44
	Army Dependents	1.9	0	52 (54)	36.4	.38	.65
	Air Force	0	0	53	0.0	.66	--
	Air Force Dependents	0	0	-- (72)	0.0	.44	.68
	Boarding School	0	0	82		--	--
Shwe Daung	Civilians	4.9	0.3	90	33.3	--	.77
Ba Htoo Myo	Army	1.3	0	38	29.2	.63	1.74
	Dependents	0	0	-- (56)	0.0	.32	.74
Lauk Sauk	Civilians	2.4	0.4	46	100.0	--	.69
Chauk	Army	1.4	0	46	27.3	.41	--
	Dependents	1.2	0	-- (59)		.37	.73
	Army Workshop Employees	0	0	--		--	--
Sé Bauk	Civilians	5.0	0	82	18.2	.36	.55
Maymyo	Army	3.1	0	44	42.8	.53	1.53
	Dependents	1.7	0	54 (46)		.42	.93
	Army Defense Academy	0.6	0	93		.62	1.50
Ngayan Chaung	Civilians	2.3	0	46	41.7	.66	1.10
Wet Wun	Civilians	1.5	0	58	33.3	.38	.72
Moulmein	Army	1.4	0	26	46.4	.60	1.40
	Dependents	0.3	0	49 (76)		.40	.98

Figures in parentheses are values for pregnant and lactating females.

APPENDIX TABLE 6A (Continued)

		Riboflavin					
		Clinical			Biochemical	Dietary	
		Angular Lesions	Angular Scars	Cheilosis	Urinary Riboflavin Excretion	mg/man/day Chemical	mg/man/day Calculated
		Percent Prevalence			mcg/gm Creatinine		
Mingaladon	Army	6.5	0	0.1	56	1.24	.90
	Dependents	7.1	1.8	0	70 (54)	.90	.54
	Air Force	6.2	0	0	64	--	--
Zigon	Civilians	19.0	3.6	0.4	31	1.1	
Seik Kyi	Navy	4.0	1.6	0	44		
	Dependents	7.2	1.0	0	107 (--)	--	--
Ratanabon	Navy	6.9	1.0	0	52	.98	.57
	Dependents	--	--	--	--	--	--
Indaing	Army	8.4	2.7	0	40	1.43	.81
	Dependents	7.7	1.8	0.3	82 (64)	--	.49
Indagaw	Civilians	13.2	0	0	90	--	.41
Toungoo	Army	7.4	1.4	0	55	1.32	1.21
	Dependents	6.2	2.4	0	22 (42)	.72	.38
Kyee Taw	Civilians	9.3	3.6	0	64	.84	.39
Meiktila	Army	2.5	2.5	0	90	.94	1.09
	Army Dependents	6.2	1.0	0	107 (124)	.82	.47
	Air Force	1.9	2.3	0	96	1.28	--
	Air Force Dependents	9.1	5.8	0	-- (120)	.76	.50
	Boarding School	9.3	4.6	0	137	--	--
Shwe Daung	Civilians	12.2	3.6	1.0	120	--	.39
Ba Htoo Myo	Army	3.6	3.4	0.1	63	.77	.92
	Dependents	5.5	3.1	0	-- (57)	.61	.48
Lauk Sauk	Civilians	11.1	2.4	0.4	62	--	.33
Chauk	Army	3.3	1.4	0	44	.87	--
	Dependents	7.4	4.3	0	-- (58)	.61	.47
	Army Workshop Employees	0	4.9	0	--	--	--
Sé Bauk	Civilians	12.4	6.9	0	64	.51	.31
Maymyo	Army	4.6	4.3	0	53	.89	.81
	Dependents	11.7	2.5	0	133 (51)	.62	.56
	Army Defense Academy	0	1.3	0	302	2.24	1.83
Ngayan Chaung	Civilians	6.3	3.4	0	74	.87	.60
Wet Wun	Civilians	20.1	8.4	0.4	77	.60	.49
Moulmein	Army	1.9	0.8	0	77	1.06	.95
	Dependents	6.3	1.6	0	70 (71)	.62	.61

APPENDIX

TABLE 6A (Continued) NUTRITIONAL STATUS OF BURMESE POPULATION AS DETERMINED BY CLINICAL, BIOCHEMICAL AND DIETARY STUDIES

		Iodine		
		Clinical	Biochemical	Dietary
		Goiter	Urinary Iodine Excretion	mcg/man/day
		Percent Prevalence	mcg/gm Creatinine	Chemical
Mingaladon	Army	1.7	37	.126
	Dependents	7.6	40	.131
	Air Force	2.3	43	--
Zigon	Civilians	7.7	60	.152
Seik Kyi	Navy	1.6	30	--
	Dependents	6.2	59	--
Ratanabon	Navy	2.9	42	.110
Indaing	Army	1.3	31	.172
	Dependents	8.2	56	--
Indagaw	Civilians	8.6	90	--
Toungoo	Army	1.4	43	.205
	Dependents	11.0	30	.143
Kyee Taw	Civilians	6.3	37	.110
Meiktila	Army	1.4	97	.136
	Army Dependents	12.5	121	.061
	Air Force	0.8	110	.195
	Air Force Dependents	7.4	74	.114
	Boarding School	0	No data	--
Shwe Daung	Civilians	1.8	227	--
Ba Htoo Myo	Army	1.6	29	.152
	Dependents	23.4	34	.090
Lauk Sauk	Civilians	17.9	34	--
Chauk	Army	1.4	No data	.103
	Dependents	32.1	No data	.109
	Army Workshop Employees	0		--
Sé Bauk	Civilians	7.9	28	.172
Maymyo	Army	2.3	27	.143
	Dependents	15.8	24	.107
	Army Defense Academy	1.9	No data	.135
Ngayan Chaung	Civilians	27.0	80	.138
Wet Wun	Civilians	32.6	36	.083
Moulmein	Army	4.6	57	.130
	Dependents	20.0	34	.122

U S GOVERNMENT PRINTING OFFICE 1963 O - 687462