The Kingdom of Thailand

Nutrition Survey

October - December 1960

A Report by the
Interdepartmental Committee on
Nutrition for National Defense

February 1962

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

February 15, 1962

MANPOWER

Dear Mr. Prime Minister:

On behalf of the Interdepartmental Committee on Nutrition for National Defense (ICNND), it is my pleasure to transmit the report of the nutrition survey of the Kingdom of Thailand, which was conducted by a joint Thai-American team, October-December 1960.

The preliminary survey report was presented to Thai team members, representatives of the Ministry of Public Health, the Ministry of Defense, the University of Medical Sciences, and U. S. Mission personnel, by the director of the survey team, Dr. Allan L. Forbes, in November 1961, for review and discussion. In addition, conferences were held in Bangkok with representatives of the World Health Organization (WHO), the Food and Agriculture Organization of the United Nations (FAO), the United Nations Children's Fund (UNICEF), and the SEATO Medical Research Laboratory. Following these discussions, this final report has been prepared with the view of including the many excellent suggestions which resulted from the conferences.

It is our sincere hope that the contents of this report will help to provide the scientific information on the nutritional status of the civilian population and the Armed Forces of the Kingdom upon which future programs on food and human nutrition can be based. With the cooperative spirit so evident during and following the survey, and in view of the high caliber of the laboratories and institutions of higher learning in Thailand, we are confident that this study will contribute substantially to the continued improvement in health and nutrition of the Thai people. The opportunities for undertaking research and development programs in Thailand on the unknown aspects of a number of major nutritional and related diseases are very great indeed. Thailand is certainly capable of taking a leading role in such activities which are of paramount importance to the peoples of Southeast Asia and to the entire world medical community.

Our Committee has a continuing interest in the health of the people of the Kingdom of Thailand and will welcome requests for assistance at any time. We look forward to the possibilities of future collaborative work.

Respectfully,

Frank B. Berry

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

His Excellency
Field Marshal Sarit Thanarat
Prime Minister of Thailand
Bangkok, Thailand

เลขทะเบียน.....
วันที่ลงทะเบียน 9 OCTOBER 62
เลขเรียกหนังสือ A 41

TABLE OF CONTENTS

		Page
	Preface	V
I.	SUMMARY	1
II.	RECOMMENDATIONS	3
III.	INTRODUCTION	10
	A. THE HOST AND HIS ENVIRONMENT	10
	B. FOOD RESOURCES	22
IV.	SURVEY RESULTS	32
	A. THIAMINE NUTRITION	33
	B. RIBOFLAVIN NUTRITION	39
	C. ANEMIA	42
	D. IODINE NUTRITION	47
	E. PROTEIN NUTRITION	57
	F. VITAMIN A NUTRITION	61
	G. VITAMIN C NUTRITION	65
	H. NIACIN NUTRITION	67
	I. CALCIUM AND PHOSPHORUS NUTRITION	68
	J. FAT AND CHOLESTEROL	70
	K. SALT AND BLOOD PRESSURE	72
	L. DENTAL HEALTH	75
V.	APPENDIX	83
	A. SURVEY TEAM MEMBERS	83
	B. THE INTERDEPARTMENTAL COMMITTEE ON NUTRITION FOR NATIONAL DEFENSE	89
	C. ACKNOWLEDGMENTS	90
	D. LIST OF TABLES	92
	E. LIST OF FIGURES	98
	F. PREFACE APPENDIX	100
	G. THE HOST AND HIS ENVIRONMENT APPENDIX	102
	H. CLINICAL APPENDIX	123
	I. BIOCHEMICAL APPENDIX	154
	J. IODINE NUTRITION APPENDIX	183
	K. DIETARY APPENDIX	185
	1. Military Dietary Survey	185
	2. Civilian Dietary Survey	210
	L. PARASITOLOGY APPENDIX	225
	M. FOOD RESOURCES APPENDIX	229
	N. VARIOUS SURVEY FORMS	232
VI.	SPECIAL STUDIES	247
	A. BANG CHAN FOLLOW-UP STUDIES (By Dr. Hazel M. Hauck)	247
	B. STUDY OF AN INSTRUMENT FOR OBJECTIVE MEASUREMENT OF THE ACHILLES REFLEX	262
	C. FOOD CONCENTRATION AND URINARY EXCRETION OF STRONTIUM^{90} IN THAILAND (By Dr. Arthur R. Schulert)	266
	D. EVALUATION OF RIBOFLAVIN AND THIAMINE LOAD TESTS	268
	E. VESICAL CALCULI IN UBOL	276
	F. BODY COMPOSITION STUDIES	277
	References	280

PREFACE

It is hoped that the manner in which this report is assembled will enhance its clarity. The basic premise has been to present the fundamentally important observations in terms of the host, the environment in which he was observed, and the specific agents of nutritional disease, as well as the recommendations, in as brief and graphic a form as possible, followed by an extensive appendix for purposes of amplification and future reference. When the etiological agents of nutritional disease are discussed separately, some overlapping of measured parameters is inevitable. A second premise has been to compare the military data with the civilian results, i.e., utilizing the military data as a type of internal control group. It is realized that these two groups are not completely comparable in the strict sense because of age and sex differences. However, it is felt that, for purposes of fundamental generalizations, it is the most pertinent comparison which can be made. If these thoughts are kept in mind, it is hoped that the report contents will remain clear to the reader.

Following the invitation of the Government of the Kingdom of Thailand (initiated by Dr. Kamdhorn Suvarnakich, The Director General of Health, and Dr. Yong Chutima, formerly The Director of the Nutrition Division and now senior consultant), transmitted through diplomatic channels to the U. S. Interdepartmental Committee on Nutrition for National Defense (ICNND) and approved by this Committee, the survey was undertaken between October 10 and December 15, 1960 by 60 members of the Thailand scientific community and 16 colleagues from the United States (see list of team members). Thailand was the sixteenth country so surveyed, and, as in the previous surveys, nutritional status has been evaluated by the interdisciplinary approach of combined studies of clinical, dental, dietary, biochemical, and food technological status. The biochemistry laboratory was established in Bangkok in the Department of Biochemistry and Nutrition of the School of Public Health, University of Medical Sciences, where it continues to operate on a permanent basis. The success of the survey depended upon the splendid support of hundreds of persons throughout the country. The team members wish in particular to express their appreciation to those individuals and groups listed under "Acknowledgments".

The geographical scope of the survey is outlined in Figure 1 and Table 1. The team is greatly indebted to the Royal Thai Air Force for transporting the team and field equipment over the long distances, to the Royal Thai Army for providing the great part of the ground transport for both the military and civilian work outside of Bangkok, and to the Ministry of Public Health and the Army for transport required in the Bangkok area. A special study on vesical calculi in children was conducted in the Ubol area which will be reported at a later date as a supplement to this report. This supplement will also contain studies done in Bangkok on body composition. Studies in the village of Bang Chan near Bangkok were conducted as a follow-up to the work of Dr. Hazel Hauck et al., Cornell University, and are reported herein separately. Several other special studies are reported individually at the end of this volume. All of the civilians studied were family groups in specific villages, except the students of Rachinutis High School in Udorn, who are also considered separately. The military groups studied within a general area were usually very similar, so they have been combined as a single group within a general area on many occasions throughout the report. In the appropriate portions of the appendix, the reader will find comments on the techniques, methods, the various forms used by each of the scientific groups and suggested guides for interpretation of biochemical and dietary intake data. The reader is referred to the Manual for Nutrition Surveys of the ICNND (revised edition, in press, 1962) (1,2) for further details on methods.

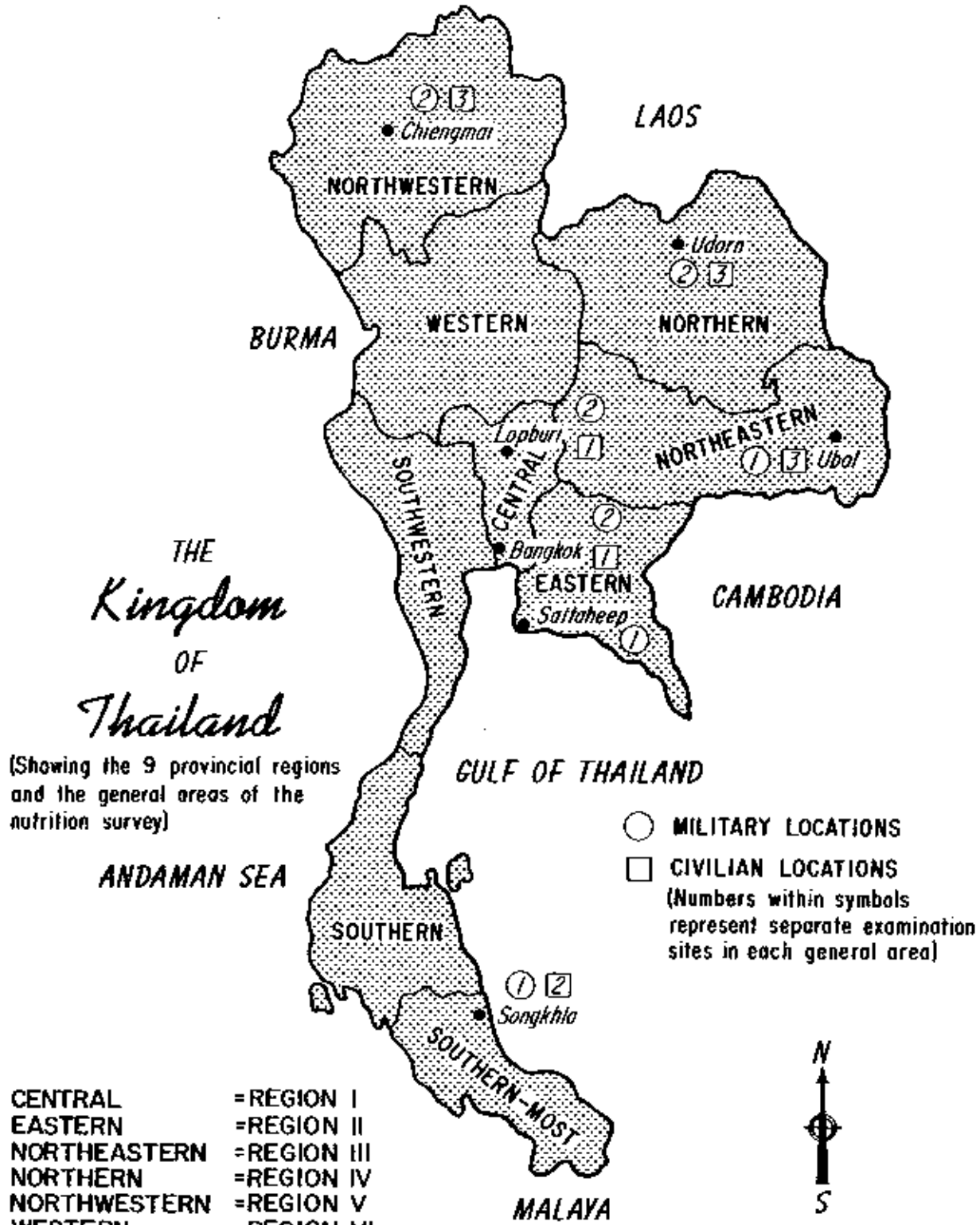

THE
Kingdom
OF
Thailand
(Showing the 9 provincial regions and the general areas of the nutrition survey)
LAOS
BURMA
CAMBODIA
GULF OF THAILAND
ANDAMAN SEA
MALAYA
NORTHWESTERN
Chiengmai
WESTERN
NORTHERN
Udorn
NORTHEASTERN
Ubol
CENTRAL
Lopburi
Bangkok
EASTERN
Sattaheep
SOUTHWESTERN
SOUTHERN
Songkhla
SOUTHERN-MOST
MILITARY LOCATIONS
CIVILIAN LOCATIONS
(Numbers within symbols represent separate examination sites in each general area)
N
S
CENTRAL =REGION I
EASTERN =REGION II
NORTHEASTERN =REGION III
NORTHERN =REGION IV
NORTHWESTERN =REGION V
WESTERN =REGION VI
SOUTHWESTERN =REGION VII
SOUTHERN =REGION VIII
SOUTHERN-MOST =REGION IX

Figure 1.

TABLE 1. LOCATION AREAS OF THE SURVEY, THAILAND[1/ 2/]

MILITARY: 11 locations	CIVILIAN: 12 locations
Bangkok Area	Bangkok Area
1st Cavalry Regiment, RTA 11th Infantry Regiment, RTA	Bang Chan Village
Songkhla Area	Songkhla Area
5th RCT and Songkhla MP, RTA	Bang Dan (Buddhist) Village Don Kee Leg (Islam) Village
Chiengmai Area	Chiengmai Area
7th RCT and Chiengmai MP, RTA (town)[3/] 7th RCT, RTA (environs)	Ban Fon Village San Pong Village Padad Village
Lopburi Area	Lopburi Area
Kokethiem Air Base, RTAF (enlisted) Kokethiem Air Base, RTAF (NCO's)	Ta Kae Village
Udorn Area	Udorn Area
13th RCT, RTA (environs) 13th RCT, RTA (town)	Rachinutis High School Phou Ngam Village Marg Yah Village
Ubol Area	Ubol Area
6th RCT, RTA	Sri Kai Village Ban Kao Village Nong Manao Village
Sattaheep Area	
Marine Base, RTN	

1/ abbreviations: RTA = Royal Thai Army; RTN = Royal Thai Navy (Marine Corps); RTAF = Royal Thai Air Force; MP = Military Province (Militia); RCT = Regimental Combat Team

2/ see Table 1-A for more detailed description of locations and dates

3/ (town) = examination site within the city; (environs) = examination site well outside the city

Throughout this report, a number of abbreviations have been used; these are defined below:

TABLE 2. DEFINITION OF ABBREVIATIONS USED IN THE REPORT

ABBREVIATIONS	DEFINITIONS
GENERAL	
(1) wks.; mos.; yrs.	week(s); month(s); year(s)
(2) min.; hr.	minute(s); hour(s)
(3) mm; cm	millimeter(s); centimeter(s)
(4) mcg; mg gm; kg	microgram(s); milligram(s); gram(s); kilogram(s)
(5) >	greater than
(6) <	less than
(7) S.D.	standard deviation
(8) S.E.	standard error of the mean
(9) -	zero, inapplicable, or not determined
(10) No.	number(s)
(11) Subj.	subject(s)
AGE, SEX, AND STATUS	
(1) M < 15	male(s) less than 15 years old
(2) M 15+	male(s) 15 years old and older
(3) F < 15	female(s) less than 15 years old
(4) F 15+, NPNL	female(s) 15 years old and older, non-pregnant non-lactating
(5) F 15+, PL	female(s) 15 years old and older, pregnant or lactating
(6) Mil.	military
(7) Civ.	civilian
(8) EM	enlisted man(or men)
(9) NCO	non-commissioned officer(s)

ABBREVIATIONS	DEFINITIONS
NUTRITIONAL	
(1) Ab.	abbreviated examination(s)
(2) Det.	detailed examination(s)
(3) FPA	filliform papillary atrophy of the tongue
(4) M/S	moderate or severe
(5) S.R.P.	swollen, red, interdental papilla(e)
(6) AJ	ankle jerk(s)
(7) KJ	knee jerk(s)
(8) B.P.	blood pressure
(9) mm. Hg.	millimeters of mercury
(10) goiter, Grade I	thyroid distinctly enlarged by palpation but not clearly visible
(11) goiter, Grade II - IV	increasing degrees of visible thyroid enlargement (WHO criteria)
(12) "Def."	deficient by current criteria
(13) Cal.	Calorie(s)
(14) I.U.	International Unit(s)
(15) CHO	carbohydrate
(16) rbc	red blood cell(s)
(17) N'MN	N'-methylnicotinamide
(18) MCHC	mean corpuscular hemoglobin concentration
(19) ppm	parts per million
(20) QNS	quantity not sufficient

A moderate amount of nutritional investigative work has been done in Thailand, particularly post-World War II, but an interdisciplinary survey throughout the country has not been performed previously. The results of these studies are commented upon where appropriate in the various chapters. The reader is referred particularly to the reviews of Uthai Bisolyaputra (3) and of M. M. Anderson (4).

In any nutrition survey, it is important to define the time of the survey in relation to the annual cycle of events pertinent to nutritional status. There are two major factors to consider in this connection, namely food availability and physical activity. The survey was conducted during the period October 10 - December 15, while the rice harvest in Thailand begins late in November or in December. The survey was therefore conducted during the immediate pre-harvest season and into the beginning of the harvest season. In some countries the food supply and nutritional adequacy of the diet decline sharply before the new harvest is in. However, these problems may be of only limited significance in Thailand which is one of the major rice exporting nations. The strenuous physical activity during rice transplanting in July and August and during harvesting in December to February may easily upset the balance between nutrient intakes and requirements. In Thailand, some 84 percent of the working population is engaged in agriculture, and about 88 percent of Thai farmers grow rice. About 80 percent of the rice is transplanted, and reaping is done largely by hand with knives and sickles (5). The survey, except for the terminal several weeks, was therefore not conducted during the seasons of maximal physical activity of the rural population.

I. SUMMARY

The following is a very brief summary of the most important observations made during the course of this survey. For most nutrients, a reasonable degree of uniformity existed from area to area in both the military and civilian groups studied.

Total caloric intake among the civilian population studied fell 100 Calories below the estimated average requirement of 1,871 Calories. Thiamine nutrition in the military services was satisfactory, primarily because of the universal use of undermilled rice. Both dietary and biochemical evidence of considerable thiamine deficits were obtained among the civilians, but clinical beriberi was not observed. Studies on the role played by thiamine deficiency in the high infant and small child mortality are urgently needed.

For practical purposes, a deficit of riboflavin exists for the entire population. However, the clinical significance of this deficit is not clear, and some doubt is shed on the relationship of riboflavin nutriture to angular lesions observed. Niacin nutriture seems adequate in all respects.

Anemia is prevalent, and the multiplicity of etiologies in Thailand renders the problem very complex. The contributions of this survey to the anemia problem are limited, but the parasitological relationships are partially clarified. Protein malnutrition appears to be limited to the infant and small child, but within these groups, the problem does exist. Vitamin A malnutrition probably exists, particularly in the infant and small child. Vitamin C nutrition presents few problems; a modest increase of vitamin C in the military diet is desirable.

Radioactive iodine uptakes and stable iodine excretions in nongoitrous subjects clearly establish the widespread prevalence of iodine malnutrition. In addition, clinical goiter is very common in the northern half of the country, being just as prevalent in the Ubol area adjacent to Cambodia as in the Chiengmai-Chiengrai-Prae regions in the north and northwest. The iodine nutrition studies establish the etiology of this goiter to be one of simple iodine deficiency.

Fat intake is low and serum cholesterols correspondingly so. Total salt intake (as sodium chloride) is high but the prevalence of hypertension is in doubt. The opportunities for cardiovascular disease research are great.

Destructive periodontal disease is extremely prevalent, while dental caries are not. The periodontal disease problem hinges on inadequate attention to oral hygiene.

It is hoped that the recommendations made will be considered practical and in keeping with the present and potential food resources of the country. Emphasis is laid upon the need for further studies and the practicability of undertaking such studies in many of the nutrition problem areas in Thailand.

II. RECOMMENDATIONS

The specific recommendations which follow are discussed in some detail below in order to avoid repetition in the nutrient chapters.

Nutrition as a science and a public health discipline is well established in Thailand through the pioneering nutrition studies of men such as Dr. Yong Chutima and the development work of such men as Dr. Kamdhorn Suvarnakich. What is urgently needed is better coordination of the many activities underway, such as those of the Nutrition Division of the Ministry of Public Health, the teaching and research activities of the School of Public Health and the medical schools, the food and beverage laboratories of the Ministry of Industries, the development activities of the Processed Food Organization and the Army Quartermaster Subsistence Division, and the teaching and research activities of Kasetsart University. The administrative establishment for such coordination exists in the form of the National Nutrition Committee. Given executive status and reasonable authority and funds, the National Nutrition Committee and its technical subcommittees could accomplish this coordination. Thailand is in the very enviable position, compared with many other countries in the world, of having a moderate number of professional people well-trained in the nutritional sciences. Lack of coordination is an expensive luxury which Thailand can ill afford.

Thailand is to be complimented on the strides it is making in many areas of food and agriculture, particularly those directed toward diversification of the diet of the people and diversification of agricultural products raised for export. Among these are the programs concerned with increasing the numbers of livestock and modern slaughterhouses, the high standards and steady improvements associated with the fishing industry, the beginnings of the canning industry, and the experimental approach to the possible adaptability of the dairy industry to Thailand. These activities--and many others discussed under Food Resources--deserve the full support and encouragement of the government and other agencies concerned.

All things considered, the particular food industry in Thailand warranting maximum support for expansion and further technical development is the fishing industry, both deep sea and fresh water. Among the principal reasons for making this strong recommendation are: (a) fish are good sources of a number of the nutrients which are in marginal supply in the Thai diet; e.g., riboflavin, calcium, and animal protein; (b) fish and fish products are very much an integral part of the Thai diet and thus acceptability presents no problem; it currently is a matter of quantity available; (c) it utilizes an immense natural resource of Thailand, as revealed in part by past studies in the Gulf of Thailand hopefully to be further extended in the near future; as a natural resource, it does not involve programs of continuing expenditures for importation of a major food item; (d) it is an industry already "on its feet" in Thailand, which has captured the interests of a number of groups, particularly FAO.

A. SPECIFIC MILITARY RECOMMENDATIONS

In addition to the general recommendations for the nation as a whole, there are several specific recommendations pertinent to the military:

1. The use of undermilled rice should be placed on a firm scientific basis, and all levels of command should be kept thoroughly informed as to the nutritional merits of such rice. Of first consideration should be an effective means of insuring a constant

degree of milling by the millers supplying military rice. The use of undermilled rice is based on a most sound nutritional principle and is the major factor providing adequate intakes of thiamine throughout the military services. However, during the course of the survey, it became obvious that among command personnel a major stimulus for the use of undermilled rice was economic rather than nutritional, undermilled rice being somewhat less expensive than 100 percent milled rice. It should be noted, however, that the subject of converting military rice from undermilled to 100 percent milled has come up in the Thai legislative body in the past, and such a change has been rejected through the wise efforts of the military medical and allied science groups. The whole undermilled rice program should be promptly placed on a scientific and nutritional foundation. This should include establishment of a much more extensive control program, presumably within the auspices of the Army Quartermaster Subsistence Division (which could also cover the Navy and Air Force needs). Such a program primarily should involve strict control of the degree of undermilling by the various millers (70 percent undermilled rice has proved successful in the Korean army) by regular inspection and thiamine analyses of rice samples, both as processed in the mills and as utilized in military messes throughout the country.

There are, of course, no reasons why other approaches to improving the nutritional value of rice should not be pursued, such as parboiling and enrichment.

2. There is a clear need for a nucleus of men in uniform, working together, who are thoroughly trained in the major nutritional disciplines: public health and clinical nutrition, biochemistry, food technology, and dietetics. One medical officer has now arrived in the United States for training leading to the master's degree in clinical nutrition. It is of the utmost importance that equivalent training in the other nutritional disciplines be provided for other members of the Armed Forces. Every means of financial support for the training of such men should be vigorously pursued.

3. The military services, and in particular ground forces, are in need of a well-equipped laboratory devoting its energies to the further development of field rations as well as to the gradual diversification of the base diet. For a relatively modest sum, the Army Quartermaster Subsistence Division could be so equipped.

4. Surveys encompassing the general approaches of the 1960 survey should be repeated regularly to provide continuous evaluation of nutritional status in the Armed Forces. The general biochemical laboratories within the Army Institute of Pathology should be considered as a possible base of operations in collaboration with the Army Quartermaster Subsistence Division and the laboratories of the Navy and Air Force.

5. Even though there are a number of devoted workers in nutrition within the services, military nutrition is in its infancy in Thailand compared with the civilian picture. The services should encourage collaborative studies and intimate contacts with the civilian groups, particularly through its participation in the National Nutrition Committee.

6. It is suggested that the military services introduce moderate amounts of fruit (citrus, papaya, pineapple), and vegetables rich in vitamin C into the military diet. Such a program should completely remove any doubt as to the status of vitamin C nutriture in the Armed Forces.

B. SPECIFIC NATIONAL RECOMMENDATIONS

A number of the following recommendations concern the desirability of scientific studies being done in Thailand. The basic reasons for making these recommendations are on the one hand the fact that some nutritional problems of world-wide significance exist in Thailand, and on the other hand Thailand is particularly well suited for conducting

these studies because of such factors as the relatively large group of well-trained professional people in Thailand, and their deep concern with nutrition, and the excellent physical qualities of certain essential aspects such as laboratory space, teaching and hospital facilities, and the relative ease of transportation to the more remote areas.

1. Thiamine malnutrition appears to remain a serious public health problem. Many avenues of approach to this situation should be followed, laying particular emphasis on (a) nutrition education in the public schools, (b) expansion of the Maternal and Child Health program, and (c), of greatest value, the pursuit of further studies to determine the true prevalence of beriberi (particularly infantile) and to elucidate more clearly the fundamental relationships of thiamine nutriture to good health under various physiological circumstances.

Following the exciting discoveries of preventive measures 50 to 75 years ago, the identification of thiamine itself 38 years ago, and the gradual development of survey techniques in the last several decades, we seem to have reached a point of little forward progress in our understanding of the finer points of the disease beriberi. The actual minimal thiamine requirements of the infant are not precisely known. The actual minimal requirements of the growing child and the pregnant and lactating woman are not known. The requirements of soldiers required to undergo very arduous duty for long periods are not known. Worst of all perhaps is that the true prevalence of an often fatal disease is not known in Thailand, Vietnam, and many other countries where the disease is known to exist. The present survey did little to contribute to these deficits in our knowledge. Other problems center around our inadequacies in evaluation of thiamine nutriture in the absence of clinical manifestations of the disease. It is obvious that individuals can excrete no detectable thiamine at a given time and yet have no clinical evidence of beriberi. How long an infant can tolerate this, how long a pregnant woman can tolerate this, how long a fighting soldier can tolerate this is unknown. Oral thiamine load tests--at least as done during this survey--seem more confusing than helpful. Evaluation of diminution of deep tendon reflexes is a clinical aspect warranting further attention. In Thailand, one is confronted by a very high infant and young child mortality rate. What part thiamine deficiency plays in this mortality is not at all clear. Other important aspects which are just beginning to receive attention are the possible seasonal variations in the incidence of the disease, and what contribution to this may be made by thiamine deterioration in foods stored for long periods, particularly rice.

Except for the very serious questions of infant mortality, it seems reasonable to state that beriberi is not killing huge numbers of people in Thailand today. However, if the Division of Vital Statistics reports and other clinical reports are correct, the disease still is a major public health problem, both in terms of mortality and morbidity. The present survey establishes that thiamine intakes among civilians throughout the country are marginal by currently available standards and that approximately half of the civilian population studied had thiamine excretions below "acceptable" levels by currently available standards. Therefore, during the interim between today and such time as a more comprehensive understanding of the beriberi and thiamine situation in Thailand is available, it is obvious that continuing efforts to augment thiamine intake should be made through the many avenues available. The most fundamental approaches are through nutrition education in the schools and gradual diversification of the national diet. In fact, nutritional and communicable diseases are of such paramount importance to public health and simple survival in Thailand that the suggestion that public health teaching, accompanied by the preparation of appropriate textbooks, should rank right alongside of reading, writing, and arithmetic in the public school system of Thailand warrants serious consideration by the Government of Thailand. Other more specific approaches worthy of thought are encouraging the use of enriched rice (it should be recalled that enrichment with thiamine alone does not alter the appearance or taste of rice, in contrast to the yellow grains present when riboflavin is included), stimulating the civilian use of

undermilled rice as being more nutritious, and perhaps most importantly laying emphasis on steadily raising the pork and fish content of the national diet--an endeavor which unquestionably would meet with strong public acceptance. The importance of further increasing the populations receiving the benefits of Maternal and Child Health Centers, such as the one in Chiengmai, cannot be overemphasized.

The recommendation of greatest lasting value to both the health of the Thai people and to the whole science of nutrition is the pursuit in Thailand of some of the deficits in our current knowledge expressed above. Such studies must be done in a country like Thailand where thiamine deficient people are available for study. The possibility certainly arises that such studies on beriberi and thiamine nutrition might form the nucleus of applied research activities in the new medical school in Chiengmai.

2. Although the Thai people are markedly deficient in riboflavin by currently available standards, the clinical significance of this deficiency is so obscure that the most important endeavor for us all in this area of nutrition is to pursue studies in Southeast Asia to clarify the true role of this nutrient in human nutrition.

The very low riboflavin intakes and excretions associated with no obvious disturbances in general well-being which have now been documented in various rice economy countries such as Vietnam and Thailand certainly raise the need for re-evaluation of the minimal requirements for this vitamin. Improved biochemical methods for evaluating the individual person are sorely needed. The question of "zero" excretion of riboflavin at any given time assuredly makes one wonder how long the human can tolerate such a situation under various physiologic circumstances such as pregnancy, infancy, and very arduous military duty, and what are the clinical results of a prolonged period of "zero" excretion. It even appears possible that the angular lesions observed so commonly in Southeast Asia may not be directly related to riboflavin nutriture and may have some other cause. It is worth noting that such lesions when seen in the U. S. are often due to monilial infections, yet during the Vietnam survey of 1959 where several villages with angular lesion prevalences exceeding 30 percent were found, a limited number of cultures of active lesions did not reveal any pathological organisms.

3. The programs currently underway on the problem of etiology and control of the anemias in Thailand warrant continued support and expansion.

Control of the anemias in Thailand is obviously a very multifaceted undertaking which will take an indefinite period of time to conquer. In view of the high iron intakes demonstrated everywhere in this survey, specific efforts to augment iron intakes further do not seem reasonable. In addition, there is abundant evidence from this and other studies that a major contributing factor to the observed anemia is the prevalence of communicable diseases, particularly the parasitic ones. Every agency in Thailand concerned with public health (the Ministry itself, the SEATO Laboratories, WHO, FAO, UNICEF, ICA, etc.) is acutely aware of this, and active programs have been underway for some years to combat each of these communicable diseases. We therefore have little to contribute in this area except to provide further corroborative data and stimulation to the disease control activities now underway. The points upon which we might lay emphasis are: (a) the need for much more elaborate studies on the etiology of anemia in the individual person, with emphasis on the communicable diseases he may have, and the role played by the hemoglobinopathies in various parts of the country, and (b) the tremendous opportunities available in Thailand for research on such problems as impaired iron (and other minerals and micronutrients) absorption and actual degree of blood loss in the presence of the various intestinal parasites, the possible nutritional problems associated with liver fluke infestation with and without cirrhosis, etc.

4. Concerning endemic goiter, three major recommendations are: (a) all salt produced commercially for domestic consumption should be iodated; (b) potassium iodide should be administered to school children in the endemic areas and to all pregnant and lactating women attending Maternal and Child Health Centers; (c) a National Committee on Iodine Nutrition should be established.

A salt iodization program necessitates that certain fundamental problems be worked out and in the following order:

(1) Initiation: It will be necessary to pass a law or decree relative to salt iodization. Regulations (and fines) pertaining thereto must be written.

(2) Subsidy: The cost of initial equipment and materials with which to carry out the program must be met. Whether these costs are to be underwritten by the Kingdom of Thailand or some other agency must be determined. It is unwise to pass them on to producer or consumer.

(3) Type of equipment: Non-corrosive metal machinery is available commercially at modest cost for units which would be sufficient to handle the amount of salt envisaged. UNICEF may be interested in aiding in the procurement of such equipment. Further technological details are available through ICNND, FAO, UNICEF, and WHO.

(4) Level of iodization: The final iodine content is, of course, related to the amount of salt consumed per day. At a salt intake of 15 grams per day an iodine level of 1:20,000 should be adequate. If salt consumption is lower, the iodine level must be higher of course; in such a situation a ratio of 1:10,000 would be reasonable. There is no evidence that such levels are toxic in any way.

(5) Iodine compound to be used: It is now well recognized that potassium iodate (KIO_3) is the material of choice. No other compound need be considered.

(6) Inert vehicle: Calcium carbonate ($CaCO_3$) to dilute the KIO_3, 1 part in 4, has been found to be most satisfactory. A local source of chalk or limestone should be explored as such would reduce the cost entailed in using imported calcium carbonate.

(7) Iodine content of product: A laboratory where iodine analyses of salt can be performed will be necessary to insure quantity control. Its site and supervision must be specified. The ICNND would be pleased to provide technical assistance to aid in establishing such a laboratory upon request.

(8) Follow-up: It would be desirable to establish the value of national iodization beyond anyone's doubt in Thailand by ascertaining the status of iodine malnutrition in a given community such as Prae prior to commencing the national program and then following the population clinically and biochemically for a number of years.

Effective parenteral therapy could be accomplished in the school population and by the public health authorities among childbearing women. The school population is shown in the Appendix, Table 50-A. One can possibly expect to reach 80 percent of the children between 8-15 years for a part of the four years during which school attendance is required. Potassium iodide could be administered in appropriate amounts each week or in one or more courses during the year. Appropriate amounts of potassium iodide could be given after pregnancy was recognized and during the period of lactation at the MCH centers.

The development of either a salt iodization program and/or parenteral administration of iodine (preferably both) requires the close cooperation of a number of governmental agencies, such as the Ministries of Defense, Health, Education, Interior, Economics,

Public Information and others. Hence, the formation of a working group is necessary to implement either or both programs if such are to be adopted. Only by this means can all of the details which such programs involve be coordinated and brought to fruition.

A Committee on Iodine Nutrition should be established to discuss the importance of iodine malnutrition in Thailand and the means whereby the problem can be most effectively met in the light of the data submitted in this report.

This Committee should be composed of such persons as the following and might be considered as a subcommittee of the National Nutrition Committee:

Director General of Health, Ministry of Public Health
Director, Nutrition Division, Ministry of Public Health
Professor of Nutrition, School of Public Health
Director, Women's and Children's Hospital
A member of the iodine study group, Department of Radiology, Siriraj School of Medicine
Senior Nutrition Officer, Nutrition Division, Ministry of Public Health
Director or representative, Ministry of Education
Director or representative, Ministry of Interior
Director or representative, Ministry of Economics
Member of the Faculty of Tropical Medicine
Member of the Faculty of Premedical Sciences

5. From the report of Netrasiri and Netrasiri (46), and from conversations with Bangkok pediatricians during the present survey, one has to conclude that clinically important protein malnutrition is a problem in Thailand, but it seems likely from the results of this survey that the problem is confined in large measure to the small child. The data currently available certainly suggest that the young child, and particularly the weaning infant, in some localities in Thailand are living on a marginal supply of essential amino acids, and that the scale is tipped over to clinically manifested protein malnutrition by intercurrent communicable diseases, particularly intestinal parasitic infestations. Nutrition education programs designed to insure that the young child and weaning infant get preference at the family table for the sources of well-balanced protein should go a long way to controlling the protein malnutrition problem, particularly in view of the reasonable supplies of such protein readily available to the Thai family. Particular food items upon which emphasis should be placed are duck and chicken eggs and fish and fish products.

6. The results of our survey suggest the possibility that a vitamin A deficiency problem may exist among the children in Thailand. If there is any related problem among the military, it would appear that it is in the area of night blindness, which would be worthy of study. In the absence of more specific findings among the civilians, it is difficult to make any specific recommendations. There is a need for determining precisely what the prevalence of xerophthalmia is among the children of Thailand. When such information is available, one can then turn to more thorough evaluation of the status of vitamin A nutriture and make constructive specific recommendations.

7. Calcium intakes in general were marginal. The calcium intake of pregnant and lactating women, infants, and growing children should be augmented. Increased use of whole fish and whole fish products is the simplest approach. Attention devoted to moderately augmenting calcium intakes in the national diet will provide a highly desirable margin of safety.

8. Concerning niacin, the only recommendation worthy of comment is that biochemical and food analytical laboratories in Thailand should limit niacin and N'methylnicotinamide determinations to those performed for academic purposes, freeing such facilities for performing more important micronutrient analyses.

9. Thailand offers superb opportunities to pursue studies of worldwide importance on the fundamental aspects of atherosclerotic and hypertensive cardiovascular disease.

The epidemiology of atherosclerosis is an immensely complex subject. One of the greatest single deficits in our current knowledge is the epidemiology of the disease in countries where the fat intake is very low. One cannot infer that the disease does not exist because serum cholesterols are low, as some workers have been somewhat overinclined to do. No answer will be forthcoming until such time as vast amounts of autopsy and electrocardiographic data become available from such countries. The spirit of inquisitiveness and the academic atmosphere among the medical and allied science professions in Thailand coupled with the excellent facilities in the medical schools makes one hopeful that such epidemiological studies will be undertaken in Thailand. If such should come to pass it would unquestionably be of great value throughout the world.

To this day, the etiology and pathogenesis of essential hypertension are by no means clearly defined. The disease is one of major public health importance to the vast portion of the world's population. The evidence to date is sufficiently strong to warrant vigorous pursuit of studies on the possible role of the chronic intake of salt well in excess of requirements (as observed in Thailand) as a major etiological factor in essential hypertension. Emphasis should be placed upon precise measurements of total salt intake by several methods and upon ascertaining the true prevalence of the disease by extensive surveys of the living population accompanied by accumulation of as much post-mortem data, including examination of the central nervous system, as is feasibly possible.

10. In view of the serious periodontal disease problem affecting such a large percentage of the Thailand people even at very early ages, it is strongly recommended that great emphasis be placed on the importance of good oral hygiene. This could be accomplished through health education by Public Health personnel directed to teaching the necessity for periodic oral prophylaxis to remove debris and calculus, which are known to be very important contributing factors to periodontal disease. Equally important is the teaching of proper and routine use of the toothbrush and other oral hygiene procedures which could be practiced by the individual. If the teaching of oral hygiene practices to the people of Thailand could be accomplished, it is felt that the magnitude of the periodontal disease problem could be greatly reduced. Early and severe periodontal disease occurring in the people of Thailand, not dental caries, is the leading cause of tooth loss and as such is their major dental health problem.

Additional investigations need to be made in Thailand of the source of fluorides, particularly in foods and their relationship to the incidence of dental caries and dental fluorosis.

III. INTRODUCTION

A. THE HOST AND HIS ENVIRONMENT

This nutrition survey is a study of the epidemiology of nutritional diseases in the Kingdom of Thailand. It is appropriate to begin, therefore, with a discussion of the host - THE THAI INDIVIDUAL, - both civilian and soldier - and the salient features of the environment in which he lives - THAILAND.

Let us first consider some principal features of the environment. Thailand is a constitutional monarchy with a population of approximately 25.6 million. Its area approximates 200,000 square miles (the size of the combined areas of Wyoming and Colorado), divided into nine administrative regions and 71 "changwats" or provinces (see Figures 1 and 1-A). The nation is entirely within the tropical climatic region, stretching from latitude 5° 30" north to 21° north (not quite 1,000 miles) and being approximately 500 miles wide from east to west. The commercial life of the country focuses on the capital city of Bangkok on the Chao Phraya River, 25 miles inland from the point where the river flows into the Gulf of Thailand. There are four natural regions delineated by the pattern of rivers and mountains (see Figure 1): (1) the mountainous northwest, (2) the great Central Plain drained by the Chao Phraya, (3) the northern and northeastern regions drained by the Mekong River through Cambodia and South Vietnam, and (4) the peninsula, shared with Burma along the west and Malaya to the south. To a great extent, the distribution of natural vegetation and agriculture, and transportation routes depend on these rivers and mountain ranges.

The waterways of Thailand are the most important means of inland transportation, carrying three fourths of the country's freight traffic, a good portion today handled by power-driven craft. Most obvious to the visitor to Thailand is the utilization of the rivers and canals for transportation of rice to Bangkok and of enormous teak logs down river from the mountains to saw mills. A quite extensive railway system with approximately 2,000 miles of meter-gauge track fans out from Bangkok, extending well into each of the four major natural regions including the full length of the Peninsula (reaching within a short distance of every major site of the nutrition survey work except the Naval Station at Sattaheep). A good portion of the steam equipment has been replaced in recent years with diesel-electric locomotives, and satisfactory passenger as well as freight facilities exist. Highways are not so extensively developed, but it is now possible and reasonable to drive from Bangkok to each major survey site, even to points as distant as Chiengmai and Songkhla. Hard-surfaced roads now radiate out from Bangkok for several hundred kilometers, and commercial trucking is rapidly becoming a major means of transport, particularly of foods.

Agricultural pursuits occupy 85 to 90 percent of the population, and Thailand is distinctly a "rice economy" country. Approximately 20 percent of the total land space is under cultivation, about three fourths of this being devoted to rice cultivation. Among the crops of secondary agricultural importance at present are coconuts, rubber, field crops, fruit, pulses, maize, cassava, chilies, and various fibers. Water buffalo and cattle provide the draft power on the farms and road transportation in rural areas, and hogs, fowl and pond fish are raised for food.

There are two distinct seasons, the rainy season or "wet monsoon" from late March or April to September or early October, during which about 90 percent of the annual rainfall occurs, and the dry season throughout the remainder of the year. During the rainy season in the Central Plain, the mean maximum temperature is 98°F and the minimum 80°F. Both the northern mountainous areas and the peninsula are somewhat cooler. The average annual rainfall in the Central Plain is 55 inches, and it is worthy of note that this is

less than the minimum of 70 inches required for growing the rice varieties used in Thailand, the water required actually coming from the annual floods of the Chao Phraya and its many tributaries and the extensive irrigation canal systems developed through the centuries. The soils of Thailand are diverse. The Central Plain has a basic variety of heavy dark clays particularly suitable for rice cultivation; the southeast Coastal plain has deep red soils now devoted largely to rubber, sugar cane, pepper, and fruit; the northern and northeastern regions (as depicted in Figure 1) have sandy loams deficient in both water and plant nutrients (but considerable emphasis is now being placed on the agricultural and livestock development of this portion of the country, in significant part through Thailand's participation in the widely publicized and immensely important Mekong River Project); the northern and northwestern mountainous areas have dark clay soils and alluvial deposits along the river valleys, where rice can be double cropped or followed in the same year by peanuts, soybeans, etc.; and the sandy loams and clay loam soils of the peninsula are devoted principally to rubber and rice. Vast evergreen and deciduous forests remain. Thailand, unlike mainland China, can still rely upon its forests for flood control by the natural regulation of runoff, and preservation of its forests is of mandatory importance to continuing agricultural development and expansion in the country.

Fishing ranks second only to agriculture in the nation's economy, and fish - both fresh and salt-water - and other seafoods play an extremely important role in the nutritional status of the people. Fishing in the Gulf of Thailand is largely confined to offshore waters, but exploitation of the immense deep-sea fishing potential extending from the Gulf of Thailand around the southern shores of Southeast Asia and into the South China Sea is commencing. The government operates three fish sanctuaries and encourages pond fish culture. Thailand is now exporting frozen shrimp to the United States.

In addition to being a "rice economy" country, Thailand is also an "export economy" country extremely dependent financially on foreign trade, the principal exports being rice (1,240,000 metric tons in 1956 valued at approximately 132 million U.S. dollars), rubber, tin, and teak. The principal imports are machinery and transport equipment, textiles, food, chemicals, and mineral fuels. However, for practical purposes, Thailand feeds its own people, and food imports are predominantly "luxury" items consumed in Bangkok and the other major cities and towns.

Let us now turn attention to some major characteristics of the host as observed during the course of the survey. The total population of 25.6 million people represents an increase of over three million during the past five years. (The population densities of the 71 provinces are depicted in Figure 1-A). The city of Bangkok, with a population of 1.6 million, is the hub around which the entire Kingdom revolves. Chiengmai is the second largest city with a population of about 63,500. Between 85 and 90 percent of the people reside in small hamlets and villages, and of the remainder, half live in Bangkok. Approximately 82 percent of the total population belong to the Thai ethnic group, 13 percent to the Chinese (half of whom live in the Bangkok area), three percent to the Malay (concentrated in the southern-most region), and the remaining two to three percent to a wide variety of ethnic minorities (Cambodian, Vietnamese, Indian, Pakistanian, mountain tribal people, Westerners, etc.).

The family as a unit (averaging five to six persons per household) is the most important institution in Thai rural life. The traditional religion of Thailand is Theravada (Doctrine of the Elders) Buddhism, to which 94 percent of the population adhere. Intimately intertwined in the family life are the activities within the "wat" or temple compound in practically every village. About half of the adult Thai males enter a wat as a novice or monk at one time or the other during their lives. Religious practices do not put complex restrictions on the types of foods to be eaten (concerning meat, it is a common practice to refrain from personal slaughter), and prolonged fasts are not practiced. The largest religious minority are the Moslems of Malay origin. Except for

the Moslem village of Don Kee Leg in the southern-most region, this survey was largely confined to rural Buddhist communities of Thai ethnic people. For further details on general background material, the reader is particularly referred to the excellent treatises entitled Thailand - Its People, Its Society, Its Culture (5) and Ku Daeng - The Red Tomb (6). (An extensive Bibliography of Thailand was published by Cornell University in 1956 (7), including 44 references on public health and welfare.)

A summary of the extent of individual survey examinations is outlined in Table 3, and the distribution of clinical examinations among civilians in terms of age and sex is presented in Figure 2. Some general characteristics of the population groups studied are presented in Tables 4 and 5.

TABLE 3. SUMMARY OF EXTENT OF SURVEY EXAMINATIONS

	Number of Subjects Examined			
	Abbreviated Clinical	Detailed Clinical	Dental	Biochemical
Military (all male)	4,325	884	2,418	256
Civilian male children (under 15 years)	587	140	306	48
Civilian female children (under 15 years)	611	146	333	60
Civilian male adults (15+ years)	520	230	444	73
Civilian female adults (15+ years)1/	671	256	557	90
Totals	6,714	1,656	4,058	527

1/ Of the 671 females with abbreviated examinations between the ages of 15 and 86, 50 (7.5 percent) were pregnant, and 167 (24.9 percent) were lactating; of the 256 adult females with detailed examinations, 21 (8.2 percent) were pregnant and 76 (29.7 percent) were lactating.

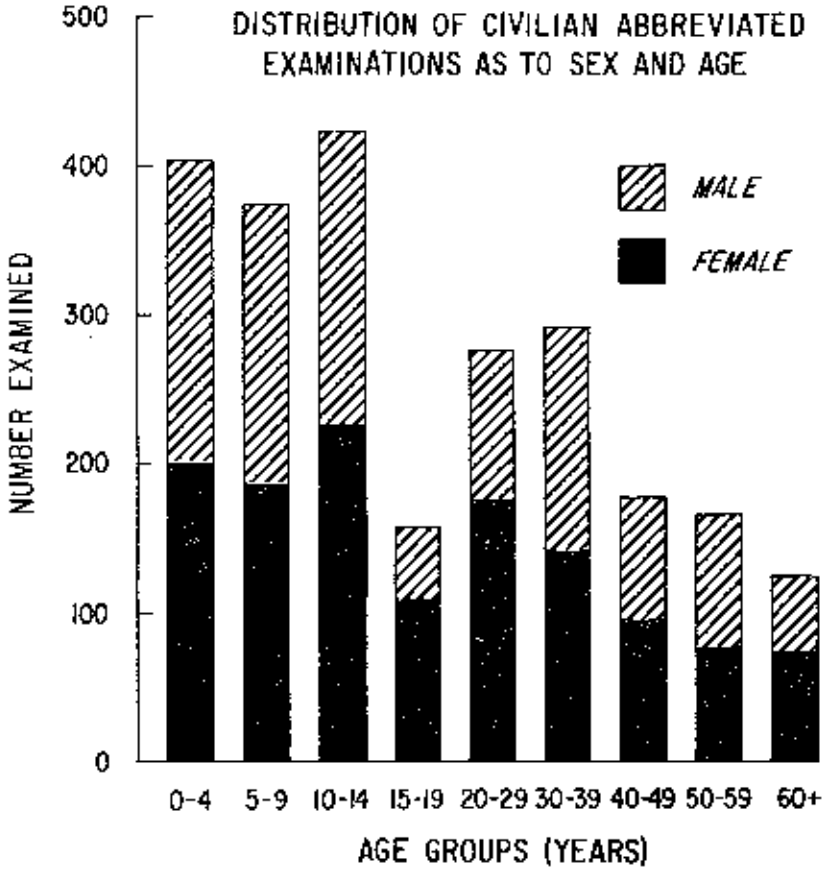


Figure 2.

TABLE 4. GENERAL CHARACTERISTICS OF THE THAI CIVILIAN FAMILY EXAMINED[1/]

CHARACTERISTIC	Percent
Family background	
rural	92.7
urban	7.3
Religion	
Buddhist	94.0
Moslem[2/]	6.0
Family Activity	
farming	90.0
unskilled labor	1.5
skilled labor	0.3
shopkeeping[3/]	3.2
administrative and professional[3/]	5.0

CHARACTERISTIC	Percent
Area of family origin[4/]	
Central (Lopburi) - Region I	7.0
Eastern - Region II	< 0.1
Northeastern (Ubol) - Region III	25.0
Northern (Udorn) - Region IV	29.6
Northwestern (Chiengmai) - Region V	22.0
Western - Region VI	0.1
Southwestern - Region VII	0.2
Southern - Region VIII	0.1
Southern-most (Songkhla) - Region IX	15.9

1/ See Table 2-A for detailed breakdown by locations
2/ All from the village of Don Kae Leg, Songkhla area
3/ Practically all accounted for by students of Rachinutis High School, Udorn
4/ For boundaries of these regions, see Figure 1; the vast majority of families originated from the area in which they were examined.

TABLE 5. GENERAL CHARACTERISTICS OF THE THAI MILITARY MAN EXAMINED (COMBINED SERVICES)[1/]

CHARACTERISTIC	Mean Values
Number examined:	
abbreviated examinations	4,325
detailed examinations	884
Average age (years)	22
Average weight (kg)[3/]	55.4
Average height (cm)[3/]	163
Average % standard weight	93.5
Average systolic B.P. (mm. Hg.)	117
Average diastolic B.P. (mm. Hg.)	74
Average pulse (per min.)	73

CHARACTERISTIC	Percent
Family background	
rural	73.4
urban	26.6
Source of meals	
home	8.6
military messes	91.4
Military rank:	
enlisted	86.5
NCO's	13.5
Religion	
Buddhist	80.7
Moslem	6.4
Christian	0.1
Not determined	12.8
Age distribution (years)	
< 21	0.2
21	48.4
22-24	40.8
25-29	7.9
30-39	2.0
> 39	0.7
Duration of military service (months)	
< 1	5.1
1-2	10.8
2-3	5.6
3-6	15.0
6-12	27.3
12-24	22.8
24+	13.4

CHARACTERISTIC	Percent
Area of family origin[2/] (regions)	
Central - Region I	22.4
Eastern - Region II	10.4
Northeastern - Region III	11.7
Northern - Region IV	14.0
Northwestern - Region V	16.7
Western - Region VI	1.0
Southwestern - Region VII	9.0
Southern - Region VIII	2.2
Southern-most - Region IX	12.8
ACTIVITIES: Army	
Infantry	49.7
Cavalry, Artillery, Mortar, Engineers, and related combat troop companies	13.4
Ordinance, Headquarters, Medical, Transportation and related support troop companies	4.4
Navy:	
Infantry	9.6
Artillery, Engineer, and related combat troop companies	4.6
Medical and related support troop companies	0.2
Air Force:	
Defense units	9.4
Support units	4.7
NCO pilots	4.0

1/ See Table 3-A for detailed breakdown by locations.
2/ For the boundaries of these regions, see Figure 1.
3/ 55.4 kg = 122 lbs ; 163 cm = 64 inches

The typical civilian Thai family examined, therefore, was a rural Buddhist farming family who had lived all their lives in the area where they were studied. The typical military man came from such a family, was 22 years old, had been in service for six to twelve months, was an enlisted infantry man, and ate the majority of his meals in his military mess. The military man in general came from the region in which he was examined, but there was more variation in this factor than the minimal degree observed among the civilians. In addition, a number of differences existed between enlisted and NCO personnel, which is further discussed in the following chapters.

It is important to keep in mind that the Royal Thai military services are "civilian" in nature, similar to the U.S. services, i.e., the average enlisted man is present in the services for a period of approximately two years as a result of a national conscription program combined with volunteer programs. By and large, the enlisted man in service closely resembles his civilian brother of the same age, as the reader will find in subsequent chapters. However, there are a minimal number of physical standards established by the combined services for acceptance as an enlisted man (rejection rate in 1953 was 8.4 percent) and a somewhat more extensive set of standards for acceptance into NCO training programs (see Table 4-A), resulting in some degree of selection of the military population group.

The Thai are relatively small in stature (Figures 3-7, Figure 2-A, and Tables 5-A--8-A) compared with people of the U.S., but they closely resemble the Vietnamese. It is of particular interest that the Thai, like the Vietnamese, attain a maximum body weight in the late teens and early twenties subsequent to which there is a gradual decline in weight as one approaches the geriatric age groups. This is in marked contrast to the steady rise in weight up until the sixth and seventh decades in the U.S. population.

Lastly in this discussion of the host and his environment, let us turn to a brief summary of the public health picture within the country and to the public health facilities available to the Thai individual.

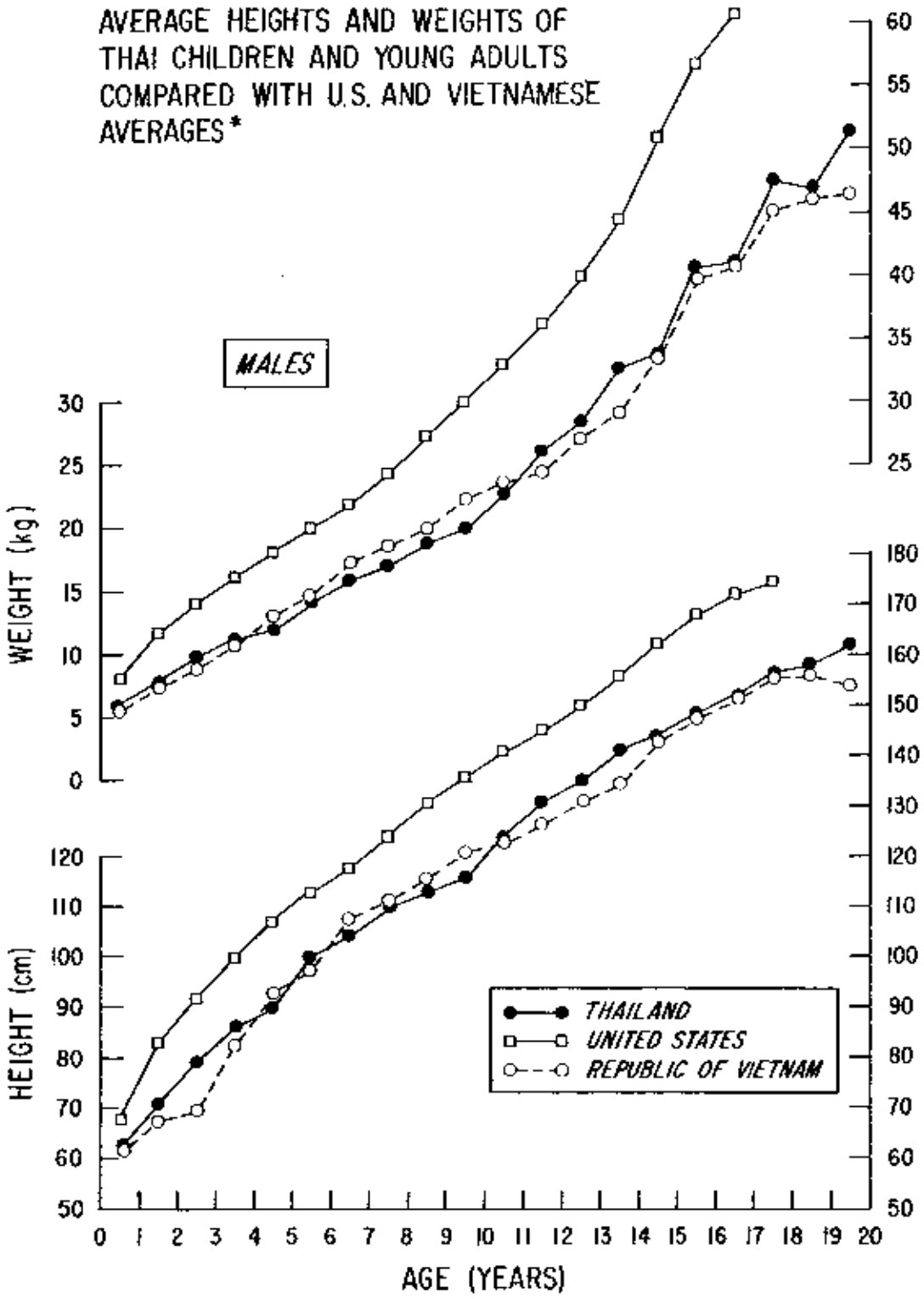
The Kingdom has developed a sophisticated establishment for public health, dating back to 1918 when the Department of Public Health was instituted, modified in 1942 into the Ministry of Public Health (see Figure 3-A for the administrative structure of the Ministry). An excellent summary entitled Public Health in Thailand (8) was published by the Ministry of Public Health in 1960, reviewing the history and current activities of the Ministry. During the past several years, an inter-ministerial top-level nutrition group, The National Nutrition Committee, has been functioning with a group of five working sub-committees (see Figure 4-A for its administrative structure) to establish national nutritional policies and to supervise the execution of such policies. The nutrition groups with which the survey team had the closest contact were the Nutrition Division of the Ministry of Public Health, the Department of Biochemistry and Nutrition of the School of Public Health, and the Preventive Medicine and Quartermaster Departments of the three military services.

Several basic statistics on public health status follow.

TABLE 6. BIRTH AND DEATH RATES IN THAILAND - 1948 and 1957[1/]

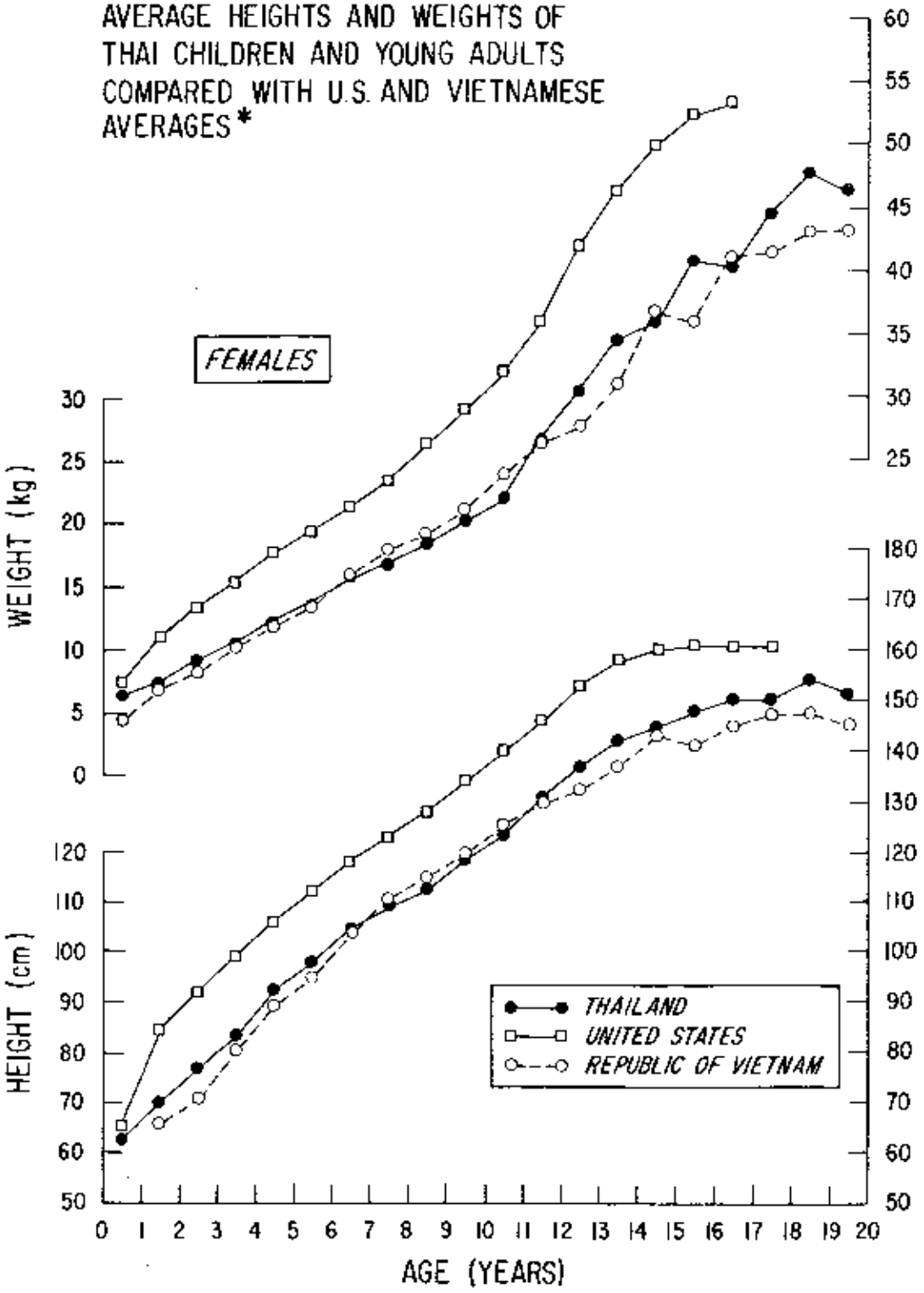
	1948	1957
birth rates (per 1,000 population)	24.0	33.7
crude death rates (per 1,000 population)	10.7	9.5
infant mortality rates (per 1,000 live births)	68.1	62.2
maternal mortality rates (per 1,000 live births)	6.9	5.0

1/ data obtained from Division of Vital Statistics, Ministry of Public Health, Bangkok.



*U.S. data from State University of Iowa Child Welfare Research Station; Vietnam data from ICNND Survey, 1959

Figure 3.



*U.S. data from State University of Iowa Child Welfare Research Station; Vietnam data from ICNND Survey, 1959

Figure 4.

DISTRIBUTION OF HEIGHTS AMONG ADULT THAI (20+YEARS)

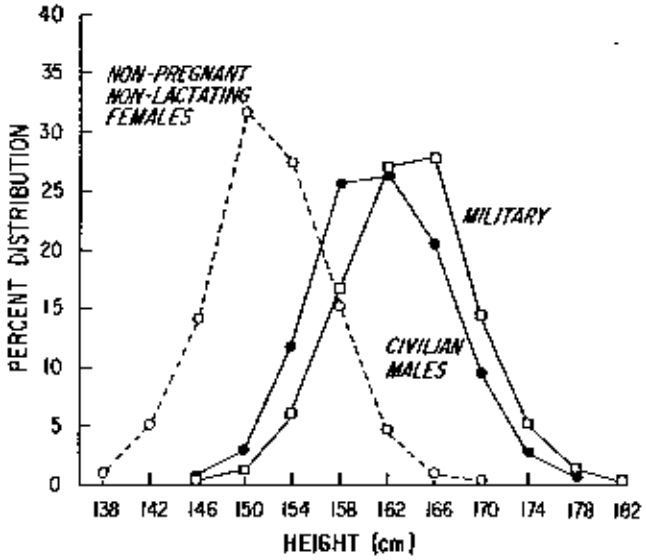


Figure 5.

DISTRIBUTION OF WEIGHTS AMONG ADULT THAI (20+Y

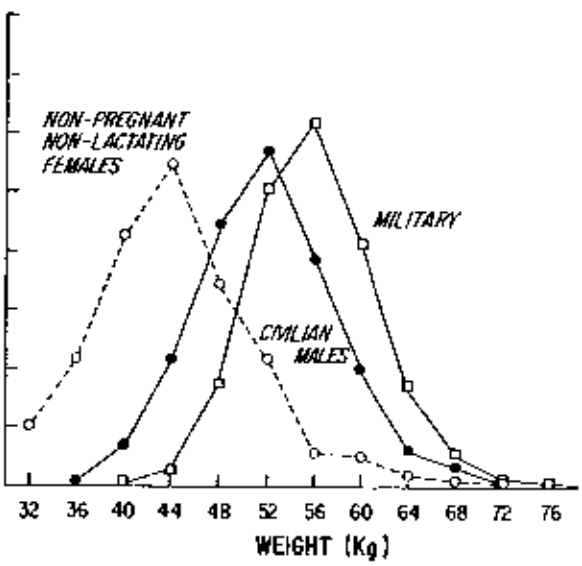


Figure 6.

WEIGHT CHANGES OF CIVILIAN ADULTS WITH AGE, COMPARING THE AVERAGES FOR THAILAND WI VIETNAM AND THE U.S.A.

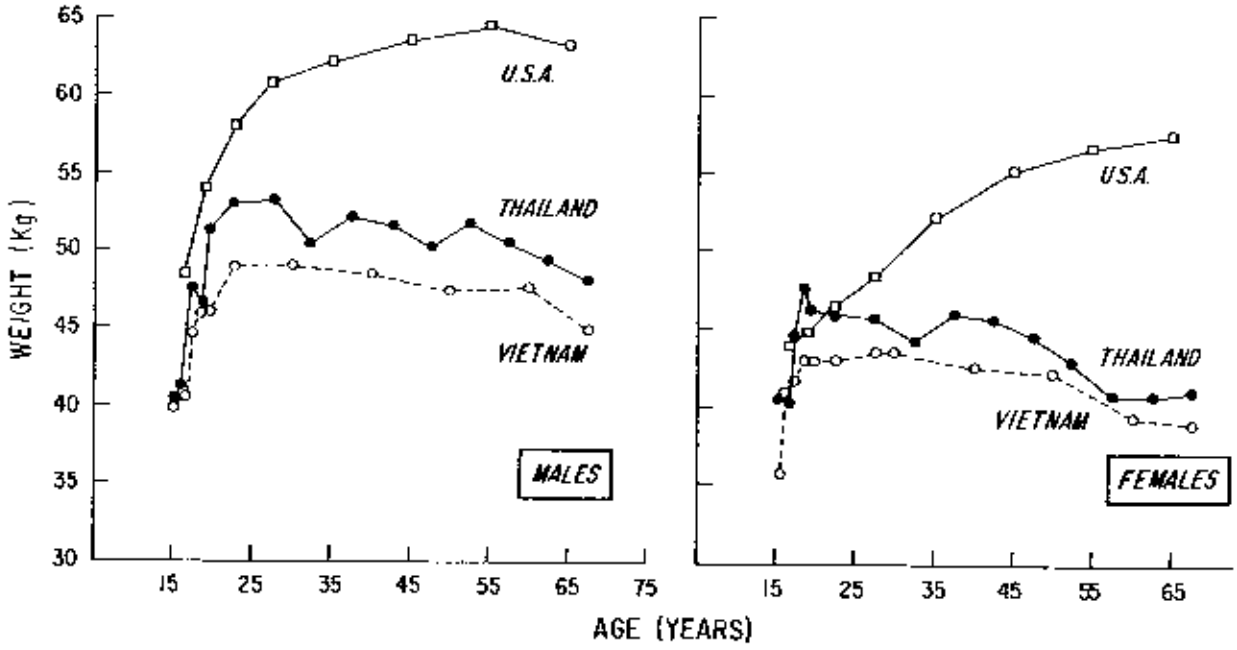


Figure 7.

Concerning communicable disease, no cases of plague have been reported since 1952. In 1959 there were 1,548 cases of smallpox with 272 deaths; 7,777 cases of cholera with 625 deaths during the course of the 1958-59 epidemic. Through extensive malaria eradication and control programs, the malaria death rate during the period 1950-58 decreased from 250 to 38.9 per 100,000 population. Filariasis (Wuchereria malayi) has recently come under attack, the infection rate reaching as high as 30 percent in some areas. An active campaign is now under way to bring yaws, affecting about ten percent of the total population, under control. There are about 200,000 cases of leprosy in the Kingdom, and the government maintains two leprosaria and 12 leprosy villages, in addition to which there is at least one private institution. Tuberculosis remains a very serious problem, the death rate being 48.6 per 100,000 in 1957. Intestinal infestation with pathogenic parasites is extremely prevalent; during a survey of over a quarter of a million persons from all over the country between 1951 and 1955, 62.9 percent of the population had one or more pathogenic parasites in their stools (see chapter on anemia).

In the field of rural health services, the Department of Health now (1958) operates 122 "First Class Health Centers" (physician and staff in residence), 639 "Second Class Health Centers" (sanitarian and midwife in residence), and 543 "Midwifery Centers" (midwife in residence). Environmental sanitation has active programs on water supply, ground water research, excreta and refuse disposal. Maternal and child health is receiving increasing attention, particularly through the training of midwives (the Health Department employs 1,862 midwives and has trained over 3,000 indigenous midwives), and the establishment of maternal and child health centers in Bangkok and in Chiengmai (see Table 9-A for examples of activities of the latter, noting particularly that 13 percent of infant mortality resulted from nutritional disturbances in 1959 and infant and maternal mortality have declined considerably over an eight-year period).

From 1949 to 1959, 87 hospitals with a total bed capacity of 10,210 have been constructed under the jurisdiction of the Department of Medical Services. In 1958, there were 75 provincial hospitals (bed capacity: 5,210) which cared for 187,115 in-patients and 1,071,490 out-patients with staffs of 372 physicians and 530 graduate nurses (see Table 9-A for examples of provincial hospital statistics, noting in particular the occurrence of such entities as beriberi and hookworm anemia).

In addition to the Ministry of Public Health, the University of Medical Sciences under the jurisdiction of the Prime Minister's Office is composed of the following 13 institutions: Siriraj Medical School (and hospital), Chulalongkorn Medical School (and hospital), the new Chiengmai Medical School, School of Dentistry, School of Pharmacy, School of Public Health, School of Public Health Nursing, School of Nursing and Midwifery, School of Sanitary Science, School of Dental Hygiene, School of Premedical Sciences, School of Tropical Medicine, and the School of Premedical Sciences.

There is a considerable concentration of medically trained personnel in Bangkok as outlined below in Table 7.

TABLE 7. DISTRIBUTION OF MEDICAL AND ALLIED PROFESSIONAL PERSONNEL IN THAILAND[1/]

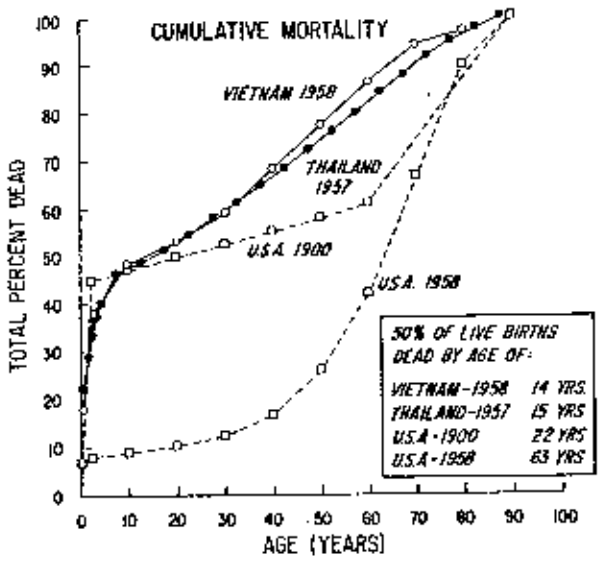
	Number per 100,000 population	
	Thailand (1961)	Bangkok (1961)
Physicians	11.2	132
Dentists	0.9	12
Dental Hygienists	2.7	37
Pharmacists	3.6	44
Midwives	25.9	305
Nurses	33.0	356

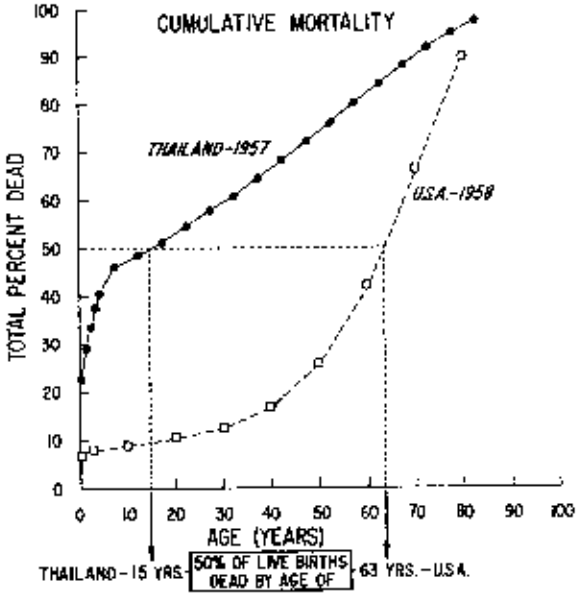
1/ See Table 10-A for ancillary data

Excellent medical statistics are available from several of the Bangkok hospitals (see Tables 11-A and 12-A). However, even in Bangkok, such entities as beriberi in children are not uncommonly encountered, and approximately 16 percent of infant and childhood deaths in one hospital were considered to result from avitaminoses, anemias, and "ill-defined diseases peculiar to early infancy."

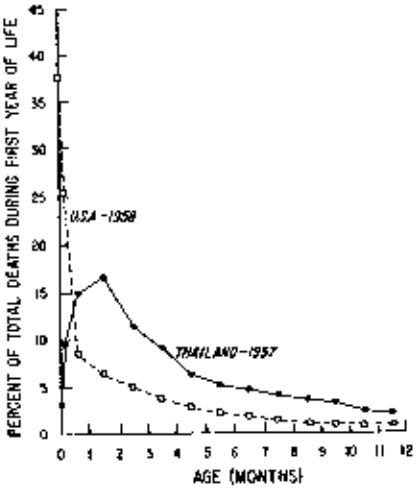
To sum up the public health picture in Thailand, let us examine the currently available cumulative and infant and child mortality data presented in Figure 8. The essential points illustrated are: (1) 50 percent of live births in Thailand are dead by approximately 15 years of age, whereas in the U. S. the 50 percent point is reached at about 63 years of age; (2) in Thailand, after the age of ten years, the proportion of deaths in a given age group remains relatively constant, whereas in the U. S. there is a steady increase after infancy as one approaches the geriatric age groups; (3) the picture in Thailand resembles that of Vietnam and many other developing countries very closely, and is quite similar to that seen in the U. S. 60 years ago; (4) infant mortality differs markedly between Thailand and the U. S., the vast portion of such mortality in the U. S. occurring during the first two to three weeks of life, whereas in Thailand mortality reaches a peak during the second month of life and more slowly declines; (5) in Thailand a much higher proportion of the total deaths during the first five years of life occurs in the one- through four-year-old child than is seen in the U. S. Comparative data on leading causes of deaths are presented in the Appendix (Tables 13-A and 16-A and Figure 5-A).

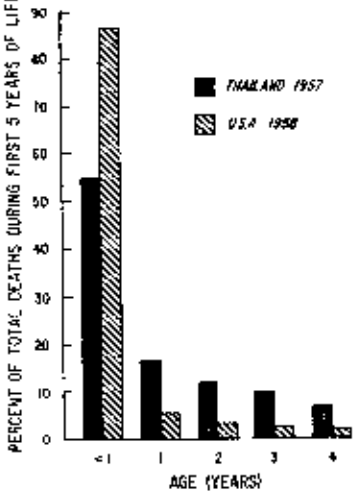
There is no question but that the successes within the U. S. in reducing mortality, particularly of infants and children, over the past 60 years rest on the foundation of public health measures in communicable disease and malnutrition control. Equally self-evident is the fact that the high mortality rates in Thailand, again particularly of infants and children are due in large measure to the inseparable interactions of nutrition and infectious disease--interactions, the importance of which cannot be over emphasized. The documented relationships of nutritional status to amebiasis (9, 10, 11) and tuberculosis (12, 13, 14, 15) are but examples of these interactions. The reader is referred particularly to the comprehensive review of these interrelationships by Scrimshaw et al. (16).





INFANT AND CHILD MORTALITY





Sources of data:

Thailand: Division of Vital Statistics, Ministry of Public Health, Bangkok

Vietnam: National Institute of Statistics, Saigon

U.S.A. 1900: Historical Statistics of the United States, Colonial Times to 1957, p. 10-29

U.S.A. 1958: Vital Statistics of the United States, 1958, vol. 2, p. 132-133, vol. I, p. 360-361

Figure 8.

B. FOOD RESOURCES

Let us now return again to the environment in which the host lived during the course of this survey.

The only meaningful manner of viewing the nutritional status of a nation is against the background of its food resources and production potential. In addition, social and economic conditions must be taken into consideration, particularly if any changes from existing diet habits or food patterns are recommended. The present chapter deals with a brief survey of the agricultural and food situation in Thailand at the time of the nutrition survey. It also touches upon some development plans which will directly affect the food availability and thus the nutritional status of the Thai people.

The major geographical and demographic characteristics of Thailand are described in the preceding section. About 90 percent of the population lives in rural areas. Agriculture provides the livelihood of about 80 percent of the population, produces almost half of the national income, and is the source of almost 90 percent of Thailand's exports. Despite Thailand's potential for a more diversified agriculture and a marked trend in that direction, rice farming continues to occupy more than 70 percent of the total cultivated area and still accounts for about 40 percent of the total value of agricultural output. Fishing and forestry, while less important than rice farming, play significant roles in the Thai economy. Timber, particularly teak, has ranked among the four most important commodities for centuries. Thailand is often designated an "export economy" much dependent on foreign trade. Rice, rubber, tin, and timber are the principal exports and the domestic economy is greatly affected by the demand for and the world price of these commodities.

The typical Thai rice farm is comparatively small, about one hectare in the well-irrigated areas and about six to eight hectares on upland farms, which in Thailand have come to mean any lands not flooded for wet rice cultivation. The Thai farmer usually grows only one rice crop per year. Probably two thirds of the population earn a living from rice farming and rice is, directly and indirectly, a major source of Government revenues.

Agricultural production has increased steadily since World War II and is now well above prewar averages. During the past ten years rice production has increased modestly (7.3 metric tons of paddy in 1959, 7.8 in 1960, and 7.9 in 1961, the latter two years being unofficial estimates), and the increases in the production of most other crops (maize, mung beans, cassava, sugar cane, oil seeds, etc.) have been several fold. Milled rice exports in 1961 exceeded 1.5 million metric tons (unofficial estimate). However, it must be kept in mind that a steadily increasing national population consumes a steadily increasing amount of rice. Great care is therefore required to maintain this very important source of Thailand's foreign exchange derived from the rice export tax or "premium." The recognition of this potential problem and its dangers plays a definite role in the substantial agricultural development and diversification programs which are discussed below.

The production of the most important food crops in 1959 is shown in Table 8, while Table 9 presents an abbreviated food balance sheet for 1958. About one fourth of the rice crop was exported in 1959 together with the entire corn crop. The only other important food crop used for export was cassava, much of this product being shipped to the U.S. in the form of tapioca starch. On the other hand, 36,000 tons of wheat flour and substantial quantities of centrifugal sugar, orange concentrates, and dairy products were imported.

TABLE 8. PRODUCTION OF SOME IMPORTANT FOOD CROPS IN THAILAND, 1959 [1/]

Rice	7,256,000	Metric tons
Maize	317,000	" "
Mung beans	46,000	" "
Cassava [2/]	180,000	" "
Sugar cane	4,988,000	" "
Oil seeds	397,800	" "
Garden crops	262,000	" "
Fruits	536,000	" "

1/ From "Agricultural statistics of Thailand, 1959." Division of Agricultural Statistics, Ministry of Agriculture, Bangkok.

2/ In term of tapioca flour.

TABLE 9. ABBREVIATED FOOD BALANCE SHEET, THAILAND, 1958 [1/]

Item	Production (in 1,000 metric tons)	Imports (+) or exports (-) (in 1,000 metric tons)	Food Available per caput per year, Kg	Consumption Calories per Person per day Number	Percentage
Cereals					
Rice (husked)	4,582	-1,133	144.0	1,420	65.0
Wheat (and flour)	--	+ 36	1.2	10	0.5
Corn	186	- 163	1.0	10	0.5
Starchy roots, tubers, etc.	213	- 125	4.0	10	0.5
Pulses, nuts, seeds	186	- 26	5.9	60	2.7
Sugar	166	+ 17	8.5	85	3.9
Vegetables	559	- 4	23.3	15	0.7
Fruits, including coconuts	1,481	--	48.8	210	9.6
Meat	209	--	9.7	65	2.9
Eggs	110	- 7	4.8	20	0.9
Fish	600	- 9	27.5	135	6.2
Milk	2	+ 88	4.2	20	0.9
Oils and fats	183	- 11	5.5	125	5.7
				2,185	100.0

1/ Foreign Agriculture Service, U.S. Department of Agriculture.

The number of animals on the farms of Thailand is increasing annually with particular increases in buffaloes, cattle, and swine. The number of elephants and horses shows a slight continued decrease. In 1959 there were 6,422,253 water buffaloes, 5,114,567 cattle, and 4,205,620 swine on Thai farms. The number of animals slaughtered shows an even more accentuated increase, indicating a continuous rise in the average intake of animal protein. To illustrate, the numbers of water buffaloes, cattle, and pigs slaughtered in 1954 were in round thousands 28; 142; and 1,200, whereas the corresponding figures for 1959 were 61; 241; and 1,860, respectively. Some 47 percent of all farms own pigs and 83 percent keep poultry. There is considerable exportation of hogs, cattle, and water buffaloes, the number of heads exported in 1959 being 55,135; 2,298; and 50,018, respectively. In addition, 1,148,379 head of poultry and 35 elephants were also exported in the same year. The Livestock Department of the Ministry of Agriculture has several extensive projects in operation or in the planning stage to increase and improve the animal industry, including egg and duck production, in Thailand.

Slaughterhouses are still simple and none of those visited by team members had refrigeration facilities. At the time of the survey some 1,500 pigs and 260 head of cattle and water buffaloes were slaughtered daily at the Bangkok Municipal Slaughterhouse which had no refrigeration facility or means for by-product utilization. However, nearby the new slaughterhouse with a daily capacity of 2,000 pigs and 500 head of cattle and buffalo was nearing completion and is planned to go into operation in the fall of 1961. This new slaughterhouse will have ample refrigeration facilities and other services required by a modern installation. One great problem seems to be the scarcity of qualified veterinary inspectors and apparently the Veterinary College is also lacking in an adequate number of candidates. The only solution to this problem seems to be an upgrading of the veterinary positions. Thailand's rapidly developing animal industry will be in a precarious position without adequate numbers of professionally trained specialists.

The dairy industry of Thailand is in its early infancy. The consumption of whole milk-equivalent milk products in 1958 was only 90,000 tons for the whole country or about 20 Calories per person per day. Almost all of this was imported. Dairy products are definitely gaining in popularity, partly at least on account of the fine milk and ice cream made by the foreign companies importing and marketing dairy products. At the time of the survey, contracts were signed for bringing in European dairy specialists (including farmers) to establish a milk production and dairy training center. Much work remains to be done in the selection of the right breeds and in solving animal nutritional problems which apparently include some unusual mineral deficiencies and, of course, many of the technological problems of sterilization, handling, and distribution remain to be solved. At the time of the survey local officials were hopeful that within a short time and with additional United Nations and United States aid the dairy training center and pilot production scheme at Saraburi could be fully activated.

The Thai farmer's ambitions are modest and his knowledge is mostly traditional. The need for education is recognized, and Thailand is outstanding in that an opportunity is provided for virtually every child to make at least a start in the public school system. However, of those who start elementary school, less than 40 percent finish the first four years, and only half of these go further in the system (17). Vocational training in agriculture is provided by specialized schools in the country.

One of the five institutes of higher learning is the University of Agriculture (Kasetsart University) at Bang Khen near Bangkok. It was organized in 1948 from previously existing colleges. The curriculum is set up on a five-year basis. Kasetsart University gives degrees in agriculture, cooperatives, home economics, forestry, fishery and veterinary science. The current enrollment at Kasetsart approximates 1,700 with about 10 percent girls. Until recently, Oregon State College held a contract to assist this institution which is still in need of buildings, equipment, experimental fields and other facilities to perform its functions with the maximum benefit for Thai agriculture. Many of the students, graduates, and staff members obtain additional training abroad, mostly in the United States.

Agricultural research is conducted in Thailand on a very small scale. Teachers at Kasetsart have little time for research activities and while there are over 50 experimental farms throughout the country, most of these appear to be mostly demonstration and extension units, rather than performing some of the much needed agricultural research. The greatest need in Thailand today is agricultural experimentation of the simplest kind and not basic research. Personnel are perhaps the greatest problem facing administrators desirous of developing agricultural research. Notable achievements have been made in Thailand in rice breeding and seed distribution and some other phases of agricultural research but considering the overwhelming importance of such activities for the future of the country the effort seems hardly adequate.

Most of the Government's agricultural extension work pertains to the program for the use of improved rice seed. There are over 300 extension officers in the whole of Thailand including those who do extension work in addition to their main assignments on the experimental farms. This, again, is clearly a matter of availability of trained personnel. Since the Government is aware of the extension needs, definite improvements can be expected as the number of local graduates increases and those now studying abroad return.

1. Rice and Rice Technology

The long-grained Thai rice is known the world-over for its high quality. There are some thirteen varieties commonly grown, all having approximately the same grain sizes. The Rice Department of the Ministry of Agriculture at Kasetsart University is conducting research in rice breeding and is charged with the propagation and distribution of desirable seed stock. The milling properties of rice are also studied at Kasetsart. At the present time very little rice is grown with fertilizers, and most desirable or generally applicable fertilization practices are still to be established. One major complicating factor is that in the typical Thai pattern of rice cultivation, the irrigation water flows from one paddy to the other. Hence, some of the fertilizer applied on higher-lying lands would be carried on to the lower-lying fields.

There are approximately 800 rice mills in Thailand, most of them in the Central Plain, and the largest ones along the Chao Phraya river in and near Bangkok. Team members visited several of these during the survey. They were of standard design, with the customary machinery and operational arrangements. Rice standards are promulgated and enforced by the Ministry of Economic Affairs.

Undermilled rice. The undermilled rice prepared for the use of military messes is milled on contract basis. The undermilled rice is not particularly liked and certainly not preferred by the men. However, the nutritional benefits derived from the use of undermilled rice are considerable, particularly because of the considerable augmentation of thiamine intake achieved.

There seems to be a need for somewhat more exact control of the extent of undermilling. At the time of purchase the extent of milling could be controlled by the milling records and by comparison with official samples of undermilled rice followed by frequent analysis for thiamine. Whereas Thai government standards are quite explicit in the definition of brokens and impurities, the determination of the extent of undermilling is inadequate. This is not surprising in view of the fact that the standards have been primarily designed for export rice which consists of white (highly milled) rice and parboiled rice.

Parboiled rice. Parboiling improves the milling quality of the paddy and the nutritive value of the milled grain. It is locally not accepted because of its off-white color and different odor. It is suspected that this objection to off-odor is mostly a memory from the days when parboiling was done by crude and unsanitary methods. Parboiled rice commands the same price as white rice. In Thailand several large mills parboil rice for export. One of these, the Kuang Hong Lee plant at Chiengmai, was visited by team members and found to be an exceptionally well designed, equipped, and operated establishment. Here the paddy was soaked in water of ambient temperature for three days with daily changes of the water. Then the rice was steamed for 15 minutes under 100 pounds of pressure. Finally, the rice was spread out on concrete floors for drying which took up to two days. The moisture content of the product, an important factor for several reasons, was measured by electrical conductivity measurements in the customary manner. Finally, the rice was milled. The production of this plant was about 5,000 tons of parboiled rice per year.

Enriched rice. A complete standard rice enrichment plant was observed in the Thai Rice Company mill at Thonburi. The plant operated under an agreement with F. Hoffman-La Roche and Company, Ltd., of Switzerland. According to the information given to us at the plant, enrichment never caught the fancy of the Thai people and the enriched rice, sold under the name of "Vita-rice," was sold only in small quantities as a health food or medicine.

Canned cooked rice. Such rice was used as a military emergency ration but appeared to be of a somewhat unsatisfactory nature. As well known, changes occur in the canned cooked rice after canning which result eventually in the contents turning into a glutinous solid mass. The Preserved Food Organization of Thailand canned some cooked rice of lower moisture content for which a better shelf life and acceptance was claimed. Even disregarding acceptability, it would seem that either product would be too expensive on the one hand and too bulky for the nutrient content on the other for extensive use in military rations. This subject is further discussed in the military rations section.

2. Fisheries

Next to rice, fish is the most important staple in the Thai diet. In addition to the fishing villages all along the long coast line, the traveler up-country can observe fishing by various devices in every river, pond, ditch, and paddy field. The commercial marine fish catch in 1959 was 144,000 metric tons while in the same year the catch of fresh water fish was 57,000 metric tons. It has been estimated that the consumption of fish not entering trade and thus not shown in statistics is approximately 20 percent more than the total commercial fish catch (17). The fishing industry has received considerable outside aid from FAO and the United States in its development but its additional potential is still great.

There are several excellent organizations involved in the commercial handling, manufacture, and marketing of fish and fisheries products. The Fish Marketing Organization, established in 1953, is a semigovernmental organization under the Ministry of Agriculture. It operates the Bangkok Fish Market dealing with live fish as well as salted and dried fishery products. The Fisheries Technology Section is engaged in the development and manufacture of fishery products such as chips and fish sausage. This group is also engaged in extension work. It has five technically trained people. Nearby is a plant of the Bangkok Cold Storage Organization, with a frozen storage capacity of 1,600 tons.

There are two other cold stores in Bangkok and the construction of additional cold stores are planned in Chiengmai and on the sea coast. Ice plants are available in many cities throughout the country, but difficulties have been experienced in storing the fish at the terminal points.

Team members visiting the Bangkok installations were impressed by the high degree of sanitation and the technical knowledge and enthusiasm of the personnel concerned with this vital aspect of Thai life and nutrition. The only suggestion to offer is that the various organizations dealing with fish products might increase their usefulness through more extensive coordination and cooperation.

Much fish is consumed in the form of such items as fish sauce, fermented fish, and salted fish mash. These will be described in the following section.

3. Food Processing and Preservation

Agricultural products for processing, canning, and preserving are plentiful in Thailand but the processing industries are still in their infancy. Rice processing is, of course, the largest food industry. Pickling, fermentation, dehydration, and salting are traditional methods but commercial scale food preservation, particularly canning and refrigeration, are recent developments. In addition to the availability of many potential raw products for the processing industries, an additional reason to encourage the development of local food processing is that substantial quantities of processed foods are now imported.

At the present time the food industries of Thailand are mainly home and small scale industries. They are turning out sizable quantities of traditional processed food products but the Western-type processed foods are mostly of low quality. The machinery used is mostly antiquated and inefficient and thus the cost of production is high. An obvious exception is the Preserved Food Organization (PFO) discussed below. It might be most clear to discuss Thai processed foods on the basis of an arbitrary classification into traditional, bottled, canned, and dehydrated products. There are excellent reports available on the manufacture of traditional Thai foods and therefore only a few of the more unusual products will be described here.

a. Traditional processed foods

Fish sauce (nam-pla). This is an important traditional food product used extensively both in the civilian and military diets. Only small fresh fish (mostly Clupeoids) are used in making this product. Large and medium size fish having too much fat are not suitable. After washing, the fish are placed in a large wooden tank or tub containing saturated salt brine at the ratio of six or seven parts fish to one part of brine, and the fish layer on the top is covered with additional dry

salt. After three to four days the fluid from the top of the tub or tank is removed, the fish layers are pressed together firmly, and then the fluid is replaced and the container closed. Traditionally, the fish is then allowed to ferment for one to two years but today the fermentation period is shorter. Finally, the sauce is exposed to sunlight and then mixed for three to four days with the residue from a previous batch of fish sauce in order to increase flavor. The sauce is then filtered and bottled in glass or earthenware containers.

The finished product has a pH of 5.0-6.0 and contains 20-to 31 percent salt, 1.0 to 3.5 percent total nitrogen and 0.15 to 3.9 percent amino acid nitrogen. Apparently there is great variation in the quality and acceptability of this most typical Thai food product. Team members visited the Army Subsistence Factory at Smudsakorn which was exemplary in its efficiency and sanitation. Three grades of fish sauce were made at this plant which was formerly a canning factory. The production was about 20,000 liters per month but the capacity was much larger. The Department of Science has experimentally developed a quick process for fish sauce manufacture. As far as could be ascertained, this product, requiring exact scientific control in the manufacture, is not used commercially.

Fermented fish (pla-ra) is another important traditional food made from any fish except fatty species. Fatty fish is said to cause spoilage. The beheaded, scaled, and eviscerated fish are washed, and then mixed with salt in the proportion of 4:1. The mixture is put into a bamboo basket or other perforated container placed over a dish to receive the fluid coming from the fish. The fluid may be used in the preparation of fish sauce. After eight to ten days the fish is thoroughly mixed with some ground rice and roasted rice bran, transferred into an earthenware jar, and allowed to mature for at least three months.

Shrimp paste (kapi). The small shrimp are washed and allowed to drain for a few hours, then mixed with salt in the proportion of six parts shrimp to one part salt and the mixture is allowed to drain overnight. More salt is added the following day and the mixture again allowed to drain overnight, spread out to dry somewhat, and then pounded to a paste. The drying and pounding is repeated for two weeks until the paste becomes rich in flavor and purple in color.

Roasted chili paste (nam-prik-pao) is made from two parts of dried chili or chili pepper, one part garlic, and one part of powdered dry shrimp or other protein-rich food, such as roasted and ground soybeans or peanuts, and the addition of some fish sauce, sugar, and aqueous tamarind pulp or lime juice. The chili and the garlic are dried and roasted separately to a light brown color and ground together to a fine powder. Then the protein-rich constituent is added and mixed in. The fish sauce, sugar, and tamarind extract or lime juice are mixed and fried in a pan and the paste is added gradually with constant stirring to the mixture until a thick paste is formed. When transferred hot into clean bottles, the paste will keep well. This food is consumed by all levels of society and is used in military rations.

There are, of course, many other traditional processed foods which are either simpler in their preparation or consumed in much smaller quantities than those listed above. Phannippa Varavej and Kliau Bunnag (18) describe many of these in detail.

b. Canned and bottled fruit juices

Approximately five to six million bottles of pasteurized bottled orange drinks were manufactured and consumed in Thailand in 1960. These are manufactured from

imported concentrates and other ingredients by foreign-owned companies or under license. Canned fruit juices are also imported in large quantities. At the present time there are no commercial fruit juice canning plants in Thailand. Bottled, chemically preserved fruit juice cordials and squashes are either imported and sold at high prices or manufactured by small home industry units that would not satisfy minimum hygiene requirements (19).

The development of a substantial local fruit juice industry is hampered by several factors. Some of these are the absence of suitable manufacturing plants for cans, the variable quality of local sugar, and the lack of standards for product quality and for hygiene and sanitation. In addition, there are today no adequate regulations governing the manufacture and labeling of such products. It is clear, therefore, that the development of a local citrus juice industry, if attempted, will be a long-range project involving many aspects and starting with the improvement and increase in the production of large uniform quantities of suitable citrus fruit. However, there is no reason why the imported cordial and juice squash-type products could not be gradually replaced by more desirable and cheaper Thai products as long as sanitary control and quality regulations are promulgated and enforced.

c. The canning industry

Tollenaar (20) mentions in his report that there were in Thailand in 1958 about 25 private canneries and two canneries belonging to the Ministry of Defense. One may add to this the canning facilities of the Preserved Food Organization, to be discussed below in detail. As already noted, most canneries are primitive and small. One of the important products is salted vegetables, amounting to an annual output of some 2.5 to 5.0 million cans of predominantly No. 2-1/2 size, mostly for the local market. This is actually not a fully sterilized product since the sealed cans receive only a brief treatment in hot water. The preservation is apparently accomplished by the approximately eight percent salt present and the frequent use of chemical preservatives. Some seven or eight factories sterilize with steam under pressure. It has been estimated that in 1957 the total production of sterilized foods did not exceed 900 tons. Sardines (pla-thu) in tomato sauce is one of the main products.

Canned pineapples have been produced in Thailand for several years. However, the local product is inferior in quality as indicated by the fact that it does not compete successfully with the Hawaiian product of equal can size which has a retail price four times that of the Thai product. This is unfortunate because Thai pineapples are of the right characteristics for canning and possess excellent flavor.

At the present time it is difficult to assess the future potentials of a Thai canning industry. Without an extensive domestic market, the manufacture would have to be predominantly for export. On the other hand, the high quality requirements on the already crowded international market make it rather dubious whether the Thai products could find customers year after year. It would seem that gradual improvement in quality and consolidation of the local canning effort into economically feasible larger units is the only rational avenue for such development. This might well start with more stringent and rational regulations concerning manufacturing facilities and product quality, including measures to improve plant sanitation and hygiene. The difficult road to be traveled is well indicated by the fact that in spite of surveys conducted and recommendations made several years ago by specialists invited by the Government, the general situation in the local canning industry seems to be little changed from that observed in 1956 and 1957.

d. Dehydrated products

The sun drying of salted and smoked fish, chili peppers, other vegetables, and fruit is traditional in Thailand as in most countries in the Far East. As in most countries, there would be need of artificial drying facilities to prevent spoilage of the food during the rainy season. The use of tobacco dryers for fruit drying has been suggested by van Eekelen (21) but it was not ascertained whether such usage actually took place.

4. The Preserved Food Organization (PFO)

The PFO was founded in 1955 as a semigovernmental organization with its central offices in Bangkok and an impressive pilot plant adjoining the campus of Kasetsart University in Bang Khen. The aim in forming the PFO was to provide the Armed Forces with an independent supply of food items in times of an emergency, and, if production capacity were sufficient, it was also intended to supply the public (20).

Team members visited the PFO several times in order to observe its activities. The pilot plant has extensive laboratory and small-scale production facilities, including jacketed cooking pans, chopping, mixing, and peeling equipment and sterilizing retorts. It includes a can-forming plant and has its own water and steam supply. The installation is spacious, well-organized, impressively clean and neat, and apparently has an excellent staff. The facilities and products activities of the PFO have been described in a pamphlet recently published by the organization (22). Nevertheless it proved to be somewhat difficult to obtain a clear picture of its activities, production, and future plans.

The PFO produces about 10,000 cans of processed foods per year. The variety of products packed is great. The pamphlet noted above lists over a hundred items packed and for sale, including meat products, chicken wings and fried chicken, prawns, sauces and dressings, a great many salted and pickled vegetable products, desserts, sweets, and canned fruit. It is difficult to see the place of many of these items in the Thai diet since the prices of the processed foods were clearly outside the means of the average family. It is also clear that the production costs of these small lots of canned foods are likely to be much higher than of canned goods produced commercially in large quantities. Nevertheless, Thailand is fortunate in having this excellent food processing facility. Information obtained on the products packed for the Armed Forces was restricted to the canned cooked rice noted under rice technology.

The problem appears to be to make the best use of this excellent experimental setup for military ration development and production and for the development of the Thai food preserving industries. As yet a great amount of testing and research remains to be done before canning on a commercial scale can become a really successful venture in Thailand. Certainly the facilities of the PFO are ideally suited for such research and development work, both for items for military rations and for the civilian market. The development of military ration items based on Thai foods for large-scale use and satisfying the exacting requirements for military rations (23) is a dire need in Thailand as in most other Eastern countries. According to our limited observations, the extent of effort extended in this direction seemed much less than that toward the production of civilian foods. Even with civilian foods, the emphasis seemed more on variety than on the solving of the basic problems involved in the utilization of local agricultural products for eventual large-scale processing. Activities of the PFO should be directed to those scientific and technological problems most important for Thailand's development as outlined by several surveys (20,21,17).

In addition to the use of the excellent PFO facilities for development work, it should be fully utilized in the training of food technologists at the university level and of food plant operators. The latter might be arranged in a manner that the license of food plant operators would depend on participation in short-term courses and demonstrations. Actually, this facility, the best or one of the best in the Far East, could be used to great advantage for the training of food technologists of many neighboring countries. The exemplary sanitary arrangements at the PFO in themselves are an outstanding demonstration of what can be accomplished in a food processing plant in this part of the world.

(Note: In the Food Resources Appendix, the reader will find comments on tapioca manufacture, the Army Quartermaster Subsistence Division, the military feeding of regular and glutinous rice, and the salt industry.)

IV. SURVEY RESULTS

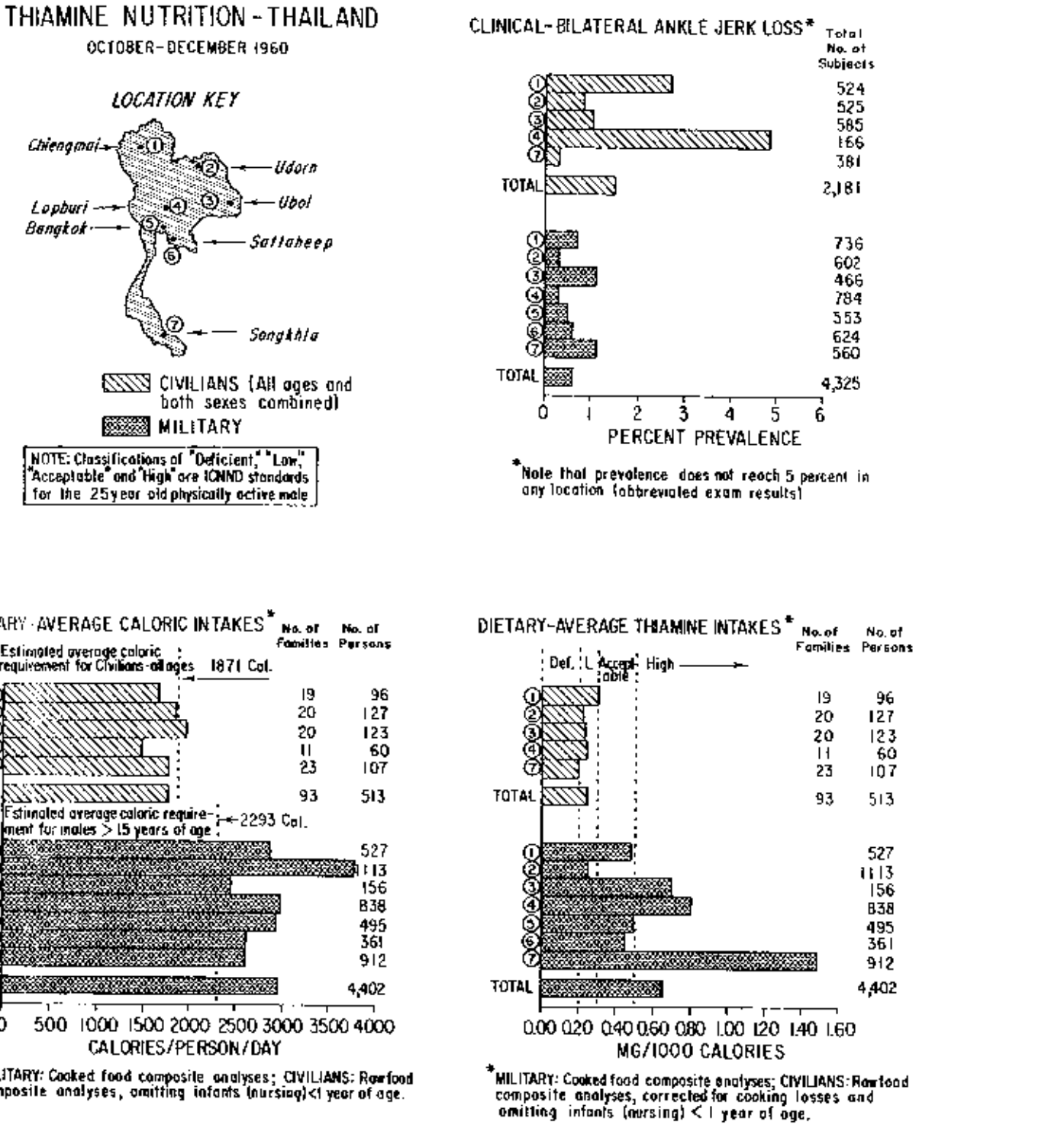


Figure 9.

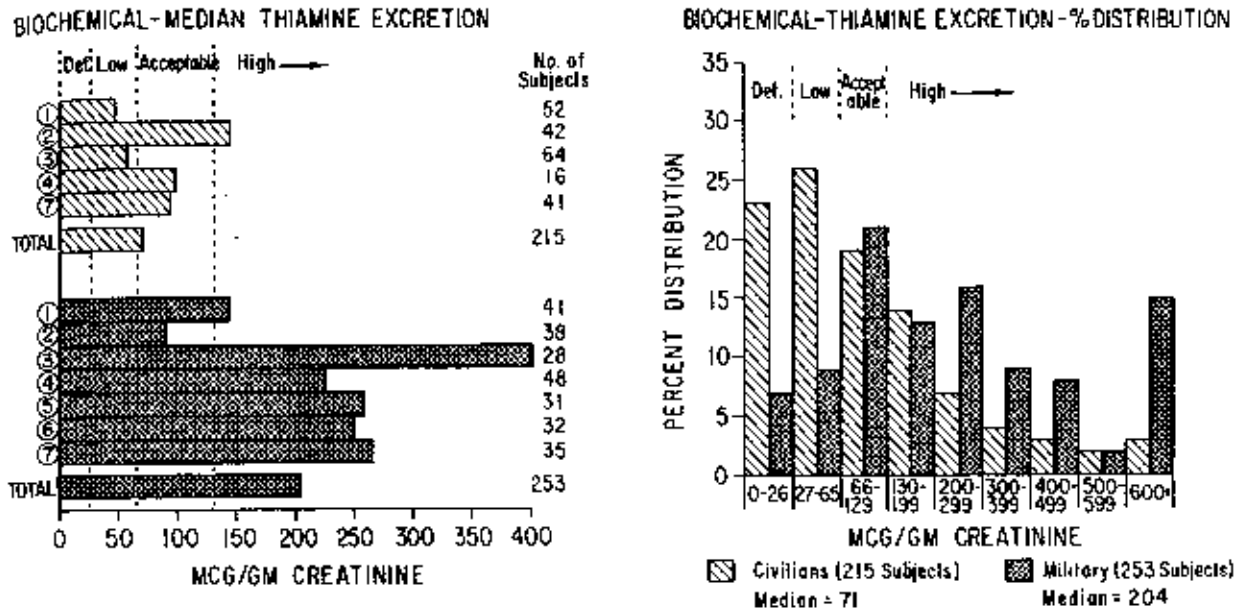


Figure 9 (continued).

A. THIAMINE NUTRITION

Very few clinical manifestations of beriberi were observed. As illustrated in Figure 9, the prevalence of bilateral loss of ankle jerks did not attain a five percent level in any area, and no unquestioned cases of beriberi were seen. The data illustrated represent the 60 individuals out of over 6,500 examined who had such loss. So few were observed in any particular age or sex group that no useful correlations were obtainable. Concerning bilateral loss of knee jerks, only 18 cases were found in 1,656 detailed examinations. When one considers the long history of beriberi in Thailand, the Department of Health's report that 1,770 persons died of beriberi in Thailand in 1957 (latest figures available), and the reports of Bangkok pediatricians that infantile beriberi is not infrequently observed on the wards of the Bangkok hospitals, one realizes the inadequacies of the current clinical survey techniques when it comes to uncovering evidence of some of the nutritional deficiency diseases. Of course the very nature of beriberi - particularly in infants - accounts for some of this failure to identify the disease during the survey in that its course may be very short indeed with a fatal result or rapid recovery. It must also be realized that a survey of this nature might very well fail to uncover a problem which existed at the one percent level at any given time, even though the problem might be of very serious public health significance. A second clinical problem with thiamine deficiency is evaluation of the deep tendon reflexes themselves. In this survey, every effort was made to record only absolute and bilateral loss by requiring testing in two positions, manual reinforcement, and verification by a second examiner (see Clinical Appendix). This fails to take account of the more subjective phenomenon of diminution of reflexes, which is recognized to be a finding associated with clinical beriberi (35). Diminution of reflexes has long been a problem in clinical interpretation, and gave rise to the study reported separately herein on the evaluation of an instrument for objective measurement of the Achilles reflex (see Special Studies Section).

The total caloric intake (see Figure 9) within the military services approached 3,000 Calories, well above the average caloric requirement for Thai adult males. On the other hand, the mean civilian intake of 1,770 Calories fell 100 Calories below the estimated average civilian requirement with comparatively little variation from area to area. It therefore is reasonable to conclude that caloric intake among civilians in general approximated the average requirements although being slightly below the theoretical requirement. There is no evidence whatever to suggest that simple starvation is a problem in Thailand.

Thiamine intakes among the military services proved to be satisfactory (see Figure 9). This can be ascribed to the universal use of undermilled rice from which the Thai soldier obtained 44 percent of his total thiamine intake (see Table 67-A), amounting to 0.28 mg/1,000 Calories. The mean intake among civilians was 0.24 mg/1,000 Calories with little variation from area to area. It is to be noted that the Thai service man received more thiamine per 1,000 Calories from his undermilled rice alone than the Thai civilian received per 1,000 Calories from his entire diet.

Since a mean civilian intake of 0.24 mg/1,000 Calories inherently represented persons and communities ingesting less than this amount, one can conclude that the national picture is one of marginal thiamine intake, certainly well below that intake where there would be universal agreement that a reasonable margin of safety existed.

Thiamine excretion in the urine correlated moderately well with thiamine intake (see Figure 9). Within the military, the median excretion was greater than 200 mcg/gm creatinine - certainly reflecting an adequate state of thiamine nutrition. It is interesting to note that the one military group with "low" thiamine intakes (Udorn - Army) was the only group falling below the "high" excretion range. The distribution of excretion values in the military spread rather uniformly over a very wide range, with seven percent falling in the "deficient" range and a considerable proportion (15 percent) excreting over 600 mcg/gm creatinine. The situation among the civilian population is not so clear cut. It must be noted that the data as presented in Figure 9 represents all ages, sexes, and physiologic states (i.e. infants, pregnant, lactating, non-gravid females, etc.) combined, and that standards of acceptable levels are not nearly so well established as they are for the young adult male in military service. There was considerable variation from area to area, and the people of the Chiengmai area had the lowest median excretion - a pertinent observation in view of the generally held idea that the principal endemic area for beriberi in Thailand in past years has been the group of provinces centering around Chiengmai. In spite of the regional variability, the national median of 71 mcg/gm creatinine was fairly representative of the entire population sample studied, just reaching the "acceptable" range. The distribution of excretion values was very different from the military picture, with 23 percent falling in the "deficient" range, the peak of the curve being between 27 and 65 mcg/gm creatinine, representing an additional 26 percent of the population studied, followed by a rapid fall-off as one approaches the higher excretion values. Among the 49 civilians with excretions in the "deficient" range, nine of these actually excreted no detectable amount of thiamine (see Table 48-A). In terms of age, there was a tendency for higher thiamine excretions to occur in the 5 to 14 year old children, as outlined in Table 10 (see Tables 45-A and 47-A for more details).

TABLE 10. MEDIAN THIAMINE EXCRETIONS AMONG THAI CIVILIANS IN TERMS OF AGE

	Age (years) --->	0-4	5-9	10-14	15-44	45+	TOTAL
Males:	No. of subjects	4	19	20	50	18	111
	Median excretion (mcg/gm C)	233	191	108	45	30	62
Females:	No. of subjects	6	24	16	24	19	89
	Median excretion (mcg/gm C)	46	142	131	74	72	99
	Pregnant: Median excretion (mcg/gm C) (5 subjects)				142		
	Lactating: Median excretion (mcg/gm C) (21 subjects)				48		

Only five subjects with bilateral loss of ankle jerks among the combined military-civilian population sample also had thiamine excretion levels determined and there was no relationship between the presence or absence of ankle jerks and thiamine excretions (the three military subjects with AJ loss all had excretions in excess of 400 mcg/gm C) (see Table 49-A). The reader is referred to the Biochemical Appendix for detailed breakdowns of the biochemical data.

A number of four hour oral thiamine load tests were performed on groups of pregnant and lactating women in the Chiengmai area (a "thiamine deficient" area) and in a Bangkok hospital clinic (a presumably more thiamine-adequate population). These studies are reported separately in the Special Studies section under Evaluation of Thiamine and Riboflavin Load Tests.

Beriberi and thiamine nutrition have a long, although somewhat sketchy, history in Thailand. Among the earliest scientific reports was one by Laurent in 1899 (24) describing an epidemic of beriberi among Thai soldiers which promptly ceased when pork and fresh vegetables were introduced into the military ration. It is interesting to recall that the first successful effort to control beriberi was laid in a military setting when Admiral Takaki, Surgeon General of the Japanese Navy, altered the ship-board ration in 1884 (25) by increasing meat and fish allowances, diversifying the diet with milk and wheat flour, and decreasing rice intakes. These efforts 78 years ago promptly reduced the incidence of beriberi in the Japanese Navy from 20 to 40 percent of total strength per year to essentially zero. Highet (26), the Health Officer of Bangkok, reported that there were 22,670 cases of beriberi in the city with over a thousand deaths between 1901 and 1909. In 1912, following a visit to Japan, the Surgeon General of the Royal Thai Navy introduced undermilled rice, mung beans, and other means of providing diversification of the diet--practices adhered to in the Navy to this day.

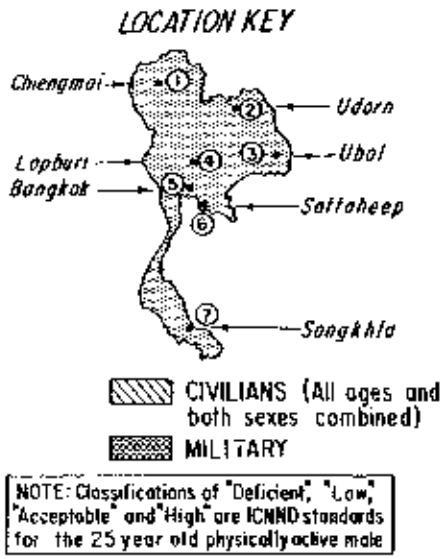
Except for a report by Hepburn et al in 1920 (27) on 100 cases of beriberi in Thailand, there appears to be a great gap in the history of the disease in Thailand until the post-World War II years. In the early 1950's, an epidemic of beriberi broke out in the Chiengmai area which was studied by the Nutrition Division of the Ministry of Public Health and recommendations were made to the Government that increased consumption of undermilled and parboiled rice and pulses be promoted. Ramalingaswami (28) reported that the incidence of peripheral neuropathy among adults and adolescents in Chiengrai Province (northeast of Chiengmai) was approximately 24 percent and in Ubol Province 12 percent, and that these prevalences paralleled the infant mortality rates. He pointed out that most families in the villages he visited in the Ubol area were using home-pounded rice whereas in the Chiengrai area, machine-milled rice was used. In addition, rice mills were introduced into a district of Chiengrai Province in late 1952, and by 1954 the incidence of beriberi had risen markedly to involve three percent of the entire district population (1,464 cases among 45,000 people). In 1959 Klerks (29)

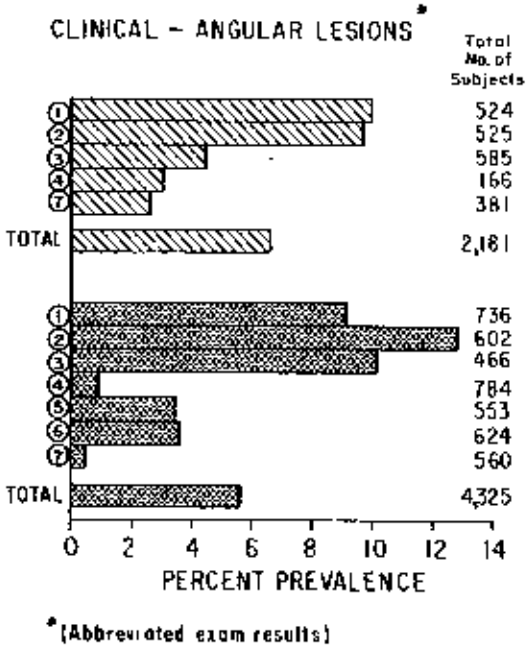
concluded from an extensive analysis of morbidity data for the whole country that the population of Thailand was living on the borderline of a permanent thiamine deficiency and that a rough but conservative estimate of the beriberi morbidity rate for the whole Thai population was one to two percent per year, including relapses. He also experienced no difficulty in observing classical cases of beriberi in a community near Bangkok and emphasized the prevalence of the disease in pregnant women.

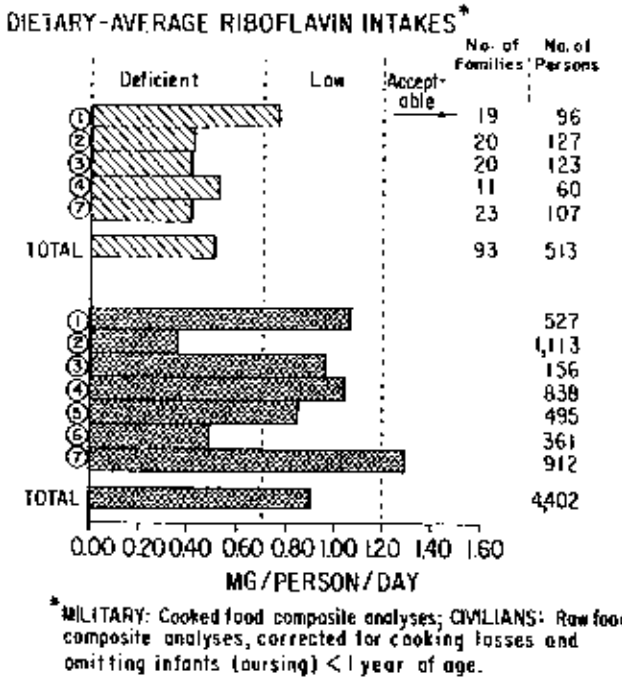
All of us who are students of nutrition in rice economy countries owe a great debt to Dr. Robert R. Williams not only for the isolation of crystalline thiamine with his colleagues in 1933, but for his recent text (30) entitled Toward the Conquest of Beriberi which gathers together in one volume the history of the development of our understanding of thiamine nutrition and clearly presents many of the questions remaining to be answered. There are a number of points brought out in this text which seem particularly pertinent to the situation in Thailand today. It is worth noting that as long ago as 1897, Vorderman (31), in a study of over a quarter of a million prisoners in Java and Madura, showed conclusively that beriberi could be prevented by the simple expedient of substituting undermilled for highly polished white rice - a practice fortunatelyadhered to in the Thai military services today. In all likelihood, the incidence of beriberi follows a seasonal pattern in many localities under the influence of a number of factors including the hard physical labor associated with the rice harvest season, possible deterioration of the thiamine content of rice on prolonged storage, and the utilization of purchased highly milled rice during the pre-harvest season when supplies of home-grown and possibly home-pounded rice run short. During the past few decades the disease has become more a disease of children (and pregnant women) and less one of adults, and there are many pitfalls in the diagnosis of infantile beriberi. For example, it is worth noting that McLaughlin and Andrews (32), as early as 1910 in Manila found that autopsies on 219 infants less than one year of age revealed the cause of death to be beriberi in 57 percent of cases, in spite of most of the deaths being ascribed clinically to "convulsions," congenital debility," "acute bronchitis," "enteritis," and "acute meningitis." Most authorities agree that the peak incidence of infantile beriberi occurs between the second and fourth months of life, and it is to be noted in Figure 8 that the peak of infant mortality in Thailand in 1957 occurred in the second month in sharp contrast to the situation in the U.S. where the peak occurs during the first week of life. A similar peak of infant mortality during the second and third months has been reported from Vietnam (33), where the ICNND Survey of 1959 (34), revealed considerable thiamine deficiency as measured biochemically and classical cases of beriberi in pregnant women in several hospitals. Another point worthy of mention is the possibility that thiaminases, particularly high in raw fish and raw fish products, may contribute to the incidence of beriberi among certain Asian peoples.

RIBOFLAVIN NUTRITION - THAILAND

OCTOBER - DECEMBER 1960







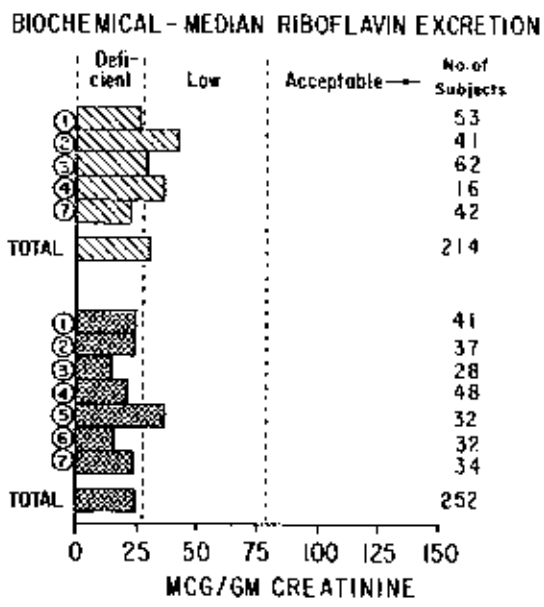


Figure 10.

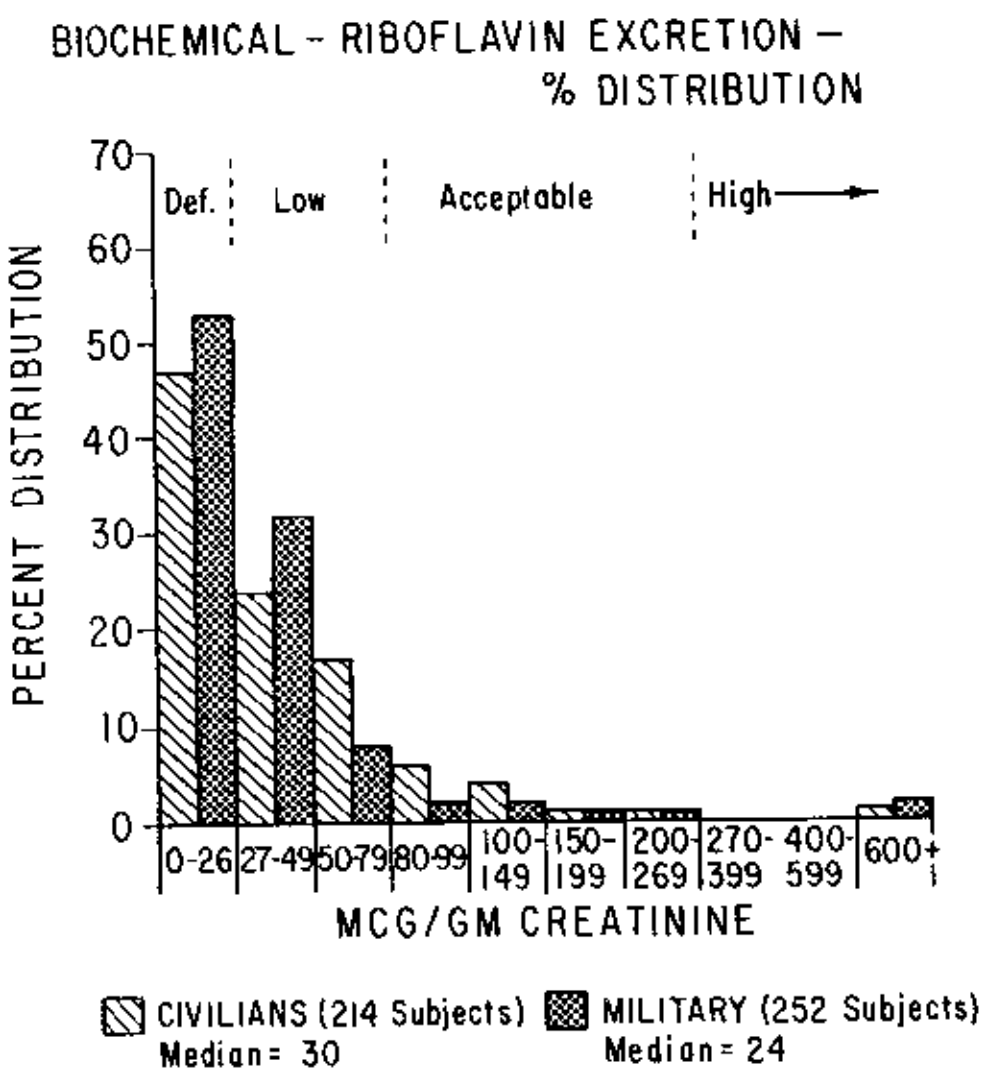


Figure 10 (continued).

B. RIBOFLAVIN NUTRITION

Angular lesions at the corners of the mouth have traditionally been associated with riboflavin deficiency. As illustrated in Figure 10, such lesions were commonly observed among both civilian and military groups in every area studied, the higher incidence areas being Chiengmai, Udorn, and Ubol. Rather rigid criteria were established for recording this lesion, so if anything, the prevalences recorded are conservative. On the other hand, angular scars and cheilosis were infrequently observed (see Tables 22-A and 29-A Among the military, angular lesions were much more prevalent in the younger men 21 to 24 years old (6.2 percent) compared with less than one percent for all older men (see Table 24-A); this was probably a reflection of the big difference between the younger enlisted men (average age of 21.6 years) with a prevalence of 6.4 percent compared with the NCO's (average age of 27.3 years) with a prevalence of 0.3 percent (see Table 28-A). Among the civilians, there was a definite peak of incidence exceeding 12 percent for both males and females five to nine years of age as outlined below (see Table 31-A):

TABLE 11. ANGULAR LESIONS AMONG THAI CIVILIANS IN TERMS OF AGE

Age (years)-->	0-4	5-9	10-14	15-44	45+
ANGULAR LESIONS		Percent Prevalence			
Males	3.0	12.2	10.7	6.3	2.3
Females, NPNL	4.5	12.4	4.4	4.3	3.5
Females, pregnant				6.0	
Females, lactating				4.2	

Although there was considerable variation from area to area in the prevalence of angular lesions, such variations do not correlate well with the dietary and biochemical findings, nor is any explanation readily apparent for the higher incidence in the five- to nine-year-old children.

As is true for so many individual nutrients in rice economy countries, the riboflavin situation in Thailand hinges on rice. It has repeatedly been shown in practically all Far Eastern countries where rice alone provides well over half of the total caloric intake that riboflavin intakes are low. Such is the case in Thailand. This is easy to comprehend when one considers that in this survey, 87 percent of total calories among the civilians (see Table 77-A) and 75 percent of total calories among the military (see Table 67-A) came from rice, and secondly, rice is a very poor source of riboflavin, whether milled or brown. For example, the large quantity of undermilled rice consumed by the Thai military (775 gms/day--see Table 59-A) provided only 27.5 percent of the total intake of riboflavin. The real problem concerning riboflavin is our ability to interpret what "low" intakes represent in terms of human health. Turning attention to riboflavin intakes in specific locations (Figure 10), all groups except the military in Songkhla were below "acceptable" levels. Although the military groups were higher in general than the civilians, it must be noted that one would expect values for civilians to be lower than military groups when the data are expressed in terms of mg/person/day since the civilian values represent the whole family, children included. The result of this interpretation of the intake data is that there is little real difference between these two major samples of the population.

The biochemical excretion data (Figure 10) allows one to compare more easily any group with another, be they military or civilian. Here we see that riboflavin excretion was very low indeed, regardless of group or area, the median excretion for all military groups being 24 mcg/gm creatinine and 30 mcg/gm among the civilians. Examination of the distribution of riboflavin excretion values revealed that only seven percent of the military and 12 percent of the civilians excreted amounts of riboflavin in excess of 79 mcg/gm creatinine, and that approximately one half of both groups excreted less than 27 mcg/gm. If angular lesions are related to riboflavin deficiency, it is rather odd that the children between the ages of 5 and 14 years of age had the highest riboflavin excretion values as outlined below (see Table 12):

TABLE 12. MEDIAN RIBOFLAVIN EXCRETIONS AMONG THAI CIVILIANS IN TERMS OF AGE

Age (years)-->	0-4	5-9	10-14	15-44	45+
MEDIAN RIBOFLAVIN EXCRETIONS		mcg/gm Creatinine			
Males	39	40	53	21	19
Females, NPNL	26	48	56	25	17
Females, pregnant				20	
Females, lactating				30	

Of 100 civilians with riboflavin excretions in the "deficient" range, 21 had no detectable riboflavin in the urine; of 134 military subjects in this range, 37 of these had no detectable riboflavin excretion (see Table 48-A). The biological significance of a complete absence of riboflavin in the urine is unknown. How long such a situation can be tolerated by the human being under various physiologic circumstances is a subject badly in need of serious study.

Further question as to the etiology of angular lesions is raised by comparing the riboflavin excretions of subjects with and without the lesion (see Table 13):

TABLE 13. RELATIONSHIP OF ANGULAR LESIONS TO RIBOFLAVIN EXCRETION AMONG THE THAI MILITARY AND CIVILIANS

RIBOFLAVIN EXCRETION	Angular Lesions			
	Military		Civilians	
	Present	Absent	Present	Absent
No. of Subjects	7	245	21	193
Median (mcg/gm C)	18	24	32	29

Similar results were obtained using 24-hour oral riboflavin load tests among groups of soldiers with and without angular lesions, in which the mean excretion of dose administered was 10.3 percent for those with lesions and 13.1 percent for those without lesions. These and other riboflavin load tests are further discussed in the section, Evaluation of Thiamine and Riboflavin Load Tests.

C. ANEMIA

Although filiform papillary atrophy of the tongue may be associated with a number of nutritional deficiency diseases, it is usually considered first in terms of various anemias, particularly simple iron deficiency anemia and iron deficiency anemia secondary to parasitic infestations. Modest incidences (<8 percent) of this lesion were observed among both military and civilian groups in each survey location (see Figure 11). Within the military, the only significant relationship seemed to be a higher incidence among enlisted men (2.7 percent) than NCO's (0.7 percent) (see Table 28-A). Among the civilians, the majority of such lingual lesions were seen among adult women--pregnant, lactating, or not--with an overall incidence of 10.3 percent among non-pregnant, non-lactating women and 10.6 percent among those pregnant or lactating, compared with prevalences of less than 2 percent in adult males and male or female children (see Table 29-A). When the findings were broken down in terms of ages (see Table 31-A), the maximum incidence group proved to be the women 45+ years of age with a prevalence of 16.5 percent.

Turning attention to iron intakes (see Figure 11), they exceeded 18 mg/person/day for every group studied, military or civilian. However, it must be recalled that it is well recognized that in many developing tropical countries an anemia which responds to iron therapy is widespread in spite of the fact that the dietary intake of iron is well above recommended levels (39). It also appears to be true that some anemias such as that of hookworm infestation clearly associated with considerable iron losses may not respond well to iron therapy because of digestive disturbances and impaired absorption (40). It certainly can be stated that the iron intakes are most satisfactory unless extenuating circumstances such as serious parasitic infestations are present. Unfortunately, the latter is common (see below).

As anticipated, anemia proved to be prevalent. Actually, the picture among the military (see Figure 11) was fairly good on the average with a mean value of 13.3 gms hemoglobin/100 ml, and only one group (Udorn-Army) had a mean value below 12 gms. However, this rather reasonable mean value tends to obscure the fact that an appreciable portion (12 percent) of the total group studied had hemoglobins below 10 gms/100 ml. Among the civilians, hemoglobin determinations revealed an appreciable--and similar--degree of anemia in every survey location, with a mean value for the entire group of 11.6 gms. In this case, 22 percent had hemoglobins below 10 gms/100 ml, ranging down to cases with less than 4 gms who were, in addition, clinically ill. Unfortunately, hemolysis was so frequently encountered in blood samples during the survey (see Biochemical Appendix discussion) that attempts to define the anemia as normochromic or hypochromic were unsuccessful (see Figure 6-A).

A number of biochemical determinations were tabulated against the presence or absence of filiform papillary atrophy, but the number of cases with the lesion was small and no relationships were found. Several examples are presented below (see also Table 49-A).

TABLE 14. RELATIONSHIP OF FILIFORM PAPILLARY ATROPHY TO A NUMBER OF BIOCHEMICAL DETERMINATIONS 1/

	(Filiform Papillary Atrophy (all grades combined)							
	Military				Civilians			
	Present		Absent		Present		Absent	
Hemoglobin: Mean (gms/100 ml)	13.4	(9)	13.2	(243)	10.8	(10)	11.7	(199)
Riboflavin excretion: Median (mcg/gm C)	38	(9)	23	(243)	14	(9)	30	(205)
Thiamine excretion: Median (mcg/gm C)	188	(9)	204	(244)	131	(10)	68	(205)

1/ numbers in parentheses represent numbers of subjects.

Despite the absence of correlations above, it was found that the sex and age group with the lowest mean hemoglobin was the group of women 45+ years of age (9.8 gms, compared with 11.4 gms for NPNL women 15-44 years of age) (see Table 45-A), the same group with the highest incidence of filiform papillary atrophy. The pregnant and lactating women tended to have hemoglobins only slightly lower than the NPNL women (10.4, 10.2, and 10.8 gms/100 ml respectively) (see Table 47-A).

Parasitological infestations and other chronic infectious diseases are of primary concern in ascertaining the etiology of observed anemia. In spite of concerted efforts--and much progress--to bring malaria, tuberculosis, and enteric infections under control in Thailand in recent years, the Division of Vital Statistics for 1957 reported 11,133 deaths from respiratory tuberculosis, 10,458 deaths from malaria, and 1,556 deaths from typhoid and paratyphoid fevers. During the course of the present survey, 318 stools were examined by smear and culture in the SEATO Laboratory at the Army Institute of Pathology, Bangkok. The major parasites and enteric pathogens discovered are tabulated in Table 15 (with a more detailed breakdown in the Parasitology Appendix). Amoebae, round worm, hookworm, and liver flukes were all observed with appreciable frequencies, and generally speaking, the results were similar to the very extensive survey done in 1951-55 (see Table 86-A). Liver flukes were confined to the areas where previously recognized, several cases of typhoid carriers were uncovered among the military in Chiengmai, and it was of interest to find several instances of Salmonella panama confined to the Ubol study. Many subjects were infested with more than one parasite (see Tables 83-A and 84-A) and no significant differences were found between military and civilian groups. Less than 10 percent of both military and civilian groups were completely free of parasites or enteric pathogens.

TABLE 15. MAJOR PARASITOLOGICAL FINDINGS AMONG THE THAI MILITARY AND CIVILIANS BY GENERAL AREAS[1/]

General Area		Bangkok	Songkhla	Chiengmai	Udorn	Ubol	Lopburi	Sattaheep	TOTAL
No. of stools examined	Mil.	30	31	14	33	27	37	30	202
	Civ.	0	17	29	32	27	11	0	116
FECAL ORGANISMS					Percent infested				
Entamoeba histolytica (amoebiasis)	Mil.	-	9.7	21.4	12.1	7.4	10.8	16.7	10.4
	Civ.		5.9	13.8	12.5	11.1	18.2		12.1
Ascaris lumbricoides (round worm)	Mil.	10.0	29.0	28.6	36.4	40.7	32.4	26.7	29.2
	Civ.		17.6	44.8	28.1	25.9	36.4		31.0
Ancylostoma duodenale (hookworm)	Mil.	16.7	35.5	14.3	12.1	14.8	16.2	10.0	17.3
	Civ.		41.2	13.8	25.0	22.2	9.1		22.4
Opisthorchis viverrini (liver fluke)	Mil.	-	-	-	9.1	3.7	2.7	-	2.5
	Civ.		-	-	12.5	14.8	-		6.9
Salmonella typhi (typhoid fever)	Mil.	-	-	14.3	-	-	-	-	1.0
	Civ.		-	-	-	-	-		-
Salmonella panama	Mil.	-	-	-	-	-	-	-	-
	Civ.		-	-	-	11.1	-		2.6
No parasites or salmonella	Mil.	30.0	6.4	14.3	6.1	3.7	10.8	-	9.9
	Civ.		11.8	10.3	-	3.7	9.1		6.0

1/ See Tables 83-A, 84-A, 85-A, and 86-A for further details.

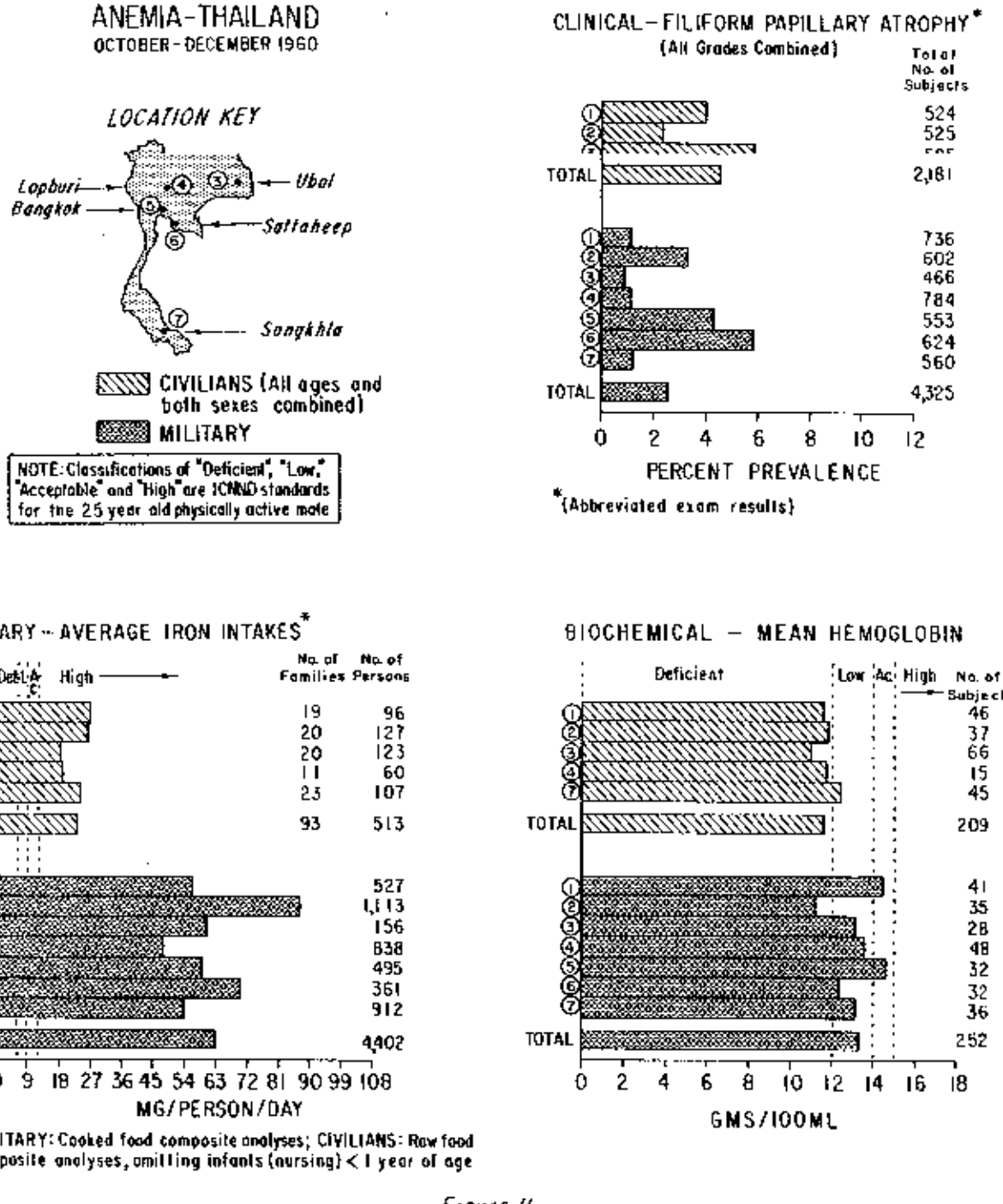
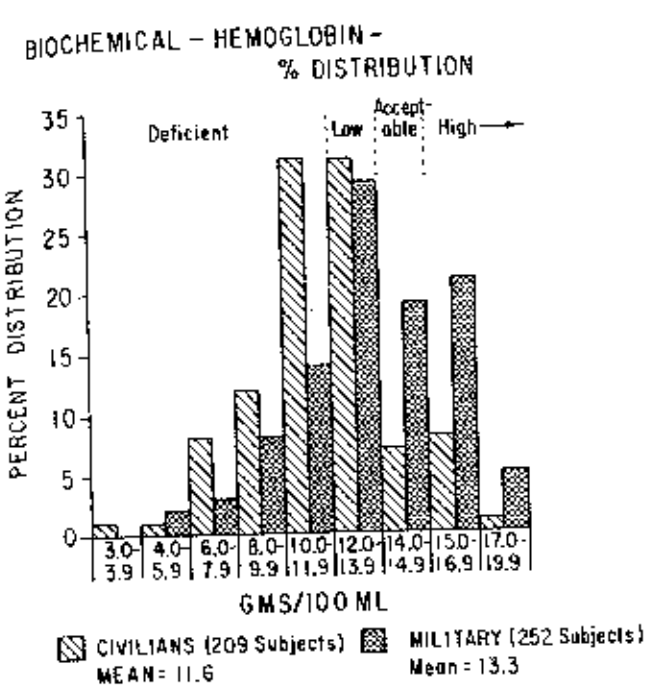
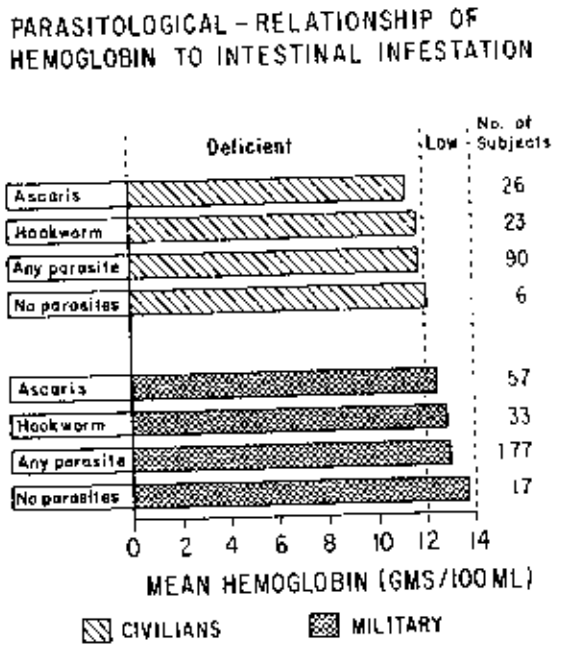
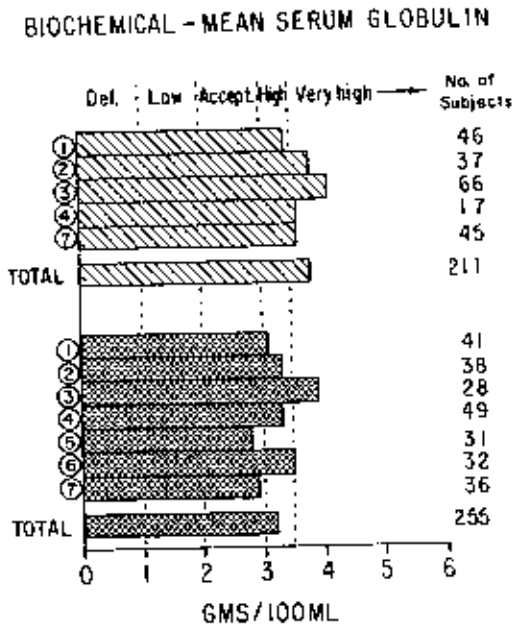

ANEMIA-THAILAND
OCTOBER-DECEMBER 1960
LOCATION KEY
Lopburi
Bangkok
Ubol
Sattaheep
Songkhla
CIVILIANS (All ages and both sexes combined)
MILITARY
NOTE: Classifications of "Deficient", "Low," "Acceptable" and "High" are ICNND standards for the 25 year old physically active male
CLINICAL - FILIFORM PAPILLARY ATROPHY*
(All Grades Combined)
Total No. of Subjects
524
525
2,181
736
602
466
784
553
624
560
4,325
TOTAL
TOTAL
0 2 4 6 8 10 12
PERCENT PREVALENCE
*(Abbreviated exam results)
DIETARY - AVERAGE IRON INTAKES*
Def. Low Ac. High
No. of Families
No. of Persons
19 96
20 127
20 123
11 60
25 107
93 513
527
1,113
156
838
495
361
912
4402
TOTAL
TOTAL
0 9 18 27 36 45 54 63 72 81 90 99 108
MG/PERSON/DAY
*MILITARY: Cooked food composite analyses; CIVILIANS: Raw food composite analyses, omitting infants (nursing) < 1 year of age
BIOCHEMICAL - MEAN HEMOGLOBIN
Deficient
Low
Ac.
High
No. of Subjects
46
37
66
15
45
209
41
35
28
48
32
32
36
252
TOTAL
TOTAL
0 2 4 6 8 10 12 14 16 18
GMS/100ML

Figure II.







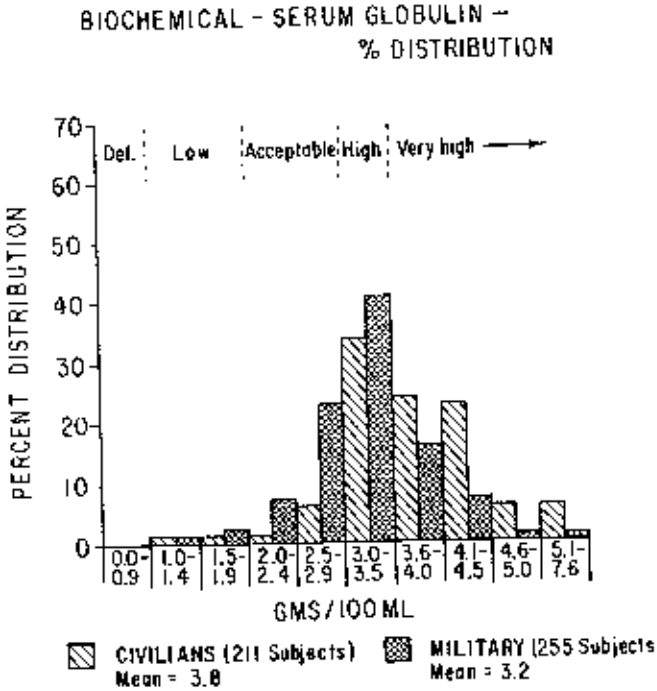


Figure 11 (continued).

Although the total numbers of subjects studied parasitologically were small, a relationship with degrees of anemia seemed to exist (see Figure 11) of a small order of magnitude. There was approximately a 1 gm/100 ml difference between those with Ascaris infestation and those with no parasites; hookworm-infested subjects; and subjects with any parasite (including "non-pathogens" such as Entamoeba coli) were intermediate.

The total serum proteins of this survey were extremely high (see Figure 6-A). This proved to be due to the combination of normal serum albumins and high serum globulins (see Figure 11), the latter reaching extraordinary values as high as 7.6 gms globulin/100 ml. The albumin/globulin ratio, usually employed more as a guide to albumin status, becomes almost meaningless under the circumstances found in Thailand. All but one civilian group (the Chiengmai villages) had mean globulin values in excess of 3.5 gms/100 ml, which clearly represents hyperglobulinemia. The values among the military were somewhat lower, but the majority were in excess of 3.0 gms/100 ml. When the globulin data were analysed in terms of various age and sex groups (see Table 45-A), the only point of interest was that the females tended to have slightly higher values than males for all age groupings. It seems reasonable to presume that these high serum globulins are largely due to the high incidence of intestinal and other parasitic diseases including malaria. Nutritionally speaking, the major lesson to be learned is that total serum protein determinations without accompanying serum albumin analyses are extremely misleading.

Interpretation of anemia in Thailand is further complicated by the presence of hemoglobin E disease, and evidence of several other abnormal hemoglobins (e.g., hemoglobin D and H).

Anemia might be said to be "traditional" in Southeast Asia. Practically every report on nutritional status in this part of the world makes reference to the presence of anemia to one degree or the other. This present survey substantiates the presence of anemia of moderate degree in Thailand, but barely scratches the surface in ascertaining the basic etiologies of the anemias. Of all the nutritional and related problems encountered in Southeast Asia, anemias are undoubtedly the most complex. In addition to the "more usual" anemias encountered in the Western countries such as the U.S., e.g., the anemias of malignancies, chronic infections, renal disease, pernicious anemia, sickle cell anemia, etc., one is confronted with a vast list of other potential causes in tropical countries, such as the numerous intestinal parasitic diseases, malaria, liver flukes, schistosomiasis, hemoglobinopathies, etc., superimposed upon all of which is the question of iron intakes (36, 37). Of course, none of this is new, it having been recognized for a long time that anemias in the tropical developing countries presented major public health problems (38, 39).

D. IODINE NUTRITION

An evaluation of thyroid enlargement, i.e., goiter, is part of both the abbreviated and detailed clinical examinations. Contrary to previous ICNND practice, the Thailand Survey Group not only recorded thyroid enlargement but graded the degree of increase in size on the basis of the WHO classification of goiter (41) (see Clinical Appendix for definition of these classification criteria).

The prevalence of goiter among the 4,325 military personnel who received the abbreviated examination is shown in Table 16 below (see tables in Clinical Appendix for further details).

TABLE 16. PREVALENCE OF GOITER IN MILITARY PERSONNEL - ABBREVIATED EXAMINATIONS

Service	Location	Total Number Examined	Goiter		
			Total Number	Percent Prevalence	
				Grade I	Grade II
Army	Bangkok	553	7	1/	1.3
	Songkhla	560	0	1/	-
	Chiengmai	736	24	1/	3.3
	Udorn	602	85	13.0	1.2
	Ubol	466	108	20.2	3.0
Air Force	Lopburi	784	74	8.2	1.3
Navy	Sattaheep	624	134	18.1	3.3
COMBINED MILITARY SERVICES		4,325	432	14.1 2/	1.9

1/ Grade I goiter not examined for

2/ 14.1 percent of total examined for Grade I goiter (2,476 subjects)

No, or only insignificant, thyroid enlargement was found in Bangkok troops or those in the Songkhla area. However, elsewhere the prevalence was increased, ranging as high as 23.2 percent in Ubol Province. Although most of the thyroid enlargement was classified as Grade I, 81 out of 432 goiters (18.8 percent) were large enough to be categorized as Grade II. It may be of interest to mention that "goiter" is not a cause per se for rejection of enlisted personnel into the Royal Thai Military Services, but it is taken into consideration in classifying men for call-up priority. "Goiter" is cause of ineligibility for NCO candidate training.

The prevalence of goiter in male and female children and civilian adults who received the abbreviated physical examination is shown in Table 17. (See tables in Clinical Appendix for further details.) As has been observed by others, the prevalence of goiter is greater in females than males.

TABLE 17. PREVALENCE OF GOITER AMONG CIVILIANS - ALL TYPES - ABBREVIATED EXAMINATIONS

Location	Ages 0 - 14 years				Ages 15+ years			
	M		F		M		F	
	No.	%	No.	%	No.	%	No.	%
Songkhla	81	0	90	0	94	0	116	2
Chiengmai	114	28	111	33	136	21	163	58
Lopburi	41	2	33	6	34	12	58	43
Udorn	215	4	231	11	129	10	158	30
Ubol	136	40	147	75	127	48	145	72

Table 18 presents data derived from examinations of the thyroid by one observer on 2,479 female and male school children, aged 7 to 18 years. The areas studied coincided with those of the general nutrition survey plus visits to the Province of Chiengrai northeast of Chiengmai and to the Province of Prae southeast of Chiengmai (both still in the northwestern region). These groups furnished the samples which were used for special studies of radioiodine uptake and stable iodine excretion. It will be noted that goiter was virtually non-existent in Songkhla Province (and Haadyai town) where uptakes and excretion ratios were found to be normal. On the other hand, in the other areas the incidence of goiter was higher. The children in these schools presented metabolic evidence of iodine malnutrition (Tables 20 and 21).

TABLE 18. PREVALENCE OF GOITER IN THAI SCHOOL CHILDREN

School Location	Number Examined	Age	Sex	Thyroid Status 1/			
				N	I	II	III
Bang Dan	74	7-12	M	74	-	-	-
Songkhla Prov.	76	7-12	F	76	-	-	-
Lomboonkulganya Haadyai, Songkhla Prov.	251	14-16	F	249	2(.8%)	-	-
Thidanukhro Haadyai, Songkhla Prov.	150	14-16	F	144	6(4%)	-	-
Dara Academy Chiengmai City	521	10-16	F	426	95(18%)	-	-
Prince Royal College	121	16-18	M	103	18(15%)	-	-
Chiengmai City	99	16-18	F	71	28(28%)	-	-
Bang Dong School	35	10-16	M	32	3(9%)	-	-
Chiengmai Prov.	32	10-16	F	27	5(16%)	-	-
Mae Thai	37	10-15	M	28	9(25%)	-	-
Chiengmai Prov.	30	10-15	F	24	16(53%)	-	-
Ban Sam Gong	57	7-14	M	22	34(60%)	1(2%)	-
Chiengrai Prov.	43	7-14	F	5	35(81%)	3(7%)	
Rachinutis High School Udorn City	388	11-17	F	220	168(43%)	-	-
Naree-Noo-Kul Ubol City	565	10-15		383	182(32%)	-	-

1/ N-Normal; I, II, III - grades of enlargement by WHO criteria

Since previous studies by others had indicated that goiter would be observed in Thailand, plans were made to study iodine metabolism in selected segments of the population. In brief, (see Iodine Nutrition Appendix for details) military males and

civilian school girls were given small amounts of radioactive iodine (I^{131}), and the uptake of this dose by the thyroid gland was determined after 24 hours had elapsed. Casual urine samples were collected at this time. These were analyzed for stable iodine (I^{127}), the amount being expressed in terms of creatinine content of the sample.

Studies of I^{131} uptakes were carried out on 135 school girls at 12 different locations and on 69 army personnel at five locations. Determinations of iodine in the urine were performed on 117 school girls and 46 army personnel. The decrease in numbers is due to insufficient volumes, breakage, or loss from other causes.

Radioiodine uptakes among the Thai military are shown in Figure 12. Values for stable iodine excretion are found in Table 19. The mean radioiodine uptake values in three sites (Songkhla, Bangkok, and Ubol) were below 50 percent, which is considered the upper limit of normal. At Chiengmai and Udorn the mean values were almost 60 percent. The ranges of values in the military tended to have a greater spread than those in the civilian groups. With one exception, i.e., Songkhla Province, when the mean uptake values were below 50 percent, the mean iodine excretion was above 50 mcg per gm of creatinine (Bangkok and Ubol); so, too, at Chiengmai where the mean uptake was above 50 percent the excretion ratio was below 50. The reason, if any, for the low urinary iodine values at Songkhla is not clear. For comparison with these Thai military groups, the excretion of stable iodine per gm of creatinine was determined in a group of U.S. military males stationed in Washington, D.C. (Table 19). The mean of this sample is 179.5 mcg iodine per gm of creatinine.

TABLE 19. I^{131} UPTAKE AND I^{127} EXCRETION AMONG THE THAI MILITARY

SITE	Percent I^{131} Uptake			Mcg I^{127} in Urine per gm Creatinine			
Province Area	No. of Subjects	Mean	S.D.	No. of Subjects	Mean	S.D.	Mean I^{131} Uptake for this Group
Songkhla	15	36	±7.1	15	38	±6.5	36.0
Bangkok	12	48	±8.9	8	55	±32.5	47.4
Chiengmai	14	58	±14.5	11	29	±13.8	57.3
Ubol	13	46	±11.5	12	78	±29.9	47.5
Udorn	15	59	±7.2	-	-	-	-
Washington, D.C.	-	-	-	15	179.5	±57.7	-

The data on the 24-hour radioactive iodine uptake by the thyroid glands of samples of school girls in 12 sites in the six provinces which were visited are presented as histograms in Figure 13. The means and standard deviations are presented in Table 20. Mean values below 50 percent were observed at three sites: both groups in Songkhla Province and at the Udorn town school. All the rest had mean uptakes above 50 percent, which, of course, indicate an increased affinity of the thyroid gland for administered iodide. The normal mean for radioactive iodine uptake should fall within the range of 30 to 45 percent.

In Table 21 are found mean values among the school girls for urinary concentration of stable iodine expressed as mcg per gm of creatinine. It will be noted that in only three areas, the same mentioned above, are values above 50 mcg iodine per gm creatinine. Included here are values for 19 school girls from a parochial school in Washington, D.C.; the mean value is 123.5 and none had values below 50 mcg iodine per gm creatinine. Also in Table 21 will be found the distribution of values of iodine excretion in all subjects.

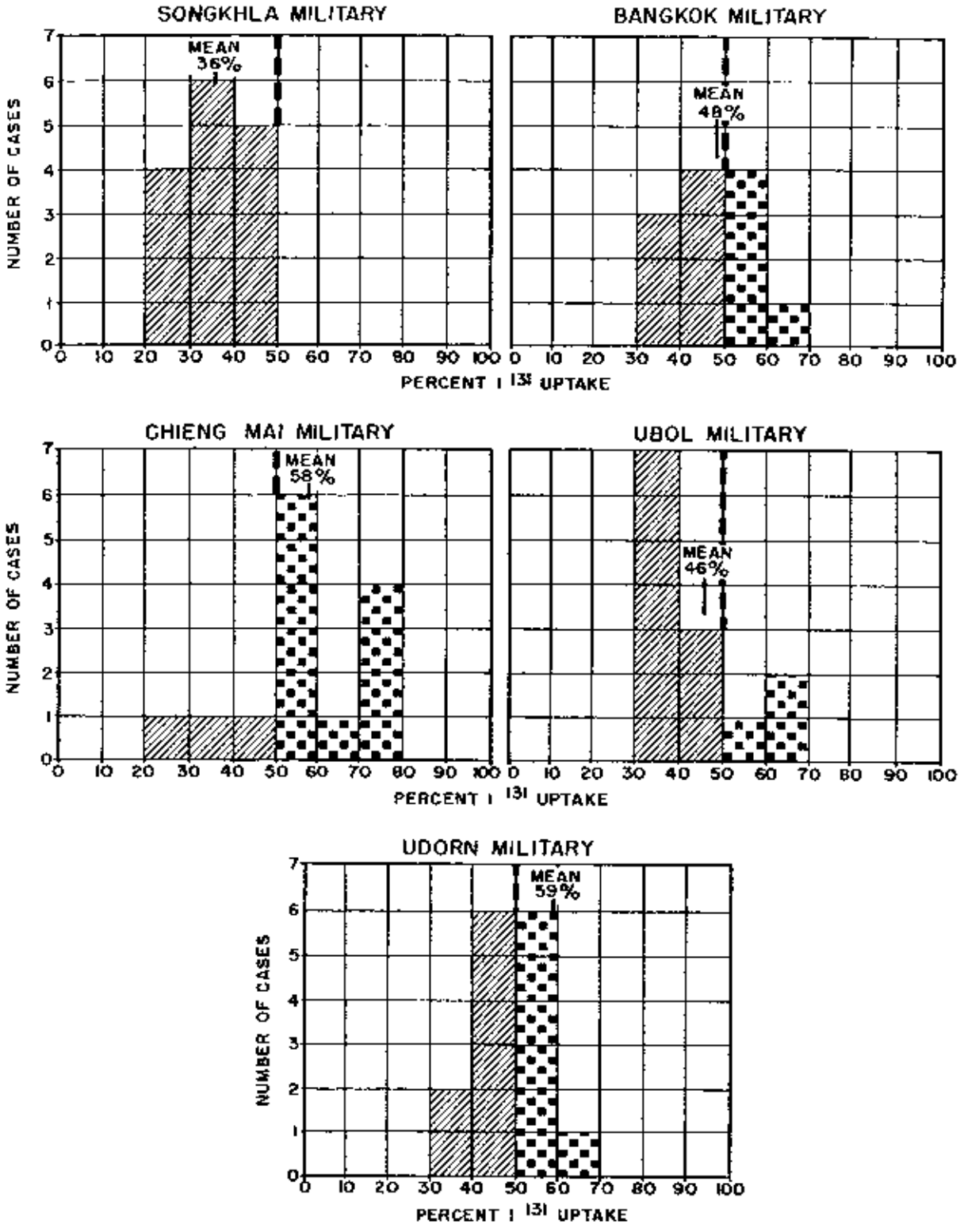


Figure 12. I^{131} Uptakes among the Thai Military.

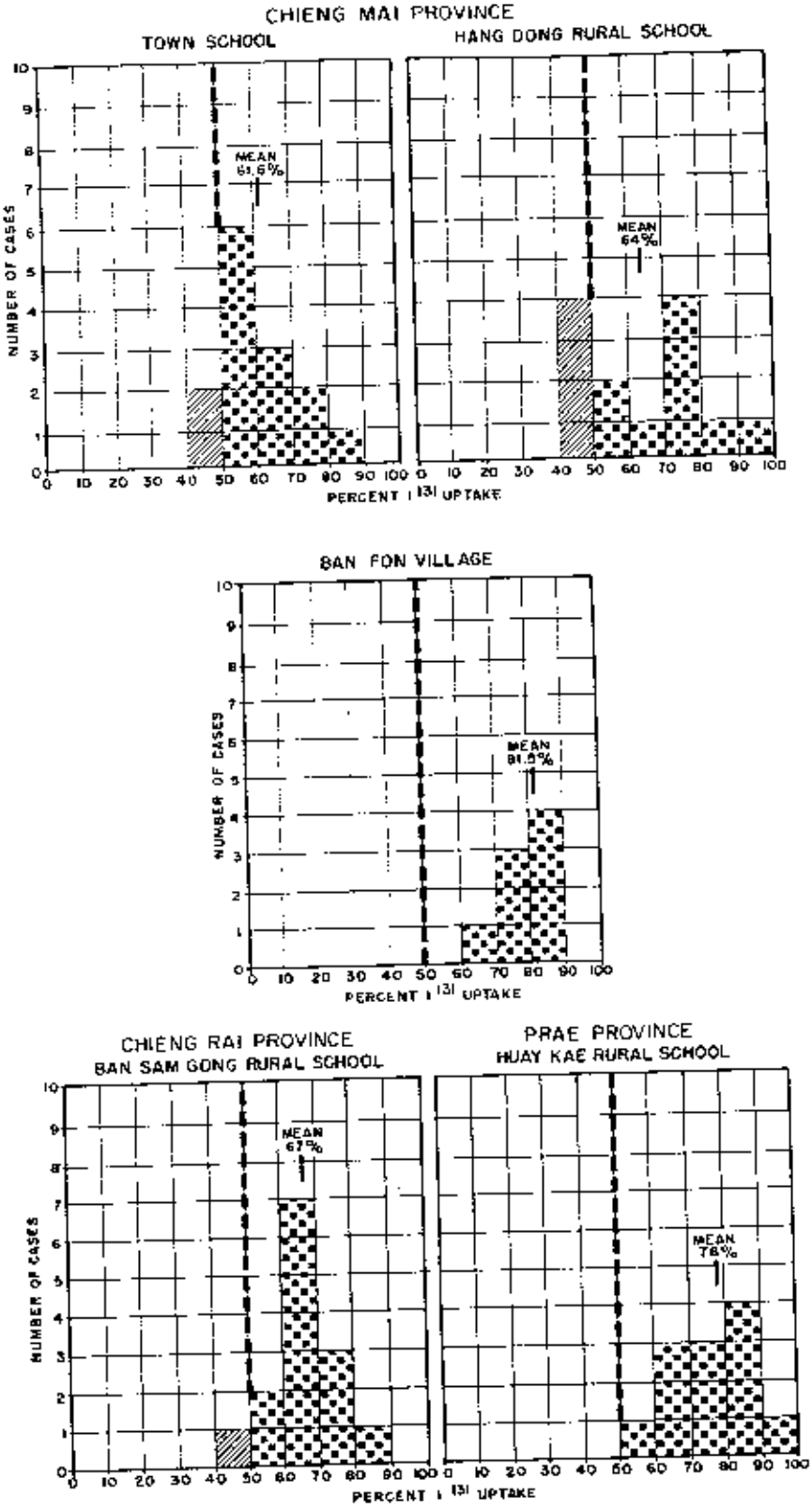
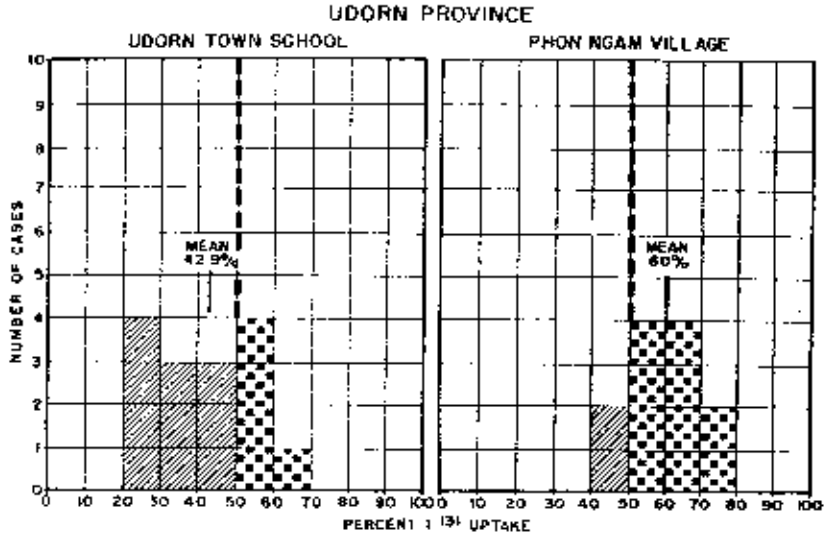
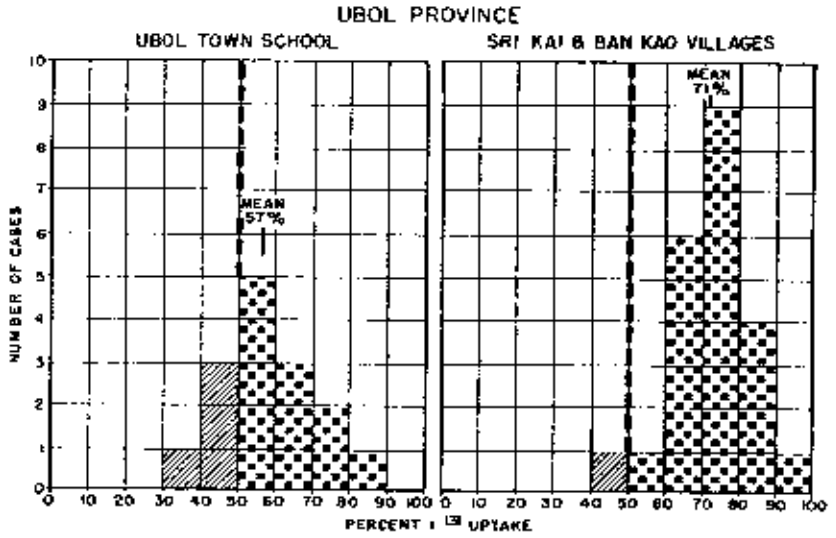


Figure 13. I^{131} Uptakes among 135 Thai School Girls.





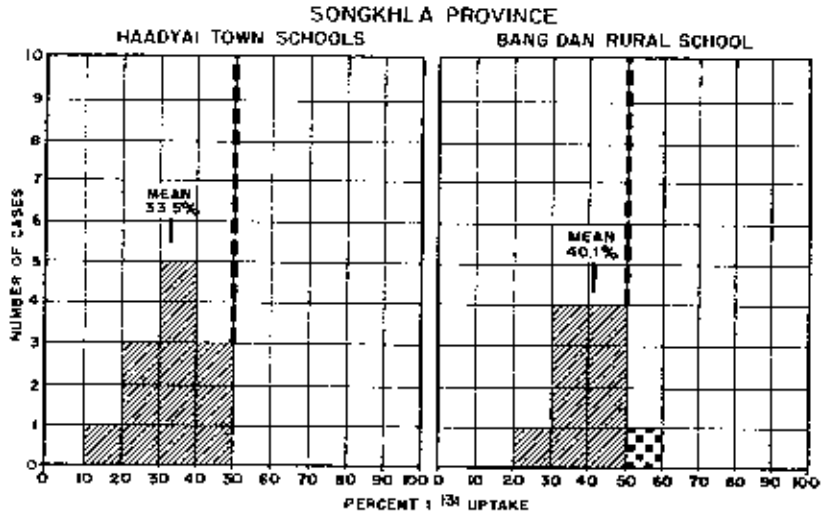


Figure 13 (continued).

TABLE 20. I^{131} UPTAKE AND I^{127} EXCRETION AMONG THAI CIVILIAN FEMALES 7-18 YEARS OF AGE

Province Area	Percent I^{131} Uptake: No. of Subjects	Mean	S.D. (±)	Mcg I^{127} in Urine per gm Creatinine: No. of Subjects	Mean	S.D. (±)	Mean I^{131} Uptake for this Group
Songkhla Prov.							
Bang Dan	10	40.1	6.7	8	74.5	19.9	39.4
Haadyai	12	33.5	8.2	9	70.3	20.5	33.4
Chiengmai Prov.							
Chiengmai	14	61.6	9.3	11	29.0	5.6	63.1
Hang Dong	13	63.9	17.7	13	38.2	22.5	63.9
Ban Fon	8	81.5	6.2	8	15.0	12.3	81.5
Chiengrai Prov.							
Ban Sam Gong	14	66.6	9.9	12	31.2	24.5	67.7
Prae Prov.							
Huay Kae	12	78.0	10.8	11	14.5	8.0	77.9
Udorn Prov.							
Udorn	15	41.9	11.6	13	58.7	29.5	41.8
Phon Ngam	12	59.7	9.5	10	40.5	19.5	61.6
Ubol Prov.							
Ubol	15	57.4	14.0	12	36.4	18.5	56.7
Sri Kai and Ban Kao	10	76.9	9.5	10	17.4	6	76.9

TABLE 21. MEANS AND DISTRIBUTION OF VALUES OF URINE I^{127} CONCENTRATION AMONG THAI CIVILIAN FEMALES 7-18 YEARS OF AGE

Province Area	No. Cases	Urine Concentration I^{127} per gm Creatinine: 0-50	51-100	101-150	151-200	201-250	251-300	301-350	351-400	Mean	S.D. (±)
Songkhla Prov.											
Bang Dan	8	2	6	-	-	-	-	-	-	74.5	19.9
Haadyai	9	1	8	-	-	-	-	-	-	70.3	16.5
Chiengmai Prov.											
Chiengmai	11	11	-	-	-	-	-	-	-	38.9	18.6
Hang Dong	13	9	4	-	-	-	-	-	-	38.2	16.1
Ban Fon	8	8	-	-	-	-	-	-	-	16.6	14.6
Chiengrai Prov.											
Ban Sam Gong	12	10	2	-	-	-	-	-	-	31.2	14.3
Prae Prov.											
Huay Kae	11	11	-	-	-	-	-	-	-	14.5	8.0
Udorn Prov.											
Udorn	12	5	7	-	-	-	-	-	-	58.7	15.8
Phon Ngam	10	9	1							38.0	13.5
Ubol Prov.											
Ubol	12	10	2	-	-	-	-	-	-	36.4	15.3
Sri Kai and Ban Kao	10	10	-	-	-	-	-	-	-	20.4	13.3
U.S.A.											
Wash., D.C. School	19	-	3	6	4	3	1	1	1	123.5	27.7

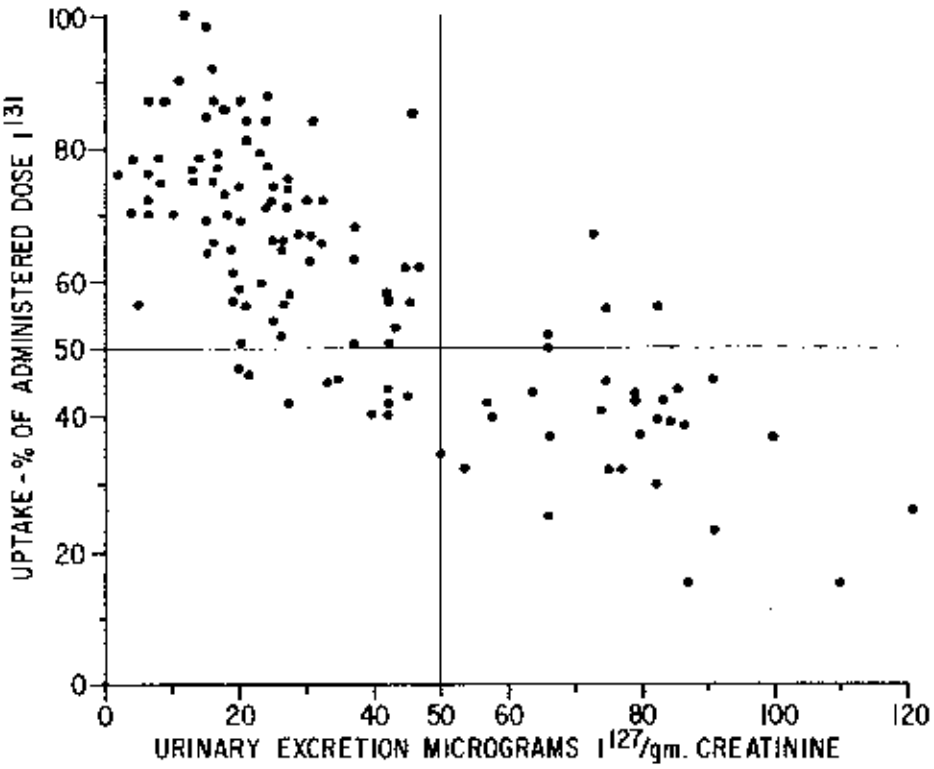


Figure 14. Scattergram of the Relationship of I^{131} Uptake to I^{127} Excretion in Thai School Girls.

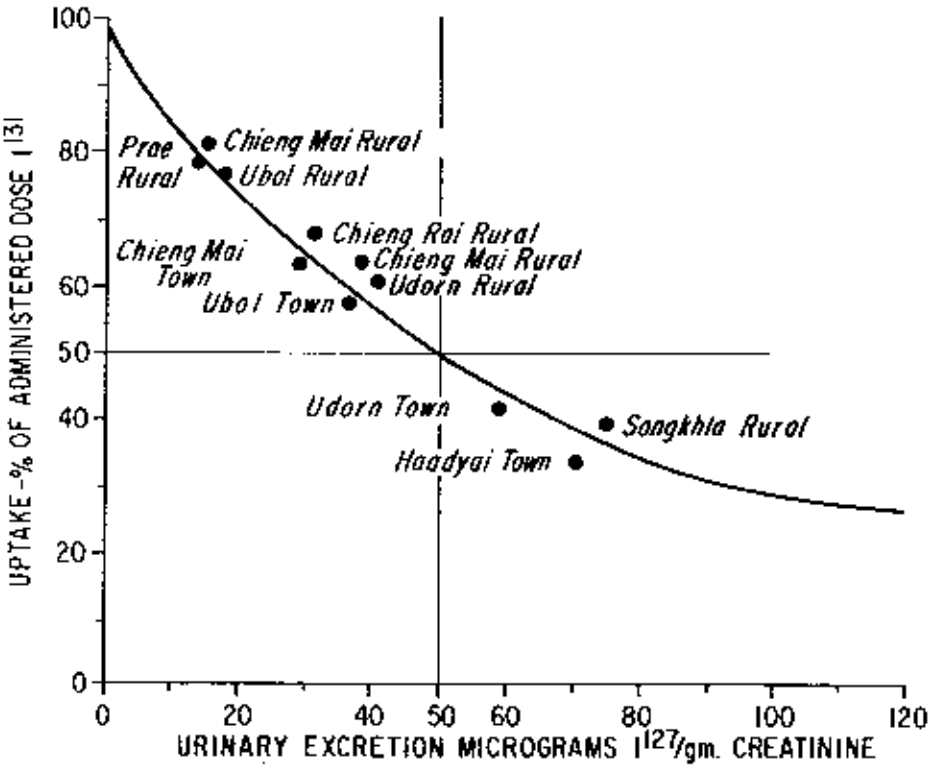


Figure 15. The Relationship of Means I^{131} Uptake to I^{127} Excretion in Thai School Girls in Various Areas of the Country.

Figure 14 is a scattergram of all of these data with percentage uptake of radioactive iodine as the vertical axis and urinary excretion of iodine as the horizontal axis.

The regression curvilinear shown in Figure 15 was developed from the formula: $y=a-bx+cx^2$. The values for a, b, and c were developed from the raw data of uptake and excretion of iodine. The formula thus derived is as follows: $y=94.6949 - 1.119725x + .004588\ x^2$.

For some years the medical profession of Thailand has been aware that goiter was highly prevalent in the northwestern provinces and to a lesser degree in the northeastern areas of the country. During the years 1937-1951, Sem Pring-puang-geo (42) made extensive clinical studies, particularly in Chiengrai Province, and delineated a "goiter belt," extending from Burma through the northern provinces of Thailand, over to the northeastern areas, and on into Laos. In 1956 Dr. V. Ramalingaswami was invited by the World Health Organization (WHO) to survey certain areas in Thailand with a view to intensifying activity in the fields of beriberi and goiter control. Ramalingaswami (43) surveyed school children and adults in the provinces of Chiengmai, Chiengrai, Ubol and Udorn, where the incidence of goiter was found to be 58, 58, 21 and 15 percent, respectively. This initial survey prompted WHO to establish a program under the direction of Dr. J. V. Klerks (44), who extended the scope of the goiter studies to three other northern provinces: Prae, Uttaradit and Lampang. In each of these areas the prevalence of goiter in school girls was above 40 percent. During the past few years, Suwarik, Nondhasuta and Nondhasuta (45) have made valuable studies of the metabolism of iodine in goitrous subjects in Prae province. Uptake of radioactive iodine was found to be increased, while 24-hour excretion of stable iodine was lower than normal.

These studies as well as clinical and biochemical data obtained by this survey clearly indicate that iodine malnutrition is a serious problem in Thailand. There is little doubt that dietary intake of iodine, as judged by urinary excretion is low. There is thus no evidence for the presence of any goitrogen.

It is apparent that natural sources of iodine, i.e., foods, both plant and animal, salt, and water, are inadequate to supply the normal amounts of this element in the diet. Natural foodstuffs which may be expected to supply sufficient iodine, i.e., seafoods, dairy products, and iodine-containing salt, are not at present available in the north and eastern sections of the country which were surveyed. Furthermore, progress in food diversification is inherently a slow gradual process, intimately related to the economic status of villagers. Hence some artificial means must be found to provide iodine to those segments of the population which suffer from iodine malnutrition, particularly the critical groups: children and childbearing females. There would appear to be two ways to accomplish this: (1) iodization of salt or (2) parenteral via administration of potassium iodide (or iodate) by mouth. In view of the current economic status of the rural populations, it seems unlikely that success in artificial supplementation programs would be possible without maximum governmental support.

The salt consumed in Thailand is derived from two sources: evaporation of sea water on the coast and "salt springs" which are prevalent in the northeastern and eastern provinces. The quantity of salt which is furnished by the "salt springs" is unknown. The following figures represent shipments of crude salt from more than 20 producers on the seacoast through Bangkok during the year 1958.

TABLE 22. SHIPMENT DISTRIBUTION OF SALT THROUGH BANGKOK, 1958

To the north - Regions I, V and VI	15,171 tons
To the northeast - Regions III and IV	14,445 tons
To the east - Region II	819 tons
To the south - Regions VII, VIII and IX	527 tons
Total	30,962 tons

All of the salt that arrives in Bangkok is stored in about 20 warehouses and is reshipped from one area to various parts of the country. Machinery for iodizing all salt shipped from Bangkok could be set up in one place without difficulty. There is no national salt monopoly in Thailand.

E. PROTEIN NUTRITION

The question which arises is what is the national situation concerning protein nutrition in general terms. The present survey sheds some light on this. No clinical evidence of protein malnutrition was observed during the course of the survey. The mean protein intakes (see Figure 16) as determined by chemical analyses of food composites and expressed in terms of gms per kg of body weight revealed that "acceptable" levels in excess of one gm per kg were attained in every group studied, both military and civilian. When the data are examined in terms of total intakes per person per day, one finds among the civilians (see Table 71-A) that values ranged from 39 gms to 56 gms with a "national" mean of 47 gms; with a mean body weight of 32 kg for all ages and sexes combined, it is apparent that one gm per kg was always exceeded. Among the military (with a mean body weight of 55 kg), the total intakes ranged from 59 to 150 gms per man per day, again universally exceeding one gm per kg (see Table 56-A).

Concerning the 465 determinations of serum albumin done during the survey (see Figure 16), each group studied--both civilian and military--attained mean values in the "acceptable" range, i.e., values of 3.4 gms/100 ml or higher. When the distribution of values is examined, it is seen that no determinations fell below 2.4 gms/100 ml. Unfortunately, only three determinations were done in children less than five years of age (mean value of 3.5 gms/100 ml). For the age groups over four years of age, no significant differences were observed (see Table 45-A). One point of interest was the somewhat higher mean serum albumin level among the military, compared with civilian groups, as outlined in Table 23.

TABLE 23. MEAN SERUM ALBUMIN LEVELS AND PERCENT IN THE "LOW" RANGE AMONG THE THAI MILITARY AND MAJOR CIVILIAN AGE AND SEX GROUPS

	Males			Females			
	Civilians		Combined Military Services	NPNL		Pregnant	Lactating
Age (years) --->	<15	15+		<15	15+	15+	15+
SERUM ALBUMIN							
No. of subjects	27	70	255	38	51	9	28
Mean (gms/100 ml)	3.6	3.7	4.1	3.5	3.7	3.1	3.7
Percent "low"	40.7	17.1	2.7	36.8	21.6	88.9	32.1

Total serum proteins and the high serum globulins encountered are considered in the chapter on anemia.

There currently seems to be a good deal of controversy as to the biological value of the protein in the diet in such countries as Thailand and Vietnam where the total protein intakes seem satisfactory but a large proportion of the total protein intake is of vegetable origin, principally rice. In the present survey, among both military and civilian groups, approximately one third of the protein intake was derived from animal sources (see Tables 55-A and 70-A), and within the military approximately 58 percent of the total intake came from rice alone (see Table 67-A). It should be recalled that rice protein compares favorably in its amino acid composition with a number of other major protein sources, both vegetable and animal (see Table 8-A). Rice protein handsomely exceeds wheat protein in its contents of isoleucine, leucine, lysine, tyrosine, threonine, valine, and methionine, and it closely approximates fish protein except for the superior lysine content of the latter (549 mg/gm versus 236 mg/gm for rice). All intake data considered, it appears that the general protein intake picture for the population at large in Thailand

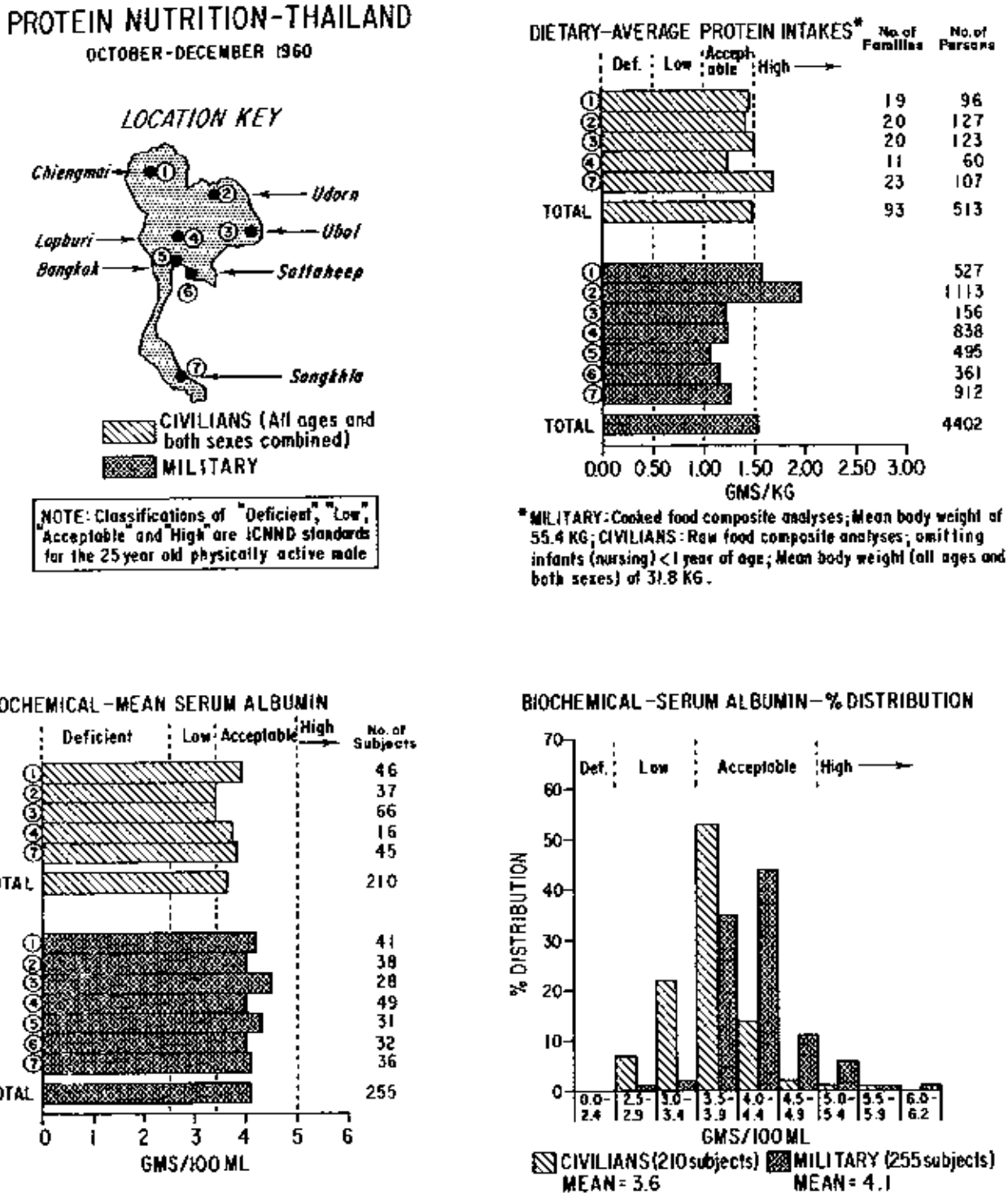

PROTEIN NUTRITION-THAILAND
OCTOBER-DECEMBER 1960
LOCATION KEY
Chiengmai
Udorn
Ubol
Lopburi
Bangkok
Sattaheep
Songkhla
CIVILIANS (All ages and both sexes combined)
MILITARY
NOTE: Classifications of "Deficient", "Low", "Acceptable" and "High" are ICNND standards for the 25 year old physically active male
DIETARY-AVERAGE PROTEIN INTAKES*
No. of Families
No. of Persons
Def.
Low
Acceptable
High
19 96
20 127
20 123
11 60
23 107
TOTAL 93 513
527
1113
156
838
495
361
912
TOTAL 4402
0.00 0.50 1.00 1.50 2.00 2.50 3.00
GMS/KG
*MILITARY: Cooked food composite analyses; Mean body weight of 55.4 KG; CIVILIANS: Raw food composite analyses; omitting infants (nursing) < 1 year of age; Mean body weight (all ages and both sexes) of 31.8 KG.
BIOCHEMICAL-MEAN SERUM ALBUMIN
Deficient
Low
Acceptable
High
No. of Subjects
46
37
66
16
45
TOTAL 210
41
38
28
49
31
32
36
TOTAL 255
0 1 2 3 4 5 6
GMS/100 ML
BIOCHEMICAL-SERUM ALBUMIN-% DISTRIBUTION
% DISTRIBUTION
Def.
Low
Acceptable
High
0.0-2.4
2.5-2.9
3.0-3.4
3.5-3.9
4.0-4.4
4.5-4.9
5.0-5.4
5.5-5.9
6.0-6.2
GMS/100 ML
CIVILIANS (210 subjects) MEAN = 3.6
MILITARY (255 subjects) MEAN = 4.1

Figure 16.

is satisfactory. This does not infer, however, that selected subgroups of the population, such as the small child, do not have a protein deficit.

The report by Netrasiri and Netrasiri in 1955 (46) of four years of case observations clearly established that protein malnutrition existed in Thailand in the form of typical kwashiorkor, with over half of their 54 cases in Bangkok being in the one- to two-year-old child. These authors pointed out that all of their patients came from the lower socio-economic groups, and that infections, particularly measles, ascariasis, amoebiasis, and bacillary dysentery, played important roles as precipitating factors. Most of their patients also had angular lesions, and half had ocular lesions associated with vitamin A deficiency (including corneal perforation). This latter association between kwashiorkor and xerophthalmia has been emphasized repeatedly by Oomen (47). The reader is referred particularly to the recent publication of the U. S. National Academy of Sciences--National Research Council (48) on the protein needs of infants and children.

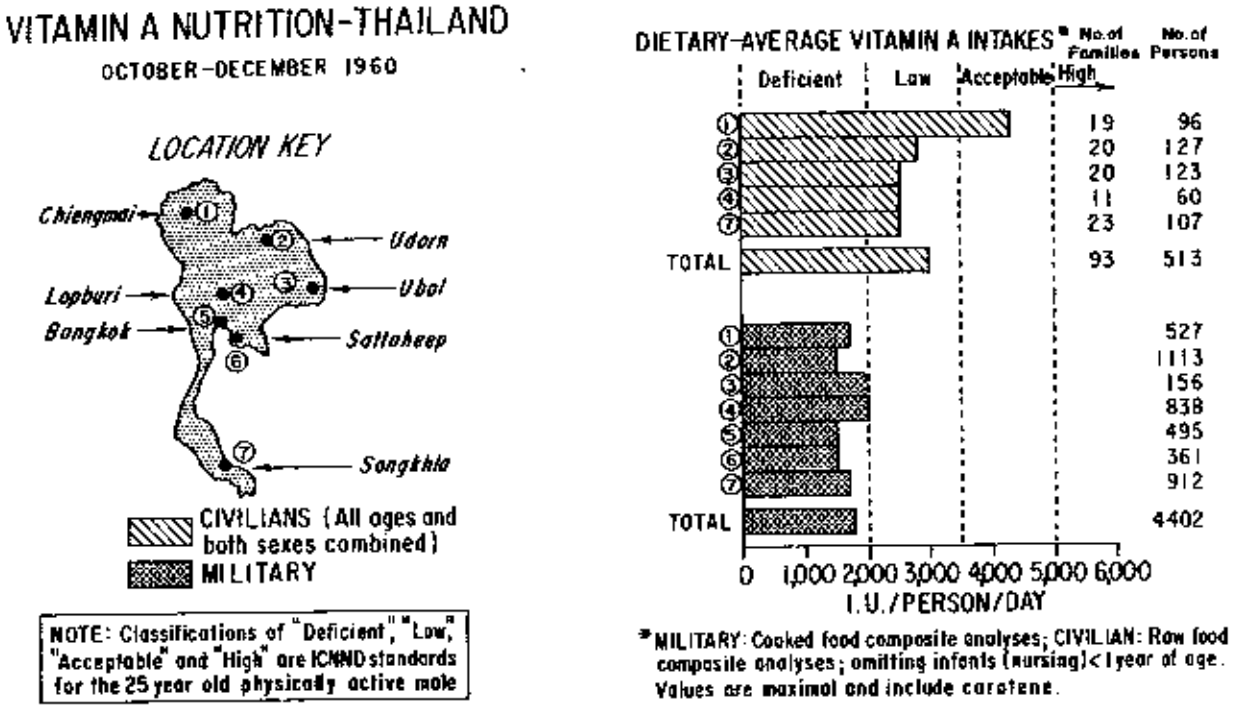

VITAMIN A NUTRITION-THAILAND
OCTOBER-DECEMBER 1960
LOCATION KEY
Chiengmai
Udorn
Lopburi
Ubol
Bangkok
Sattaheep
Songkhla
CIVILIANS (All ages and both sexes combined)
MILITARY
NOTE: Classifications of "Deficient", "Low", "Acceptable" and "High" are ICNND standards for the 25 year old physically active male
DIETARY-AVERAGE VITAMIN A INTAKES*
No. of Families
No. of Persons
Deficient
Low
Acceptable
High
TOTAL
0 1,000 2,000 3,000 4,000 5,000 6,000
I.U./PERSON/DAY
*MILITARY: Cooked food composite analyses; CIVILIAN: Raw food composite analyses; omitting infants (nursing) < 1 year of age. Values are maximal and include carotene.
BIOCHEMICAL - MEAN SERUM VITAMIN A
Def.
Low
Acceptable
High
No. of Subjects
TOTAL
0 10 20 30 40 50 60
MCG/100ML
BIOCHEMICAL - MEAN SERUM CAROTENE
Def.
Low
Acceptable
High
No. of Subjects
TOTAL
0 20 40 60 80 100 120
MCG/100 ML

Figure 17.

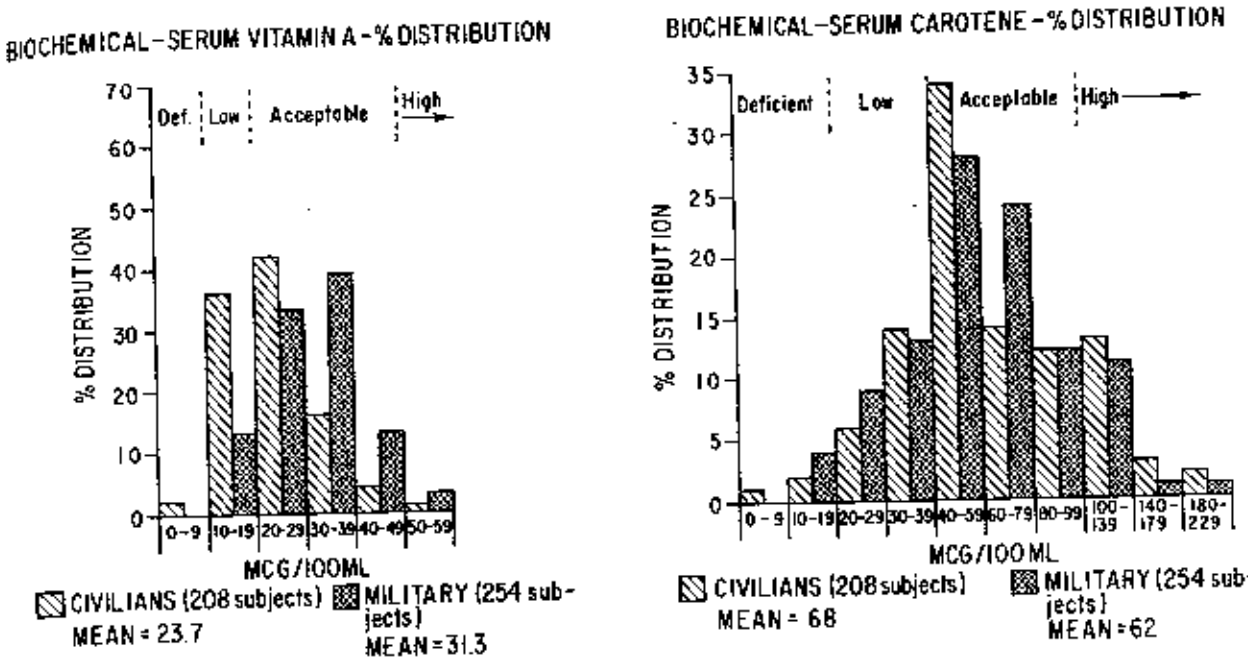


Figure 17 (continued).

F. VITAMIN A NUTRITION

We saw no cases of xerophthalmia during the survey. However, we examined only 1,198 children less than 15 years of age and 420 children less than five years of age. A total of eight cases of Bitot's spots were seen in all age groups among the civilians, six of which were in the Moslem village of Don Kee Leg near Songkhla. Yet only two of these were in children, and they were five to nine years of age. None of the other lesions reported to be associated with vitamin A deficiency such as follicular hyperkeratosis were observed except rarely, and those few seen were mild in degree and probably represented the follicular stage of tenia versicolor. Although it has been suggested by Katsilambros (49) and others that vitamin A deficiency may lead to asymptomatic enlargement of the parotid glands, only one case was observed throughout this entire survey (see Table 20-A). The simple truth of the matter is that xerophthalmia may well exist today in Thailand, but a general nutrition survey of the type performed might well miss it. Such is a reasonable expectation for clinical entities which exist at something less than the one percent level in a selected age group. It is interesting to note that Netrasiri and Netrasiri (46) in their article on kwashiorkor in Bangkok found evidence of vitamin A deficiency in 55.6 percent of their cases (30 out of a total of 54 children), manifested by xerophthalmia with or without corneal ulceration, Bitot's spots, anterior staphyloma (three cases) and corneal perforation (two cases). Secondly, the January-June 1960 Semi-Annual Report of the Children's Hospital, Bangkok (50), lists nine cases of "vitamin A deficiency" out of a total of 3,500 patients (0.26 percent). In spite of the paucity of clinical evidence of serious vitamin A deficiency in the present survey, the subject is discussed here at some length

simply because there is evidence from other sources that xerophthalmia does exist and there are few things in the nutritional deficiency field which are more tragic than the child blinded for life by the sudden destructive appearance of irreversible xerophthalmia.

Turning attention to the dietary findings (Figure 17), the intakes of vitamin A among the military approximated 1,800 I.U. per man per day in the "deficient" range with very little variability from area to area. The intakes among civilians were considerably higher averaging 3,000 I.U. per person per day, particularly when one recalls that the civilian "person" represents the average person in a family including children. Recalling that six of eight civilians with Bitot's spots were observed in Don Kee Leg, it is interesting to note that this Moslem village had the same vitamin A intakes by food composite analyses (see Table 71-A) as did the neighboring Buddhist village of Bang Dsn (both < 2,500 I.U.) and had much higher intakes when vitamin A was calculated from standard food tables (1,114 I.U. versus 277 I.U., see Table 70-A).

Although the dietary studies suggest that vitamin A intake is "deficient" or "low," the mean serum vitamin A and serum carotene data (Figure 17) show almost all groups studied --both military and civilian--falling in the "acceptable" range. Examination of the actual distribution of serum values revealed only the rare subject with less than 10 mcg/100 ml of either substance, but a moderate percentage of subjects among both the military and civilian groups in the "low" ranges. Very few subjects fell in the very high ranges. Comparing the two neighboring villages in the Songkhla area, in one of which the majority of cases of Bitot's spots were observed, the serum levels were very similar (see Table 44-A). A gradual rise in serum levels of vitamin A and carotene with age has been reported in the past and is substantiated in this survey (see Table 45-A for further details).

TABLE 24. THE RELATIONSHIP OF AGE TO SERUM LEVELS OF VITAMIN A AND CAROTENE AMONG THAI CIVILIANS

Age (years) ---->	0-4	5-9	10-14	15-44	45+
			mcg/100 ml		
MEAN SERUM VITAMIN A					
Males	-	17.9	20.1	29.5	25.1
Females, NPNL	16.2	17.5	20.2	23.8	25.4
MEAN SERUM CAROTENE					
Males	-	55	55	60	67
Females, NPNL	45	43	60	86	86

Vitamin A deficiency has a long history in Southeast Asia, as recently reviewed by Oomen in his text entitled An Outline of Xerophthalmia (47). This monograph should be considered a "must" for those concerned with vitamin A malnutrition, and includes a number of fundamental observations which are particularly pertinent to the present discussion:

1. "There is very little reason--if we disregard the eye signs-- to consider xerophthalmia as a special variety of malnutrition. There are strong reasons to regard every degree of xerophthalmia, except possibly incipient alterations, as a case of general malnutrition or nutritional dystrophy."

2. "As carotene in the Green Tropics is omnipresent, and is consumed in varying quantities, the problem for the majority of the cases may not be the absolute quantities but the efficient utilization of this vitamin A source.... On diets containing reasonable quantities of carotene, fat, and protein, the occurrence of xerophthalmia is very unusual. It is apparent that in many individuals a meager quantity of carotene suffices to protect against xerophthalmia, whereas in some a relatively large quantity fails to do so."

3. "In contradistinction to former opinions, it should be emphasized that neither the serum level of vitamin A nor that of carotene is very helpful in establishing a diagnosis. Though in cases of xerophthalmia a decrease of both is typical even if the range is rather wide, the same low values are found in kwashiorkor. The levels, especially in apparently normal children in a vulnerable environment, are not much higher. The most that can be said of serum levels of vitamin A in xerophthalmia is that they are never high and rarely average; that they are lowest in cases of keratomalacia; that in groups of xerophthalmia cases the averages are lower than in healthy controls. Their significance is about the same as that of protein levels in "subclinical" protein malnutrition cases. In short, the biochemist, especially in an endemic environment, cannot help us decide whether an individual child has xerophthalmia."

There may be those who do not fully agree with some of Dr. Oomen's statements, but they do point out the complexities of applying dietary and biochemical data to the patient with or without xerophthalmia in a potentially endemic area.

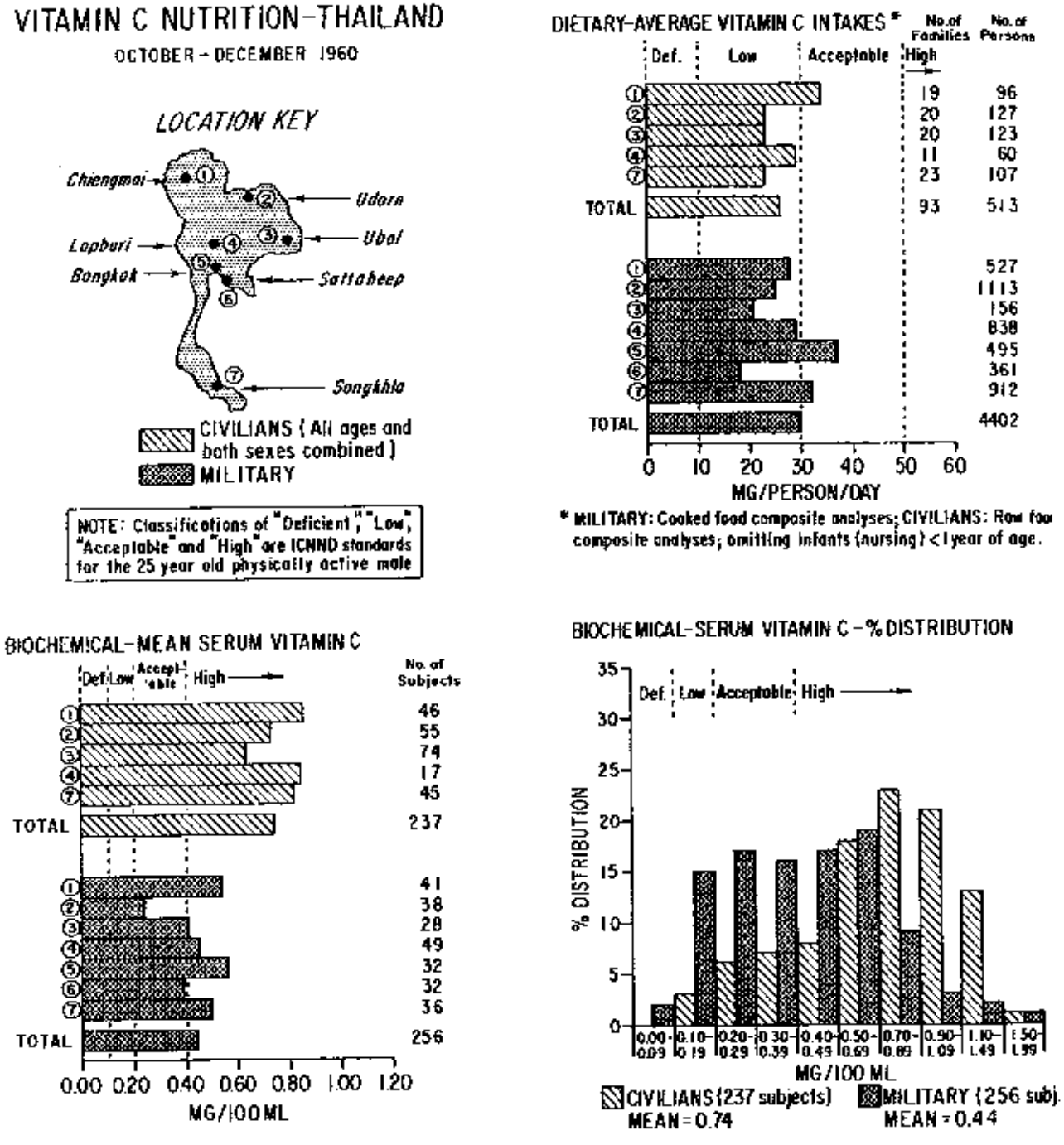

VITAMIN C NUTRITION–THAILAND
OCTOBER – DECEMBER 1960
LOCATION KEY
Chiengmai
Udorn
Ubol
Lopburi
Bangkok
Sattaheep
Songkhla
CIVILIANS (All ages and both sexes combined)
MILITARY
NOTE: Classifications of "Deficient", "Low", "Acceptable" and "High" are ICNND standards for the 25 year old physically active male
DIETARY–AVERAGE VITAMIN C INTAKES *
No. of Families
No. of Persons
Def.
Low
Acceptable
High
19 96
20 127
20 123
11 60
23 107
TOTAL 93 513
527
1113
156
838
495
361
912
TOTAL 4402
0 10 20 30 40 50 60
MG/PERSON/DAY
* MILITARY: Cooked food composite analyses; CIVILIANS: Raw food composite analyses; omitting infants (nursing) < 1 year of age.
BIOCHEMICAL–MEAN SERUM VITAMIN C
Def.
Low
Acceptable
High
No. of Subjects
46
55
74
17
45
TOTAL 237
41
38
28
49
32
32
36
TOTAL 256
0.00 0.20 0.40 0.60 0.80 1.00 1.20
MG/100 ML
BIOCHEMICAL–SERUM VITAMIN C – % DISTRIBUTION
% DISTRIBUTION
Def.
Low
Acceptable
High
0.00-0.09
0.10-0.19
0.20-0.29
0.30-0.39
0.40-0.49
0.50-0.69
0.70-0.89
0.90-1.09
1.10-1.49
1.50-1.99
MG/100 ML
CIVILIANS (237 subjects) MEAN = 0.74
MILITARY (256 subj.) MEAN = 0.44

Figure 18.

G. VITAMIN C NUTRITION

Scurvy is not considered to be a problem in Thailand to the best of our knowledge, and no clinical evidence whatever to suggest scorbutic lesions was seen during the clinical survey. Very high prevalences of various gingival lesions were seen, such as "swollen red interdental papillae," "marginal redness," "gingival recession," etc., but, to the best of our knowledge, these represented various phases of periodontal disease discussed in detail in the chapter on Dental Health.

Vitamin C intakes (Figure 18) were not quite as high as one might like to see to be absolutely certain that each person was receiving an adequate intake, but in no location was the intake less than 18 mg/person/day, i.e., none closely approached the "deficient" range of less than 10 mg. It is true, however, that the ICNND standards are lower than some other standards such as those of the U.S. National Research Council (51), and there is currently considerable discussion concerning the possible value of intakes well above those required to prevent scurvy itself. As is also noted several times elsewhere in this report, citrus fruits and some of the other good sources of vitamin C are expensive in Thailand, in spite of the fact that Thailand has--and is starting to develop--an excellent potential for large scale raising of various fruits.

The mean serum values for vitamin C in the various locations (Figure 18) were universally in the "high" or "acceptable" ranges. The values among civilians were considerably higher than among the military groups, presumably a reflection of the almost complete absence of fruit from the military diet (see Military Dietary Appendix). Analysis of the distribution of serum values revealed a spread over a very wide range up to 2.00 mg/100 ml, with 4 military subjects having levels of less than 0.10 mg/100 ml (but none of zero--see Table 40-A) and 15 percent of the military group falling in the "low" range. It is worthy of note among the civilians that the 0 to 4-year-old children had the lowest values as outlined below (see also Table 45-A):

TABLE 25. MEAN SERUM VITAMIN C LEVELS AMONG THAI CIVILIANS IN TERMS OF AGE

Age (years)-->	0-4	5-9	10-14	15-44	45+
MEAN SERUM VITAMIN C			mg/100 ml		
Males	0.46	0.86	0.94	0.70	0.68
Females, NPNL	0.58	0.82	1.03	0.85	0.63

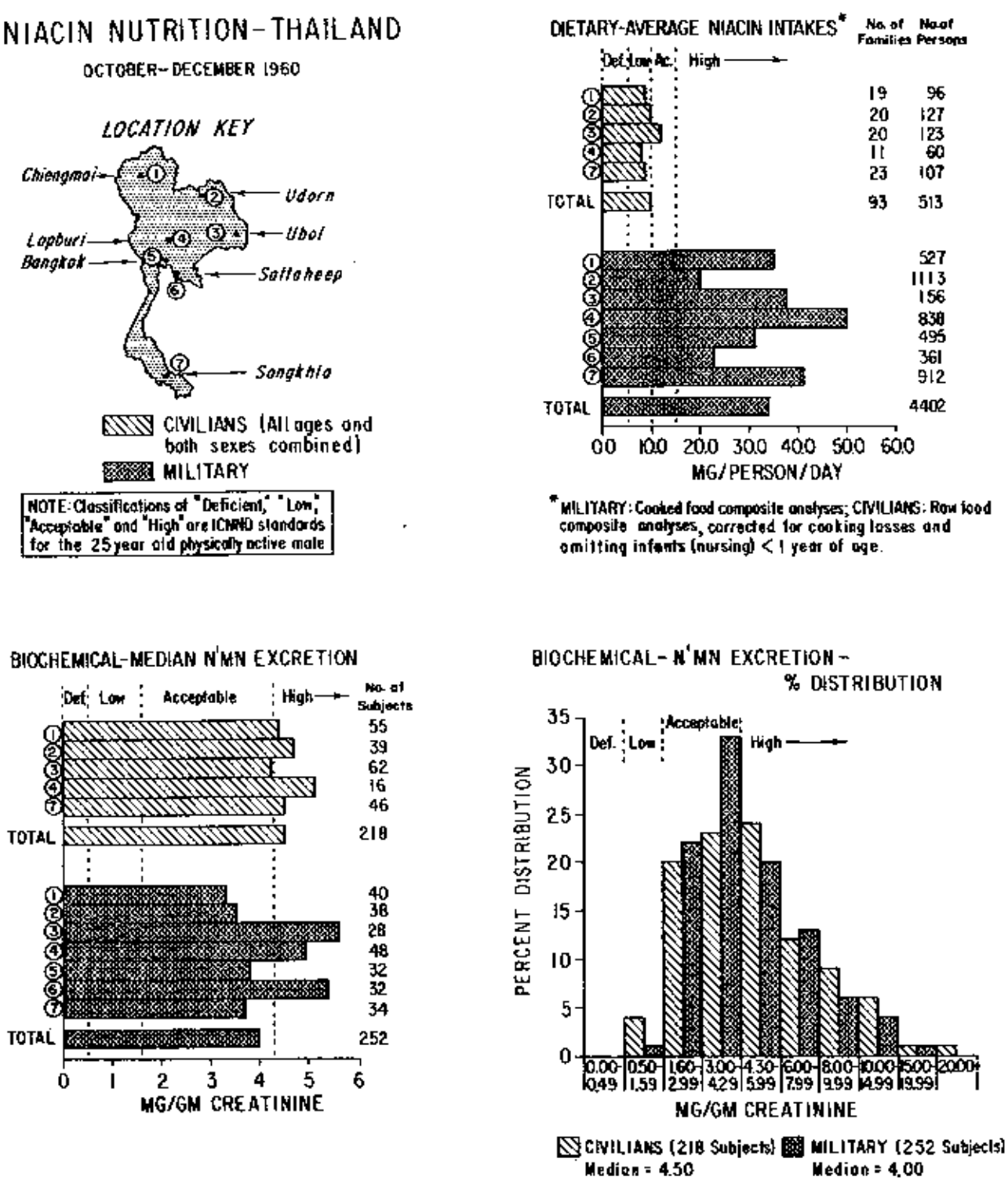

NIACIN NUTRITION - THAILAND
OCTOBER - DECEMBER 1960
LOCATION KEY
Chiengmai
Udorn
Lopburi
Ubol
Bangkok
Sattaheep
Songkhla
CIVILIANS (All ages and both sexes combined)
MILITARY
NOTE: Classifications of "Deficient," "Low," "Acceptable" and "High" are ICNND standards for the 25 year old physically active male
DIETARY-AVERAGE NIACIN INTAKES*
No. of Families
No. of Persons
Def.
Low
Ac.
High
TOTAL
19 96
20 127
20 123
11 60
23 107
93 513
527
1113
156
838
495
361
912
4402
0.0 10.0 20.0 30.0 40.0 50.0 60.0
MG/PERSON/DAY
* MILITARY: Cooked food composite analyses; CIVILIANS: Raw food composite analyses, corrected for cooking losses and omitting infants (nursing) < 1 year of age.
BIOCHEMICAL-MEDIAN N'MN EXCRETION
Def.
Low
Acceptable
High
No. of Subjects
55
39
62
16
46
TOTAL 218
40
38
28
48
32
32
34
TOTAL 252
0 1 2 3 4 5 6
MG/GM CREATININE
BIOCHEMICAL - N'MN EXCRETION - % DISTRIBUTION
PERCENT DISTRIBUTION
0 5 10 15 20 25 30 35
Def.
Low
Acceptable
High
0.00-0.49
0.50-1.59
1.60-2.99
3.00-4.29
4.30-5.99
6.00-7.99
8.00-9.99
10.00-14.99
15.00-19.99
20.00+
MG/GM CREATININE
CIVILIANS (218 Subjects) Median = 4.50
MILITARY (252 Subjects) Median = 4.00

Figure 19.

R. NIACIN NUTRITION

Niacin nutrition presents no public health problems to Thailand. No evidence of pellagra was seen during the course of the survey, and inquiries made of the medical profession throughout the country strongly suggested that the disease does not exist, except rarely where serious concomitant disease exists. Previous dietary surveys in Thailand have revealed adequate intakes of niacin (52, 53, 54). This is the same situation as found in rice eating countries throughout the Far East. The explanation is clear--rice in any form contains appreciable amounts of niacin, which is largely retained during milling, washing, soaking, or cooking. Analyses of 6 different types of rice utilized in Thailand (see Table 78-A) revealed niacin contents ranging from 2.33 mg/100 gms for fully milled white rice to 3.94 mg/100 gms for home-pounded rice. The average intake of rice among civilians (including children) was 440 gms per person per day. Even utilizing the lowest value of 2.33 mg/100 gms, the average civilian intake of niacin from rice alone exceeds 10 mg/day--a most satisfactory intake.

The dietary and biochemical data of this survey support the above conclusions (see Figure 19). Concerning the dietary intake portion of the Figure, one must recall that the indicated standards of acceptability are for the young adult male. When the entire family including children is grouped together to derive the average civilian intakes, it is to be expected that these values will fall well below those of the young adult males of the military. The biochemical excretion data clearly show that appreciable amounts of N'methylnicotinamide were universally excreted in the urine. Note that not one subject, military or civilian, proved to have an excretion of less than 0.50 mg/gm creatinine. It is worth noting that the findings of the ICNND survey in Vietnam in 1959 (34) revealed almost identical results.

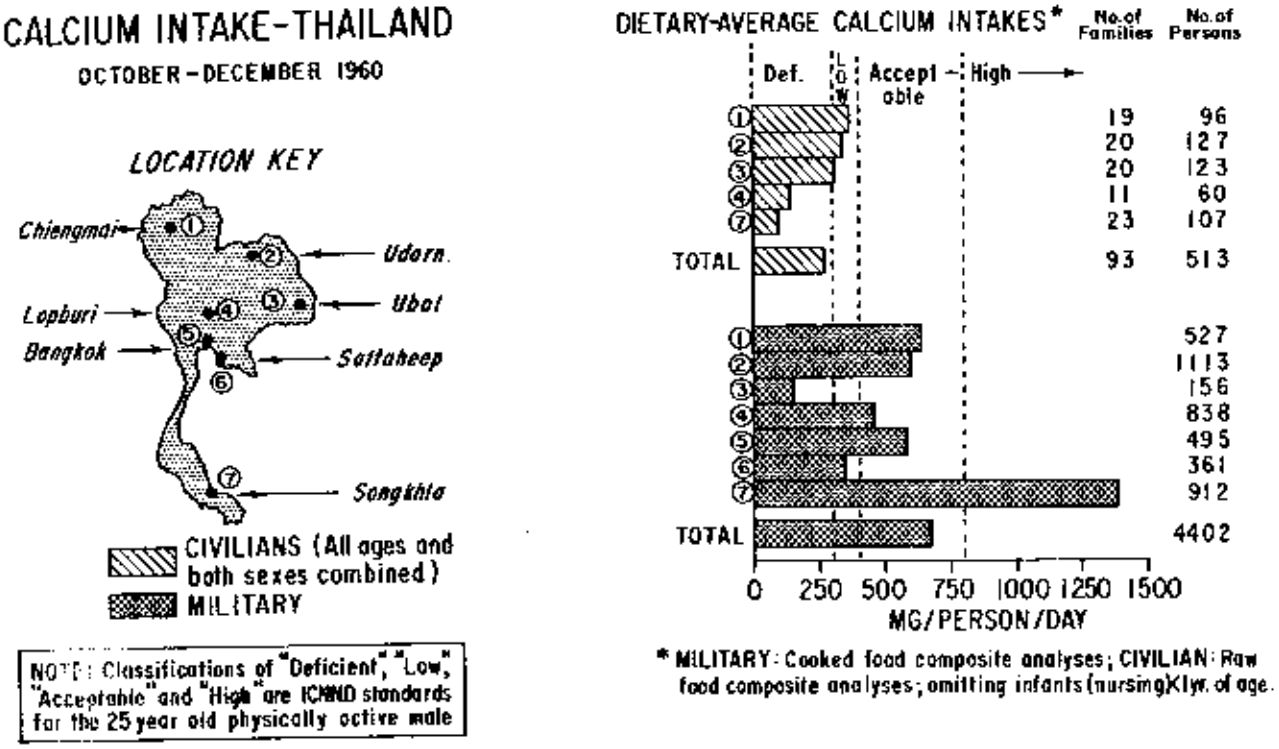


Figure 20.

I. CALCIUM AND PHOSPHORUS NUTRITION

There is comparatively little that one can say concerning the status of calcium and phosphorus nutrition. Only one specific parameter was carefully measured--calcium intake: as presented in Figure 20 determined by chemical analysis of civilian and military food composites (in addition, phosphorus intakes were calculated from standard food tables). It is clear enough that calcium intake among the military is adequate with a mean of 675 mg/man/day. The civilian situation is not quite so clear, with a mean intake of 266 mg/person/day, and with considerable differences between the various communities. All civilian values fall within the "low" or "deficient" categories, but it must be recalled as in previous chapters that civilian figures for any nutrient will be lower than military on a given intake of the nutrient because the civilian population sample includes the children. Secondly, the acceptability standards are based on the active young adult male, and are, therefore, not strictly applicable to all members of a family. Within the military, calcium intakes as measured chemically were considerably higher than intakes calculated from food tables, as has often been observed in other surveys. This has proved in the past to be due primarily to additives such as calcium salts used in soaking or put into the food while cooking, and to the use of whole seafood products including shells and bones--items not accounted for in food tables. Among the Thai civilians, however, this pattern did not hold true (calculated mean intake = 278 mg; analysed intake = 266 mg), and there was a great deal of fluctuation between neighboring villages and between calculated versus analysed data. The explanation for these civilian findings is not clear.

The civilian intake data certainly suggest that calcium intakes are marginal. On the other hand, no clinical evidence of any type was encountered to suggest calcium deficiency, and no cases of rickets were seen to suggest that vitamin D metabolism was compromised. Conversations with physicians further supported the rarity of calcium problems among children and pregnant women. It should be noted that Thai children spend many hours outdoors with little clothing, in contrast to some children of the Middle East where rickets is observed in spite of much time outdoors, apparently because of clothing virtually covering the entire body.

There is no direct evidence to suggest that calcium absorption is in any way compromised by disproportionately high phosphorus intakes. As calculated from standard food tables, the mean intake of phosphorus among all Army units combined was 1,422 mg/man/day (see Table 55-A) and among all civilian groups combined 658 mg/person/day (see Table 70-A).

The reader is referred to the Dietary Appendix for further details.

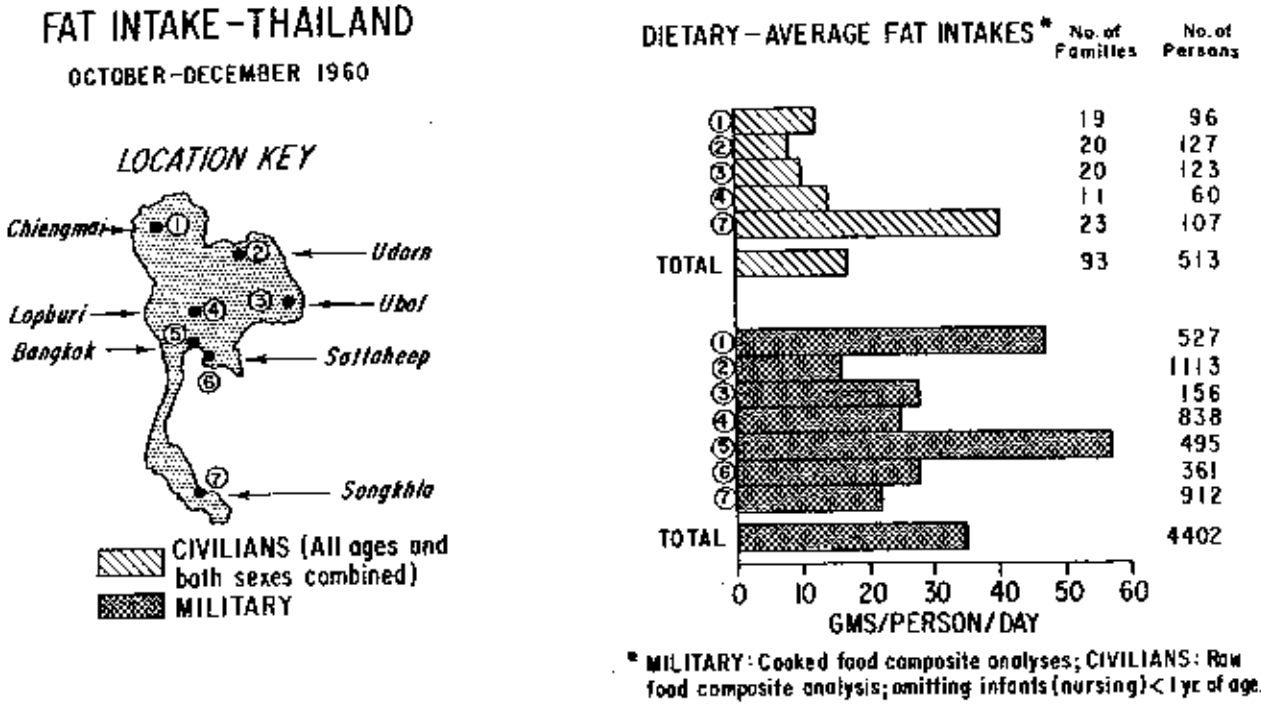


Figure 21.

J. FAT AND CHOLESTEROL

As illustrated in Figure 21, fat intakes are very low compared to the situation existing in many Western countries. The mean intake among civilians was 17 gms accounting for about nine percent of total Calories, and 35 gms among the military accounting for eleven percent of total Calories. A moderate amount of variability from area to area was observed, but it is suspected that if longer dietary surveys were conducted, this variability would flatten out. In no area did intakes approach the currently existing situation in the U.S. where most studies reveal intakes in excess of 100 gms/person/day accounting for over 40 percent of total Calories. The principal value of the Thailand fat intake data is to confirm that the national diet of the Thai people is low in fat, as is the case in most other Far Eastern countries where rice makes up a very large proportion of the total caloric intake and dairy products are not widely used. The values in Vietnam in 1959 (34) were very similar, fats accounting for ten percent of Calories among civilians and thirteen percent among the military.

The limited number of serum total cholesterol analyses performed further illustrated the similarity of the Thai people to other peoples of the Far East with regards to lipid intakes and metabolism. For 24 analyses in children less than 15 years of age, the mean value was 128 mg/100 ml, and for 38 adults, the mean was 132 mg/100 ml. Only one of these determinations exceeded 200 mg/100 ml and this was in a female child in the 5-9 year age range,

suggesting that such disorders as familial hypercholesteremia may exist in Thailand. It should be added that it is very rare indeed in the U.S. for a serum cholesterol value in an adult to be as low as 132 mg/100 ml. These cholesterol determinations failed to show any relationship to sex, diastolic or systolic blood pressure, age, or location (see Table 26 below and Table 36-A).

TABLE 26. SERUM TOTAL CHOLESTEROLS AMONG THAI CIVILIANS

	Sex	Age (years)				
		5-9	10-14	15-44	45+	TOTAL
Number of subjects	M	8	4	13	6	31
	F, NPNL	6	6	11	8	31
Mean values (mg/100 ml)	M	110	138	119	139	123
	F, NPNL	139	136	140	134	138

Maximum value observed: 248 mg/100 ml in a female child 5-9 years old; no other values exceeded 200 mg/100 ml.

If the current hypotheses concerning the role of fat, particularly saturated fats of animal origin, in the etiology of atherosclerotic cardiovascular disease have any meaning, then it is reasonable to conclude that the Thai people by virtue of their low fat intakes enjoy a marked degree of protection against the disease which kills over half of the U.S. population. It might also be stated that it is practically unheard of to see a myocardial infarction in the U.S. in a person with a serum cholesterol of 132 mg/100 ml.

629788 O - 62 - 6

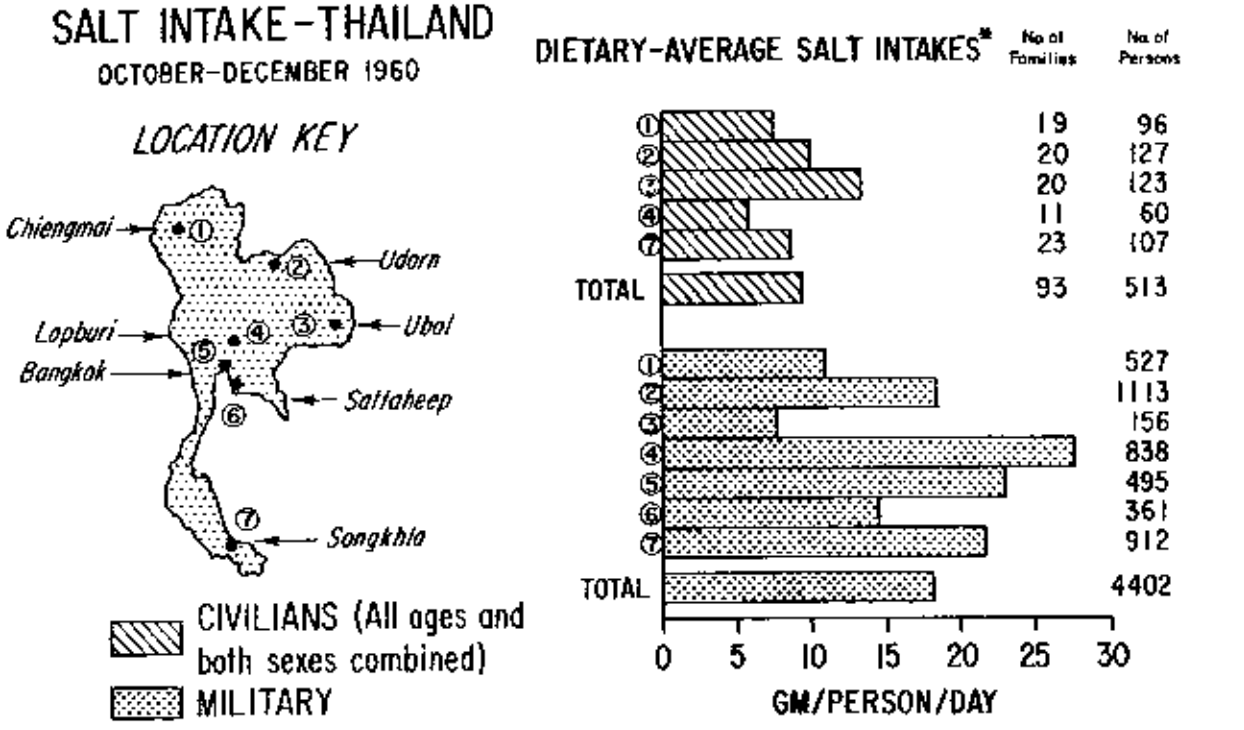


Figure 22.

K. SALT AND BLOOD PRESSURE

As illustrated in Figure 22 there was considerable variability from location to location in salt intake (as NaCl) as determined by food composite analyses among both civilian and military groups. It must be recalled as in previous chapters that civilian intakes for any nutrient when expressed as a quantity per person per day will be lower than the military on a given intake of the nutrient because the civilian population sample includes the children. The average salt intake among the Thai military as determined by analysis of 8 food composites was 18.1 gms/man/day with a range of 7.5 to 27.5 gms/man/day (see Table 56-A). The average intake among civilians, as determined by analyses of 9 food composites, was 9.1 gms/person/day with a range of 4.1 to 17.0 gms (see Table 71-A). Even though the average military intake approximated 18 gms, most of this total was derived from various food items including those very high in salt content such as the various fish sauces; only 1.1 gm of this total was salt as actual table salt or salt added during cooking (see Table 60-A). A qualitatively similar situation existed among the civilians with only 2.4 gms of the total 9.1 gms being derived directly from salt as such (Table 76-A). It should also be noted that in the general national sense, relatively crude sea salt was the major source of salt, except in specific areas such as villages near Ubol where crude subsoil salt was the principal type used (See the chapters and appendices on Food Resources and Iodine Nutrition for further details on salt).

Previous military nutrition surveys in other rice economy countries have consistently demonstrated total salt intakes to be high compared to the usually quoted intakes of 8 to 10 gms for American adult population groups. Average values from some of these surveys are tabulated below (see Table 27 for comparisons of other nutrients).

TABLE 27 . MEAN INDIVIDUAL TOTAL SALT INTAKES OF MILITARY GROUPS OF VARIOUS RICE ECONOMY COUNTRIES

Nation	Year of Survey	Reference	Mean Total Salt Intake/Man/Day
Republic of China (Taiwan)	1954	(55)	> 20.0
Republic of China (Taiwan)	1960	(56)	12.9
Pakistan (East Pakistan data only)	1956	(57)	16.0
Republic of Korea	1957	(58)	20.1
Republic of Vietnam	1959	(34)	13.7
Kingdom of Thailand	1960		18.1

There was little variability in mean blood pressures among the military in the various locations, based upon 880 determinations, the mean for all groups combined being 117/74, with a range of mean systolic pressures for each location of 114 to 120 mm. Hg. and of mean diastolic pressures of 69 to 77 mm. Hg. (see Table 3-A). Among civilian adults (15+ years), 384 determinations provided a mean of 118/73, very similar to the military personnel (see Table 36-A). The ranges of means for the various civilian locations were somewhat wider (systolic: 108 to 123 mm. Hg.; diastolic: 67-79 mm. Hg.), but the numbers of subjects examined in each location were small and the entire adult age span was included in contrast to the more limited age span of the military groups. Strikingly little increase in blood pressure accompanied advancing years until the eighth decade as illustrated in Table 28.

TABLE 28. RELATIONSHIP OF AGE TO BLOOD PRESSURE AMONG THAI CIVILIAN AND MILITARY GROUPS[1/]

AGE GROUPS (years)	Males			Females (NPML)		
	No. of Subjects	Mean Values (mm. Hg.) Systolic B.P.	Diastolic B.P.	No. of Subjects	Mean Values (mm. Hg.) Systolic B.P.	Diastolic B.P.
CIVILIANS[2/]						
20-29	53	122	73	31	117	73
30-39	70	116	72	28	115	73
40-49	34	118	73	27	119	74
50-59	34	120	75	21	118	77
60-69	10	119	75	13	122	75
70-79	5	142	81	4	134	82
MILITARY[2/]						
21-24	770	117	74			
25-29	83	115	72			
30-34	19	118	76			
35+	12	115	73			

1/ See Tables 24-A and 36-A for further details.
2/ The average ages of the abbreviated clinical examination groups of which the above represented a subsample were as follows: civilian males, 15+ years - 39 years; females, 15+ years - 40 years; military - 22 years.

Among the 880 military subjects, no systolic pressure exceeded 160 mm. Hg. and 4 subjects had diastolic pressures between 100 and 110 mm. Hg. with none higher. Among the 384 adult civilians, 4 subjects had systolic pressures above 160 mm. Hg. and 5 subjects had diastolic pressures above 100 mm. Hg. Utilizing the common definition of hypertension of 140/90 or over, 2.8 percent of the military, 8.4 percent of the civilian adult (20+ years) males, and 4.8 percent of the adult (20+ years) females had systolic pressures of 140 mm. Hg. or higher; concerning diastolic pressures of 90 mm. Hg. or higher, these groups had incidences of 5.6 percent, 7.9 percent and 7.3 percent respectively. Hypertension, presumably largely essential, therefore does exist in Thailand with reasonable frequency, yet the prevalence encountered did not seem to be unusually high.

The role of salt in cardiovascular hypertension was the subject of a recent comprehensive seminar (59). There seems to be no question but that chronic feeding of large amounts of salt to experimental animals results in sustained hypertension, as evidenced by the work of Meneely, Lemley-Stone, and Darby (60) and others. The efficacy of salt restriction in the control of signs and symptoms of cardiac failure associated with hypertension is common knowledge. The work of Dahl (61) and his colleagues is particularly worthy of note. Utilizing 24-hour urinary excretion of sodium as an index of minimal sodium chloride intake, they have shown a striking linear correlation between the average daily salt intake and the percentage of hypertensive subjects in population groups from among Alaskan Eskimos, Marshall Islanders, Northern U. S. Americans, Southern Japanese, and Northern Japanese. Dahl and Heine (62) have also reported the extremely interesting fact that rats fed a high intake of sea salt over long periods developed more severe hypertension than animals fed similar amounts of salt as sodium chloride. Few extensive studies on the prevalence of hypertension have been conducted in the Far Eastern rice economy countries. Perhaps the most noteworthy to date is the study by Cho et al. (63) in Korea demonstrating a prevalence of hypertension of approximately 6 percent based upon examination of 40,000 persons 5 years of age and older, and defining hypertension by a graded system by age, commencing with 140/90 and progressing upwards to 160/100.

Both the salt intake and the blood pressure data collected in Thailand were inadequate to demonstrate the presence or absence of any relationships between these two sets of variables. These data also could not be directly related to Dahl's population group studies primarily because of the different techniques used to estimate salt intakes, i.e., dietary versus urinary excretion. However, a few general conclusions can be drawn. Hypertension clearly exists in Thailand, but the prevalence of the disease is not well established. The disease, with and without heart disease, is also clearly encountered in the experience of the Women's Hospital in Bangkok (64) (see Table 12-A) and the Thai vital statistics for 1957 (65) listed a death rate from diseases of the heart, not further defined, of 16.4/100,000 (see Table 16-A). The limited number of food composite analyses done during this survey strongly suggested that the salt intake of the Thai population is high.

L. DENTAL HEALTH

Four dentists, two from Thailand and two from the United States, examined over four thousand persons, 1 - 80 years of age, during the Thailand nutrition survey. Included in the sample were 2,418 military males and 1,640 civilian males and females (Table 29). All nine regions of Thailand were represented in the sample of military personnel who received dental examinations and five of the nine regions were represented in the civilian sample.

The dental examinations were performed in good natural light using standard criteria with mouth mirror and explorer (66, 67, 68, 69, 70, 71). The examination included the determination of dental caries, hypoplasias of enamel, fluoroses, gingival and periodontal conditions, attrition of molar teeth, and the status of oral hygiene. Water samples were collected from most examination sites and later analyzed for fluoride content. In addition, pooled samples of urine were collected from examinees in many areas of the country and analyzed for urinary output of fluoride.

Dental caries were practically non-existent in the younger age groups examined in Thailand. The mean number of decayed, missing, and filled permanent teeth (DMF) for persons in the age group 0-9 years was only 0.13, in the 10-19 year old group 0.71, and for the age group 20-29, only 0.84 DMF teeth (Table 30). The mean DMF levels remained at less than one tooth per person through the age of 39 for all persons examined but a sharp rise occurred in the age group 40-49, who had a mean DMF of 2.89 teeth per person. For all those 50 years and over, the mean DMF for permanent teeth was 10.57. The rise in the mean DMF for the older age groups is due to tooth loss from periodontal disease which is at a high level throughout the country.

The mean number of DMF teeth per person for military males by area of origin is shown in Table 31 and for civilians in Table 32. When different areas of the country are considered individually, differences are seen in caries patterns with the Northeastern, Northern, and the Northwestern Regions showing less dental decay than that recorded for the remaining regions (Table 33 and Figure 23).

Dental fluorosis was common in people from all nine geographical regions, with the Northern, Northeastern, and Northwestern Regions having the greater prevalence and severity. Approximately 60 percent of those examined in the three northern regions had fluorosis varying from questionable to severe according to Dean's classification. The other six regions had a prevalence of less than 30 percent, with the degree of fluorosis occurring mostly in the lower limits of the scale; i.e., either being questionable or very mild. The degree of fluorosis may well contribute to the lower DMF means of persons in the northern regions as compared to those of the central and southern areas. The prevalence of fluorosis varied from a low of six percent positive for fluorosis in the Southernmost Region around Songkhla to a high of 76 percent positive in the Northwestern Region around Chiengmai.

The fluoride in the water samples ranged from 0.00 to 0.80 ppm fluoride and in the urine samples from 0.79 to 2.92 ppm (Table 34). Water samples collected at the examination sites did not contain sufficient fluoride to be the sole explanation for the low prevalence of dental decay (72). In contrast, the pooled samples of urine from each examination site were usually high in fluoride content possibly indicating that the intake of fluoride was not from water alone (73).

While the prevalence of dental caries is extremely low for the people of Thailand, the opposite exists for the prevalence of periodontal disease among the groups studied.

TABLE 29. NUMBER OF PERSONS RECEIVING DENTAL EXAMINATIONS IN THAILAND, 1960

Area of Origin[1/]	Males Military	Males Civilian	Females Civilian	Total Civilians	Total Military & Civilians
Region I CENTRAL	547	88	91	179	726
Region II EASTERN	259	-	-	-	259
Region III NORTHEASTERN	123	157	215	372	495
Region IV NORTHERN	395	188	225	413	808
Region V NORTHWESTERN	473	161	190	351	824
Region VI WESTERN	34	-	-	-	34
Region VII SOUTHEASTERN	192	-	-	-	192
Region VIII SOUTHERN	55	-	-	-	55
Region IX SOUTHERN-MOST	340	156	169	325	665
TOTAL	2,418	750	890	1,640	4,058

1/ See Figure 1 for limits of these regions

TABLE 30. MEAN NUMBERS OF DMF[1/] TEETH PER PERSON, BY AGE, MALES AND FEMALES COMBINED, THAILAND, 1960

Age Group	Mean Age	Number	DMF Sums	Mean DMF
0-9	6.7	340	44	.13
10-19	13.9	424	300	.71
20-29	22.8	2,564	2,149	.84
30-39	34.3	329	311	.95
40-49	44.9	179	518	2.89
50+	59.7	222	2,347	10.57
Total	24.5	4,058	5,569	1.37

1/ Decayed, Missing, and Filled

TABLE 31. MEAN NUMBER OF DMF[1/] TEETH PER PERSON BY AGE, MILITARY MALES, THAILAND, 1960

Age / Area of Origin	20-24	25-34	35-44	45+	Total
Region I - CENTRAL					
No.	394	119	29	5	547
Mean DMF	1.1	1.9	1.7	12.8	1.4
Region II - EASTERN					
No.	227	30	2	-	259
Mean DMF	1.4	2.4	4.5	-	1.5
Region III - NORTHEASTERN					
No.	114	8	1	-	123
Mean DMF	.2	.1	.0	-	.2
Region IV - NORTHERN					
No.	388	7	-	-	395
Mean DMF	.1	1.0	-	-	.1
Region V - NORTHWESTERN			2		
No.	404	67	3.0	-	473
Mean DMF	.2	.3		-	.2
Region VI - WESTERN					
No.	14	20	-	-	34
Mean DMF	1.1	4.5	-	-	3.1
Region VII - SOUTHEASTERN					
No.	169	20	2	1	192
Mean DMF	1.2	2.3	2.0	4.0	1.3
Region VIII - SOUTHERN					
No.	52	3	-	-	55
Mean DMF	.4	.3	-	-	.4
Region IX - SOUTHERNMOST					
No.	326	14	-	-	340
Mean DMF	1.3	2.9	-	-	1.4
TOTAL					
No.	2,088	288	36	6	2,418
Mean DMF	.7	1.7	1.9	11.33	.9

1/ Decayed, Missing and Filled

TABLE 32. MEAN NUMBER OF DMF[1/] TEETH PER PERSON BY AGE, MALES AND FEMALES, THAILAND, 1960

Area of Origin		Region I CENTRAL		Region III NORTH-EASTERN		Region IV NORTHERN		Region V NORTH-WESTERN		Region IX SOUTHERN-MOST		TOTAL	
Age		No.	Mean DMF	No.	Mean DMF	No.	Mean DMF	No.	Mean DMF	No.	Mean DMF	No.	Mean DMF
0-4	M	4	.0	9	.0	7	.0	5	.0	8	.0	33	.0
	F	1	.0	17	.0	10	.0	6	.0	2	.0	36	.0
5-9	M	26	.4	28	.0	27	.0	25	.0	28	.3	134	.1
	F	19	.7	38	.0	25	.0	28	.1	27	.3	137	.2
10-14	M	19	.4	17	.2	50	.5	24	.0	29	.5	139	.4
	F	22	.7	27	.3	66	1.0	19	.0	26	1.4	160	.8
15-19	M	3	.0	5	.2	13	.3	7	.0	15	2.1	43	.8
	F	7	2.3	13	.9	31	.6	17	.3	14	2.6	82	1.1
20-24	M	2	.0	1	.0	10	.1	14	.1	13	2.3	40	.8
	F	3	1.0	22	.5	13	.0	13	.0	25	3.0	76	1.2
25-34	M	5	.0	31	.7	33	.4	23	.3	20	1.4	112	.6
	F	15	1.9	32	.7	39	.7	42	.3	21	1.9	149	.9
35-44	M	13	4.7	32	1.2	26	.5	26	1.6	15	.9	112	1.5
	F	8	3.6	28	.4	19	.6	22	1.3	13	4.5	90	1.5
45+	M	16	10.9	34	6.4	22	4.0	37	11.1	28	12.9	137	9.2
	F	16	8.9	38	4.6	22	5.3	43	9.9	41	10.6	160	8.1
Total	M	88	3.0	157	1.8	188	.8	161	2.9	156	3.1	750	2.2
	F	91	2.7	215	1.1	225	1.1	190	2.5	169	4.1	890	2.1

1/ Decayed, Missing and Filled

TABLE 33. MEAN NUMBER OF DMF[1/] TEETH PER PERSON BY AGE AND GEOGRAPHICAL LOCATION, MALES AND FEMALES COMBINED, THAILAND, 1960

Age Group	Mean Number of Decayed, Missing and Filled Teeth	
	Northeastern and Northwestern Region	Southern and Central Region
0-9	.01	.36
10-19	.49	1.16
20-29	.18	1.37
30-39	.67	1.44
40-49	1.94	4.31
50+	8.98	13.59

1/ Decayed, Missing and Filled

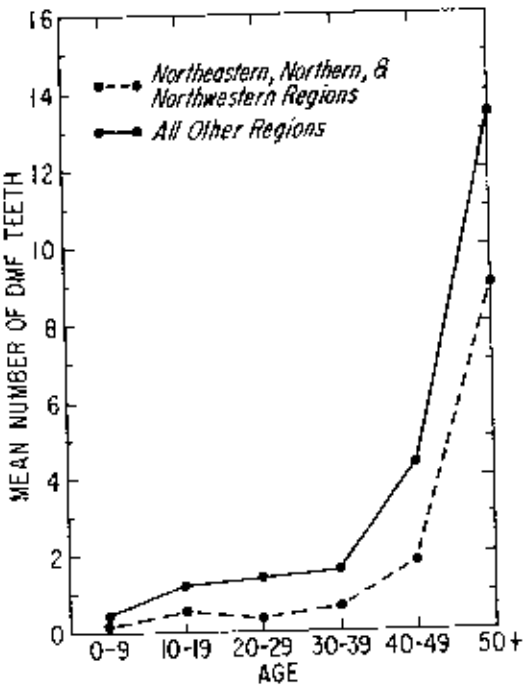


Figure 23. Mean number of decayed, missing, and filled teeth per person by age and geographical location, males and females combined. Thailand, 1960.

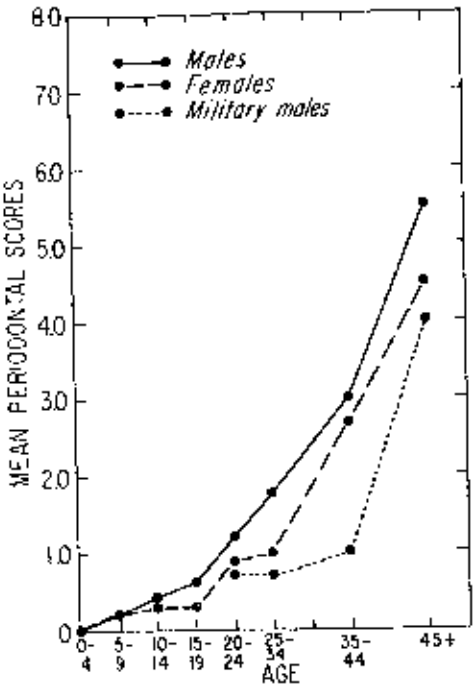


Figure 24. Mean periodontal disease scores by age for persons examined in Thailand - 1960- Males and females.

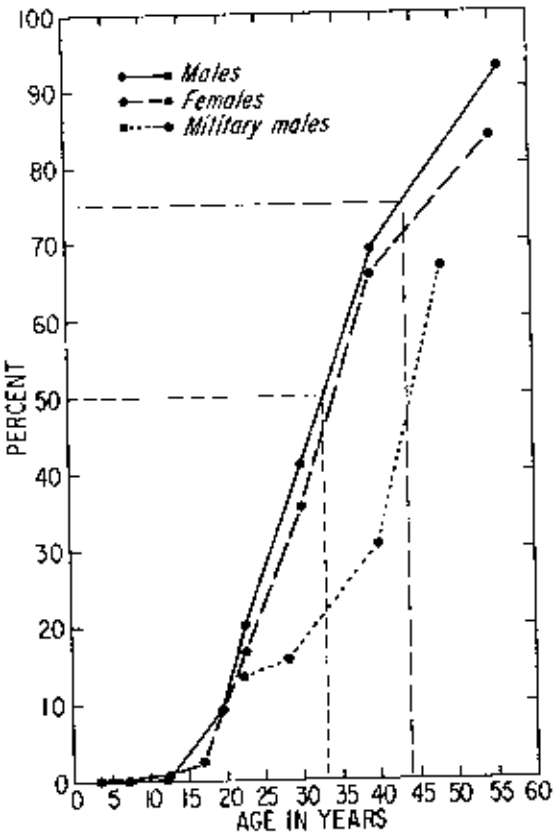


Figure 25. Percentage of persons with destructive periodontal disease by age and sex – Military and Civilian – Thailand, 1960.

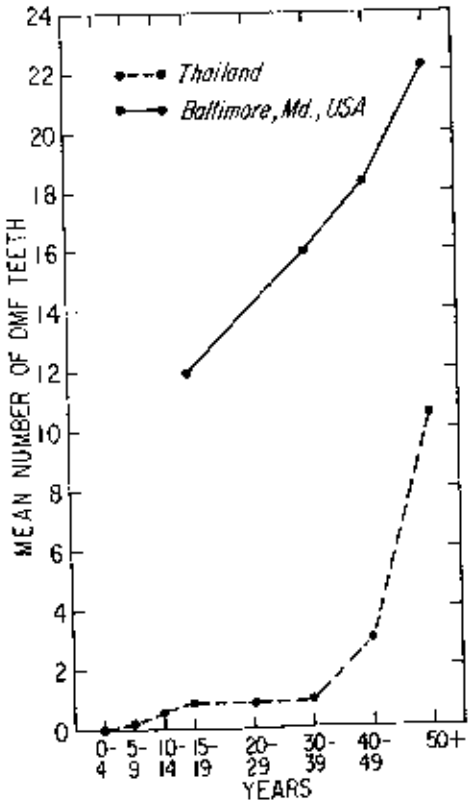


Figure 26. Mean number of decayed, missing, and filled teeth per person by age – males and females combined.
Thailand and Baltimore, Maryland, USA.

TABLE 34. FLUORIDE CONTENT OF WATER AND POOLED URINE SAMPLES COLLECTED IN THAILAND, 1960

General Area	WATER SAMPLE	Fluoride - ppm[1/]
Bangkok		.09
Haadyai		.00
Haadyai		.09
Haadyai		.07
Chiengmai		.35
Chiengmai		.32
Chiengmai		.40
Chiengmai		.40
Chiengmai		.25
Chiengmai		.80
Lopburi		.05
Lopburi		.05
Lopburi		.02
Udorn		.02
Udorn		.03
Udorn		.01
Ubol		.03
Ubol		.34
Ubol		.03
Ubol		.00
Sattaheep		.67

General Area	URINE SAMPLE	Fluoride - ppm[1/]
Bangkok		.92
Haadyai		.76
Haadyai		1.08
Haadyai		.86
Chiengmai		1.47
Chiengmai		1.23
Chiengmai		2.92
Chiengmai		1.22
Chiengmai		1.03
Lopburi		.98
Lopburi		1.01
Lopburi		.94
Udorn		.79
Udorn		1.34
Udorn		1.08
Ubol		1.99
Ubol		1.14
Ubol		2.37
Sattaheep		1.08

1/ Parts per million

TABLE 35. MEAN PERIODONTAL DISEASE SCORES PER PERSON BY AGE AND SEX, MILITARY AND CIVILIAN, THAILAND, 1960

Age Group	Sex	Military No.	Military Mean PI[1/]	Civilians No.	Civilians Mean PI[1/]
0-4	M	-	-	32	.04
	F	-	-	36	.04
5-9	M	-	-	134	.22
	F	-	-	137	.24
10-14	M	-	-	139	.43
	F	-	-	160	.32
15-19	M	-	-	43	.59
	F	-	-	82	.31
20-24	M	2,088	.68	40	1.22
	F	-	-	76	.87
25-34	M	288	.67	113	1.98
	F	-	-	149	1.05
35-44	M	36	1.01	111	3.01
	F	-	-	90	2.72
45+	M	6	4.10	126	5.53
	F	-	-	147	4.54
Total	M	2,418	.69	738	1.93
	F	-	-	877	1.46
Total	M+F	2,418	.69	1,615	1.68

Military + Civilians Totals: No. of subjects: 4,033
Mean PI: 1.08

1/ Periodontal Index

ing Russell's index for scoring gingival and periodontal conditions, the periodontal sease scores ranged from a low of 0.04 for civilian males 0-4 years of age to a high 5.53 for those 45 years and older. This Periodontal Index ranges from one to eight d is adjusted to give greater emphasis to the upper end of the scale which denotes tual bone loss with gingival inflammation (severe periodontal disease) and lesser em- asis on the lower end of the scale which indicates degree of gingivitis (mild reversi- e periodontal disease). The periodontal disease scores for males and females, military d civilian, are given in Table 35 and shown graphically in Figure 24. The scores are ch lower for the military males than for either civilian males or females. In all prob- ility, this is directly attributable to better oral hygiene of military personnel in ntrast to that of the civilian groups. If the percentage of those with destructive riodontal disease (one or more periodontal pockets and an irreversible periodontal dis- se condition) are considered, it is seen from Figure 25 that by age 33, 50 percent of e civilian males are affected and 45 percent of the females. At the same age, only 20 rcent of military males have advanced irreversible periodontal disease. By the age of years, 75 percent of the civilian males and 70 percent of the females have developed vere, irreversible periodontal disease while only 50 percent of the military males were fected (Table 36).

The practice of betel nut chewing was observed throughout Thailand and was common ong both males and females; the practice is however slowly declining. No conclusions ve been drawn from this study as to the effect of betel nut chewing on dental health.

In contrast to the United States, the prevalence of dental caries in Thailand was tremely low, especially in the younger age groups (Table 37 and Figure 26). The mean MF for permanent teeth for individuals 15 years of age and older examined in Thailand s 1.6 teeth per person. For a quasi-random sample of comparable ages examined in Bal- more, Maryland, U. S., the mean DMF per person was 18.1, indicating a 91 percent great- dental caries attack rate in the Baltimore group than in the Thailand group. A mean less than one DMF tooth per person was recorded for those examined in Thailand through e age of 39. Low DMF levels were constantly observed until after 40 years of age when ere was a sharp rise due to the loss of teeth caused by periodontal disease.

There was evidence of fluoride ingestion throughout the country with the prevalence fluorosis ranging from a low of six percent in one area to a high of 76 percent in an- her area. The prevalence and severity of the condition was greater in the northern re- ons than in the southern and central areas. Approximately 50 percent of all the mili- ry males examined showed some degree of fluorosis.

Periodontal disease is one of the most important oral health problems of Thailand; rtainly it is more of a problem for civilians than for the military personnel. Before e age of 40 years is reached, nearly 70 percent of the civilian males and 66 percent of e females have advanced irreversible periodontal disease. In contrast, however, only out 30 percent of military males of the same age have similar periodontal disease. The ractice of oral hygiene by military personnel is considered to be the most important sin- e factor for their improved gingival status as compared to the civilian population.

TABLE 36. PERCENTAGE OF PERSONS WITH DESTRUCTIVE PERIODONTAL DISEASE BY AGE AND SEX, MILITARY AND CIVILIAN, THAILAND, 1960

Age Group	Sex	Military		Civilian	
		Mean Age	Percent With DPD[1/]	Mean Age	Percent With DPD[1/]
0-4	M	-	-	3.6	0
	F	-	-	3.7	0
5-9	M	-	-	7.4	0
	F	-	-	7.6	0
10-14	M	-	-	12.3	0
	F	-	-	12.6	.6
15-19	M	-	-	17.2	9.3
	F	-	-	17.4	2.4
20-24	M	22.1	13.9	22.7	20.0
	F	-	-	22.7	17.1
25-34	M	28.0	15.6	30.2	40.7
	F	-	-	29.9	35.6
35-44	M	40.2	30.6	39.5	69.4
	F	-	-	39.1	65.6
45+	M	48.4	66.7	56.4	92.9
	F	-	-	55.1	83.7
Total	M	23.1	14.5	26.2	34.2
	F	-	-	25.6	28.6

1/ Destructive Periodontal Disease

TABLE 37. MEAN NUMBER OF DMF[1/] TEETH PER PERSON BY AGE, MALES AND FEMALES COMBINED, THAILAND AND BALTIMORE, MARYLAND, U.S.A.

Age Group	Thailand	Baltimore, Md.
0-4	.00	-
5-9	.16	-
10-14	.58	-
15-19	.96	11.92
20-29	.84	14.01
30-39	.95	15.94
40-49	2.89	18.26
50+	10.57	22.34
> 15	1.59	18.06

1/ Decayed, Missing and Filled

V. APPENDIX

A. MEMBERS OF THE THAILAND NUTRITION SURVEY TEAM

(See list of institutional addresses at the end of this list to complete individual addresses)

Name and Address	Team Position
ADMINISTRATIVE	
Allan L. Forbes, M.D. Interdepartmental Committee on Nutrition for National Defense National Institutes of Health Bethesda 14, Maryland	Co-director and clinician
Lt. Col. Irvin C. Plough, M.C., U.S. Army Commanding Officer U.S. Army Tropical Research Medical Laboratory APO 851, New York City, N.Y.	Planning Consultant
Prachoom Indrambarya, M.D., M.P.H. Director, Nutrition Division	Co-director and clinician
Vong Chutima, M.D., C.P.H. Senior Medical Advisor Ministry of Public Health	Senior medical advisor
Maj. Pravat Sacholvijarana, D. Med., D.T.M.&H., C. Malariology Preventive Medicine Division Army Medical Department	Liaison officer
Capt. Cheowchan Charumas Transportation Department, Royal Thai Army, Patibhat Rd., Bangkok	Transportation officer
Banyone Thaveramara, M.D., M.P.H. Assistant Chief, Preventive Medicine Division Royal Thai Navy	Navy liaison officer
CLINICAL	
Jeffrey H. Fryer, M.D. Associate Professor of Clinical Nutrition c/o Cornell University Ithaca, New York	Chief, Clinical Group
Bertram D. Dinman, M.D. Associate Professor Department of Preventive Medicine The Ohio State University 410 W. 10th Ave., Columbus 10, Ohio	Clinician
Amara Chandrapanond, M.D., D.Sc. Professor of Nutrition School of Public Health	Clinician
Aree Valyasevi, M.D., D.Sc. Siriraj School of Medicine Department of Pediatrics	Clinician
Puangtong Tantiwongse, M.D., M.P.H. Nutrition Division	Clinician
Capt. Visal Sarmaram, M.D., M.P.H. Preventive Medicine Division Army Medical Department	Clinician

62yTAB O -62 - 7

Lt. Commander Seni Wattasingh, M.D., M.P.H. Naval Medical Department	Clinician
Miss Kosoom Buraphagkul, R.N. Nutrition Division	Nurse
Miss Pranee Sakornpunt, R.N., P.H.N. Division of Nursing, Department of Health	Nurse
Chief Petty Officer Prasit Musigachareon Naval Medical Department	Parasitological technician
Sawang Semsarn Clerk, Department of Health	Clinical clerk
Savek Chomjamrool Clerk, Department of Health	Clinical clerk
DENTAL	
Col. George V. Burnett, D.C., U.S. Army Walter Reed Army Institute of Research Washington 25, D.C.	Dental surgeon & finance officer
Ernest C. Leatherwood, D.M.D. Epidemiology Division National Institute of Dental Research National Institutes of Health Bethesda 14, Maryland	Dental surgeon
Pranee Sirikaya, D.D.S. School Health Division	Dental surgeon
Rajda Chandravejjsmarn, D.D.S. School Health Division	Dental surgeon
Ranee Kongsamran Clerk, Department of Health	Dental clerk
MILITARY DIETARY	
C. Frank Consolazio Chief, Bioenergetics Division U.S. Army Medical Research & Nutrition Laboratory, Fitzsimons General Hospital, Denver 30, Colorado	Chief, Military Dietary Group
Sgt. Juan B. Torres, U.S. Army Bioenergetics Division (see above)	Nutritionist
Col. Chalerm Thongoothai, B.Sc. Technical Advisor, Subsistence Division Army Quartermaster Department	Nutritionist and consultant
2nd Lt. Seri Ridiroj Subsistence Division Army Quartermaster Department	Nutritionist
Sgt. Kularb Piangthavorn Subsistence Division Army Quartermaster Department	Mess survey assistant

Cpl. Suvan Sangtong-sook Subsistence Division Army Quartermaster Department	Mess survey assistant
CIVILIAN DIETARY	
Kenneth E. Harshbarger, Ph.D. Associate Professor Department of Dairy Science University of Illinois, Urbana, Illinois	Chief, Civilian Dietary Group
Miss Myrtle M. Anderson, B.Sc. FAO Nutritionist, Nutrition Division	Nutritionist
Mrs. Vina Viravaidhaya, B.Sc. Nutrition Division	Nutritionist
Miss Chamnean Tankeyura, B.Sc. Nutrition Division	Nutritionist
Miss Paktra Vanikiarti, B.Sc. Nutrition Division	Nutritionist
Miss Krisana Kittiveja, Dietician Nutrition Division	Nutritionist
Miss Wichitmalee Snidvongs, Dietician Nutrition Division	Nutritionist
FOOD TECHNOLOGY	
Zoltan I. Kertesz, Ph.D. Professor of Chemistry c/o Department of Food Science & Technology New York State Agricultural Experiment Station Cornell University, Geneva, New York	Food technologist & agriculturist
Uthai Bisolyaputra, B.Sc. Senior Nutrition Officer, Nutrition Division	Food technologist & agriculturist
BIOCHEMICAL	
R. Gaurth Hansen, Ph.D. Professor and Head of the Department of Biochemistry Michigan State University East Lansing, Michigan	Chief, Biochemistry Group
James S. Dinning, Ph.D. Professor and Head of the Department of Biochemistry, School of Medicine University of Arkansas, Little Rock, Arkansas	Biochemist
Stanley N. Gershoff, Ph.D. Assistant Professor of Nutrition School of Public Health Harvard University, Boston, Massachusetts	Biochemist
Zeki M. Tolgay, Ph.D., D.V.M. Visiting Scientist National Institute of Arthritis and Metabolic Diseases, National Institutes of Health Bethesda 14, Maryland (Currently: Kovan Sokak 44 Aydinlikevler, Ankara, Turkey)	Biochemist

Anusith Rajatasilpin, M.D., S.M., M.P.H. Instructor in Nutrition, School of Public Health	Biochemist
Miss Anothai Bhamarapravati, B.Sc., M.NS. Instructor in Nutrition, School of Public Health	Biochemist
Miss Suvimol Balawongse, B.Sc. Instructor in Nutrition, School of Public Health	Biochemist
Sangsan Grisan, M.D. Department of Physiology, Chulalongkorn School of Medicine	Biochemist
Netrachaleo Sanpitak, M.D., D.Med. Department of Physiology, Chulalongkorn School of Medicine	Biochemist
Miss Suparb Pusobha, B.Sc. Nutrition Division	Biochemist
Miss Rabiab Vachananda, B.S., C.P.H. Nutrition Division	Biochemist
Miss Brateep Kreuangkamhang, Dental Hygienist School of Public Health	Biochemist
Maj. Prachaubsuk Kanchanalak, Ph.G., Preventive Medicine Division, Army Medical Department	Biochemist
Capt. Samrit Jatinandana, M.D., D.C.P., D.T.M. & H. Chief, Laboratory Service in Clinical Pathology Naval Medical Department	Biochemist
Mrs. Veravan Suphatharapandu, R.N., P.H.N. Instructor in Public Health Nursing School of Public Health	Biochemist
Miss Surin Marshomsomboon School of Public Health	Laboratory assistant
PARASITOLOGY	
Lt. Col. Oscar Felsenfeld, M.C., USAR Executive Director, SEATO Cholera Research Laboratory	Microbiologist
Sqd. Ldr. Samarn Nanthavanit, RTAF SEATO Cholera Research Laboratory	Microbiologist
PHOTOGRAPHY	
M/Sgt. Warren R. Criss, U.S. Army Photographic Laboratory Walter Reed Army Institute of Research Washington 25, D.C.	Photographer
Amnat Nikomrat Division of Health Education Department of Health	Photographer

IODINE METABOLISM STUDY GROUP

Richard H. Follis, Jr., M.D. Chief, Laboratory for Pathologic Anatomy and Research Armed Forces Institute of Pathology Walter Reed Army Medical Center Washington 25, D. C.	Clinician
Sem Pring Puang-Geo, M.D., F.I.C.S. Director, Women's and Children's Hospitals	Clinician
Romsai Suwanik, M.D., F.I.C.S., M.Sc., C.R. Chief, Isotope Division, Department of Radiology Siriraj School of Medicine	Clinician
Trakool Lakavat, M.D. Chief, Department of Radiology Women's and Children's Hospitals	Clinician
Charn Boonmongkol, M.D. Department of Biochemistry Women's Hospital	Clinician
Kanchana Vanprapa, M.D. Department of Radiology Siriraj School of Medicine	Clinician
Direck Damrongsakdi, M.D. Department of Radiology Siriraj School of Medicine	Clinician

VESICAL CALCULI STUDY GROUP (additional team participants)

Cholvit Chutikorn, M.D. Director, Ubol Provincial Hospital	Clinician
Yanyong Pootrakool, M.D. Assistant Director, Ubol Provincial Hospital	Clinician
Sanong Unakul, M.D., M.S. Associate Professor of Physiology Siriraj School of Medicine	Clinician
Wanich Laohapan, M.D. Staff Physician, TUFEC	Clinician
Miss Varapon Vangkuntod Department of Radiology Women's Hospital	X-ray technician
Miss Chongchit Patrachon, G.N. Staff Nurse, TUFEC	Nurse
Suk Chaisri Clinical Laboratory Ubol Provincial Hospital	Laboratory technician
Miss Napa Nuntamanop Clinical Laboratory Ubol Provincial Hospital	Laboratory technician

Prakong Kuntong Sanitarian, Ubol Department of Public Health	Sanitarian
Miss Kularb Trakarncharn, G.N. Ubol Department of Public Health	Nurse
Sukri Sirikoon Sanitarian, Ubol Department of Public Health	Sanitarian

ADDRESSES OF INSTITUTIONS

Nutrition Division
Department of Health
Ministry of Public Health
Dhevaves Palace, Bangkok

Army Medical Department
Chaofa Road, Pak Klong Lord
Bangkok

School of Public Health
University of Medical Science
420/1 Rajvithi Road, Phyathai, Bangkok

Army Quartermaster Department
Royal Thai Army
Ministry of Defense, Bangkok

Siriraj School of Medicine
University of Medical Science
Dhonburi

SEATO Cholera Research Laboratory
Army Institute of Pathology
Rajvithi Road
Phyathai, Bangkok

Ubol Department of Public Health
Ubol, Thailand

Ubol Provincial Hospital
Ubol, Thailand

Naval Medical Department
Royal Thai Navy, Dhonburi

School Health Division
National Stadium
Rama 1 Road, Bangkok

Chulalongkorn School of Medicine
Chulalongkorn Hospital
University of Medical Science
Saladaeng, Bangkok

Women's Hospital
Children's Hospital
Rajvithi Road
Phyathai, Bangkok

Thailand UNESCO Fundamental
Education Center (TUFEC)
Ubol, Thailand

B. INTERDEPARTMENTAL COMMITTEE ON NUTRITION FOR NATIONAL DEFENSE

Department of Defense:
Dr. Frank B. Berry, Deputy Assistant Secretary of Defense (Manpower - Health and Medical), Chairman
Brig. Gen. Douglas B. Kendrick, Jr., USA, MC

Army:
Major Ralph C. Singer, MC
Lt. Col. Jacques L. Sherman, MC

Navy:
Dr. Howard T. Karsner
Rear Admiral Calvin B. Galloway, MC
Dr. Robert Van Reen (Alternate)

Air Force:
Lt. Col. Richard K. Miller, MC
Lt. Col. Franklin L. Bowling, MC

Department of State:
Mr. Walter M. Rudolph

Department of Agriculture:
Mr. Clarence M. Purves
Dr. Hazel K. Stiebeling

Department of Health, Education, and Welfare:
Dr. Floyd S. Daft, Vice Chairman

International Cooperation Administration:
Dr. Eugene P. Campbell
Dr. Katharine Holtzclaw

Atomic Energy Commission:
Dr. James L. Liverman

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. Arthur G. Peterson, Agricultural Economist

Consultant Panel

Dr. William F. Ashe
Dr. S. Bayne-Jones
Dr. George H. Berryman
Mr. Edwin B. Bridgforth
Dr. Gerald F. Combs
Dr. William J. Darby
Dr. Charles S. Davidson
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. Z. I. Kertesz
Dr. L. A. Maynard
Dr. William J. McGanity
Dr. William N. Pearson
Lt. Col. Irvin C. Plough
Dr. Herbert Pollack
Dr. W. H. Sebrell, Jr.
Dr. Fredrick J. Stare
Dr. Lester J. Teply
Dr. Philip L. White
Dr. John B. Youmans

C. ACKNOWLEDGMENTS

His Excellency Phra Bamras Naradool, Minister of Public Health
His Excellency General Thanom Kittikachorn, Deputy Prime Minister and Minister of Defense

Dr. Kamdhorn Suvarnakich, Director General of Health, Ministry of Public Health, who, as chairman of the committee for the organization of the nutrition survey, provided guidance to the team and secured the full cooperation and assistance of Provincial Health Departments throughout Thailand.

Major General Briard P. Johnson, Chief, Joint U.S. Military Advisory Group (JUSMAG) (Thailand), and his staff for the outstanding cooperation and support afforded the entire nutrition survey effort by JUSMAG.

The Royal Thai Air Force, Army, and Navy and the Ministry of Public Health for the excellent transportation facilities placed at the disposal of the entire team throughout the survey.

The Ministry of the Interior for the fine cooperation extended to the team throughout Thailand by provincial, and local government officials.

Lt. Col. Leonard A. Johnson, MC; Lt. Col. Emmett L. Peterson, MSC; and Capt. Frank Axtens, MSC, JUSMAG (Thailand)	for their constant support of the overall team activity, and for arranging housing facilities for the U.S. team throughout the country.
Major General Thanom Upathambhanond, Surgeon General, Royal Thai Army (RTA); Air Vice Marshall Tragool Thavaravej, Surgeon General, Royal Thai Air Force (RTAF); Rear Admiral Sanit Posakrisna, Surgeon General, Royal Thai Navy (RTN), and their staffs.	particularly for the medical and allied science personnel assigned to the team, and for the splendid cooperation of the medical companies, detachments, and hospital staffs throughout the country.
Col. Esan Chantrasen, RTA, Staff Officer, General Staff Department, Ministry of Defense.	for his constant support in the transportation needs of the team.
Dr. Swasdhi Daengsavang, Rector of the University of Medical Science, and Acting Dean, School of Public Health	particularly for the medical and allied science personnel assigned to the team from The University, for providing the laboratory space, and for his advice and consultation.
Dr. Ouy Ketusingh, Professor of Physiology, Siriraj School of Medicine, University of Medical Science	for his interest and cooperation in the special study on body composition.
Capt. Prasith Tansathit, Chief, Preventive Medicine Division, RTN, and Lt. Commander Savet Bunyasop, RTN, Supply Department, Dhonburi	for their assistance in the general organization of the survey and the Sattaheep work.

)l. Siri Pengcharoen, Chief, Preventive Medicine Division, RTA	for his assistance in the general organization of the survey, and the participation of several of his staff as team members.
)d. Leader Boonyon Peenratna, RTAF Flight Lt. Narong Suvanavisutra, RTAF, Air Force Medical Department, and Flight Lt. Vimol Senanaronka, RTAF, Supply Department, Donmuang Air Base	for their assistance in the general organization of the survey.
:. Lowell A. Woodbury, Statistician WHO, Dr. L.W. Fitzmaurice, WHO Area Representative for Thailand, and Dr. Ratko Buzina, Regional Advisor in Nutrition, WHO Regional Office for Southeast Asia	particularly for their general interest and for providing background medical statistics.
:. S.S. De, Nutrition Officer, FAO Regional Office	for his assistance in food technology and agriculture.
:. Duangmani Viseskul, Children's Hospital, Bangkok	for her assistance in field work and the opportunity of working with her in her hemoglobin E studies.
)l. Aldon M. Hoffman, Army Attache, American Embassy, Bangkok	for his assistance in communications and personal requirements of the U.S. team members.
ajor General Phorn Pirapan, RTA, Commanding Officer, Lopburi Military District, and Col. Patana Vongsanit, RTA, Director of Anandmanidol Military Hospital, Lopburi	particularly for their assistance providing transportation and lodgings for the entire team in Lopburi.
:. Chalor Chandrasuvarn, Senior Provincial Health Officer of Chiengmai Province	particularly for his additional support to the special studies on thiamine metabolism in Chiengmai.
:. Soonthara Pongspipat, Medical Officer-in-Charge, Maternal and Child Health Project, Chiengmai	for discussions and data on maternal and child health in Chiengmai.

D. LIST OF TABLES

		Page
1.	Location Areas of the Survey, Thailand	VII
2.	Definition of Abbreviations Used in the Report	VIII
3.	Summary of Extent of Survey Examinations	12
4.	General Characteristics of the Thai Civilian Family Examined	13
5.	General Characteristics of the Thai Military Man Examined (Combined Services)	14
6.	Birth and Death Rates in Thailand - 1948 and 1957	15
7.	Distribution of Medical and Allied Professional Personnel in Thailand	19
8.	Production of Some Important Food Crops in Thailand, 1959	23
9.	Abbreviated Food Balance Sheet, Thailand, 1958	23
10.	Median Thiamine Excretions Among Thai Civilians in Terms of Age	35
11.	Angular Lesions Among Thai Civilians in Terms of Age	40
12.	Median Riboflavin Excretions Among Thai Civilians in Terms of Age	40
13.	Relationship of Angular Lesions to Riboflavin Excretion Among the Thai Military and Civilians	41
14.	Relationship of Filiform Papillary Atrophy to a Number of Biochemical Determinations	42
15.	Major Parasitological Findings Among the Thai Military and Civilians by General Areas	43
16.	Prevalence of Goiter in Military Personnel--Abbreviated Examinations	47
17.	Prevalence of Goiter Among Civilians--All Types (Abbreviated Examinations)	48
18.	Prevalence of Goiter in Thai School Children	48
19.	I^{131} Uptake and I^{127} Excretion Among the Thai Military	49
20.	I^{131} Uptake and I^{127} Excretion Among Thai Civilian Females 7-18 Years of Age	53
21.	Means and Distribution of Values of Urine I^{127} Concentration Among Thai Civilian Females 7-18 Years of Age	53
22.	Shipment Distribution of Salt Through Bangkok, 1958	56
23.	Mean Serum Albumin Levels and Percent in the "Low" Range Among the Thai Military and Major Civilian Age and Sex Groups	57
24.	The Relationship of Age to Serum Levels of Vitamin A and Carotene Among Thai Civilians	62
25.	Mean Serum Vitamin C Levels Among Thai Civilians in Terms of Age	65
26.	Serum Total Cholesterols Among Thai Civilians	71
27.	Mean Individual Total Salt Intakes of Military Groups of Various Rice Economy Countries	73
28.	Relationship of Age to Blood Pressure Among Thai Civilian and Military Groups	73
29.	Number of Persons Receiving Dental Examinations in Thailand, 1960	76
30.	Mean Number of DMF Teeth per Person by Age, Males and Females Combined, Thailand, 1960	76
31.	Mean Number of DMF Teeth per Person by Age, Military Males, Thailand, 1960	77
32.	Mean Number of DMF Teeth per Person by Age, Males and Females, Thailand, 1960	78
33.	Mean Number of DMF Teeth per Person by Age and Geographical Location, Males and Females Combined, Thailand, 1960	78
34.	Fluoride Content of Water and Pooled Urine Samples Collected in Thailand, 1960	80
35.	Mean Periodontal Disease Scores per Person by Age and Sex, Military and Civilian, Thailand, 1960	80
36.	Percentage of Persons with Destructive Periodontal Disease by Age and Sex, Military and Civilian, Thailand, 1960	82

Page

37. Mean Number of DMF Teeth per Person by Age, Males and Females Combined, Thailand and Baltimore, Maryland, U.S.A. 82

LIST OF APPENDIX TABLES

PREFACE APPENDIX

-A. Location Areas of the Survey, Thailand (Ancillary Data to Table 1) 100

THE HOST AND HIS ENVIRONMENT APPENDIX

:-A. Various Parameters Among the Thai Civilians (Numbers Examined, Ages, Rural-Urban Background, Family Activity, Religion, and Area of Origin) by Locations (Abbreviated Examination Data) 102

)-A. Various Parameters Among the Thai Military (Age, Height, Weight, % Standard Weight, Source of Meals, Military Rank, Religion, Area of Origin, Blood Pressure and Pulse) by Locations 104

)-A. The Medical Acceptance and Rejection Standards for Entrance into the Royal Thai Military Services 106

)-A. Average Heights and Weights of Thai Children and Young Adults Compared with U.S. and Vietnamese Averages 107

)-A. Distribution of Heights and Weights Among Thai Military and Adult Civilians 108

)-A. Weight Changes of Civilian Adults (15+ Years) with Age, Comparing the Averages for Thailand with Vietnam and U.S.A. Groups of Approximately the Same Heights 109

)-A. Comparison of Average Heights and Weights of Thai Adults with Averages From a Number of Other Countries 111

)-A. Excerpts from Typical Examples of Nutritional and Public Health Data Obtained from Provinces Distant from Bangkok 112

)-A. Distribution of Medical and Allied Professional Personnel in Thailand and Comparable Data from the U.S. and Vietnam 114

)-A. Nutritional and Related Disease Experience in the Children's Hospital, Bangkok from January through June 1960 117

)-A. Nutritional and Related Disease Experience in the Women's Hospital, Bangkok from January through June 1960 118

)-A. Comparative Cumulative Mortality Data 119

)-A. Infant and Child Mortality by Age Groups 120

)-A. The Principal Causes of Intant (< 1 year) Mortality in Thailand Compared with Their Incidence in the U.S.A. 120

)-A. The Leading Known Causes of Death in Thailand and the U.S.A. 121

CLINICAL APPENDIX

)-A. Weights of Clothing of Thai Subjects 124

)-A. Description of Clinical Criteria Used for a Number of Clinical Entities 124

)-A. Major Clinical Findings Among the Thai Military and Civilians by General Locations--For All Groups (Sex, Age, and PL) Combined (Abbreviated Examinations) 126

)-A. Clinical Findings Among the Thai Military and Civilians with Negligible or Zero Prevalence--Detailed Examinations 127

)-A. Low-Prevalence Clinical Findings Largely Confined to Military and Adult Civilian (15+ yrs.) Males 129

LIST OF APPENDIX TABLES (Continued)

		Page
22-A.	Clinical Findings Among the Thai Military by Locations--Abbreviated Examinations	130
23-A.	Clinical Findings Among the Thai Military by Locations--Detailed Examinations	131
24-A.	Clinical Findings Among the Thai Military (Combined Services) in Terms of Age and Percent Standard Weight	132
25-A.	Height, Weight, and Percent Standard Weight Among the Thai Military as Related to Age	133
26-A.	Clinical Findings Among the Thai Military (Combined Services) in Terms of Rural Versus Urban Background and Duration of Military Service	134
27-A.	Various Parameters Among the Thai Military (Locations, Age, Weight, % Standard Weight, Height, and Area of Origin) as Related to Rural-Urban Background and Duration of Military Service	135
28-A.	Comparison of Non-Commissioned Officers (NCO's) with Enlisted Men (EM's) in Terms of Various Clinical Parameters	137
29-A.	Clinical Findings Among the Thai Civilians by Age Groups and Locations--Abbreviated Examinations	138
30-A.	Clinical Findings Among the Thai Civilians by Age Groups and Locations--Detailed Examinations	141
31-A.	Clinical Findings Among the Thai Civilians in Terms of Age and Sex	
34-A.	Age, Height, Weight, and Percent Standard Weight Among Thai Civilian Adults (15+ Years) by Location	149
35-A.	Height, Weight, and Percent Standard Weight Among Thai Civilians in Terms of Age and Sex Groups (Abbreviated Examinations)	150
36-A.	Blood Pressure, Pulse, and Total Serum Cholesterols Among the Thai Civilians in Terms of Sex, Age, and Weight	152

BIOCHEMICAL APPENDIX

37-A.	Effect of Storage of Blood on Serum Levels of Vitamin A and Vitamin C	156
38-A.	Suggested Guide to Interpretation of Blood and Urine Data	157
39-A.	Biochemical Findings Among the Thai Military by Locations--Mean and Median Values	158
40-A.	Biochemical Findings Among the Thai Military by Locations--Distribution of Values	160
41-A.	Biochemical Findings Among the Thai Military (Combined Services) in Terms of Age, Percent Standard Weight, and Duration of Military Service	163
42-A.	Biochemical Findings Among the Thai Civilians (Sex, Age, and PL Groups Combined) by General Areas--Mean and Median Values	165
43-A.	Biochemical Findings Among the Thai Civilians (Sex, Age, and PL Groups Combined) by General Areas--Distribution of Values	166
44-A.	Biochemical Findings Among the Thai Civilians by Major Age Groups and Individual Locations--Mean Values	169
45-A.	Biochemical Findings Among the Thai Civilians in Terms of Age and Sex	173
46-A.	Biochemical Findings Among the Thai Military and Civilians--Distribution of Values in Detail for All Groups Combined	175
47-A.	Biochemical Findings Among the Thai Civilians in Terms of Major Age and Sex Groups with Comparisons of Pregnant and Lactating Women and the Military	179

LIST OF APPENDIX TABLES (Continued)

		Page
58-A.	Biochemical Findings Among the Thai Military and Civilians--Subjects with Zero Blood Levels and Urinary Excretions	181
59-A.	Relationship Between Some Biochemical Values and Several Clinical Lesions	182
	IODINE NUTRITION APPENDIX	
60-A.	School Census of Thailand, 1945-1955	184
	DIETARY APPENDIX--MILITARY	
61-A.	Basic Monetary Ration Allowance--Thai Military Privates (Baht/Day)	186
62-A.	Over-Preparation of Foods (leftovers)--Thai Military Units	191
63-A.	Nutrient Composition of the Thai Combat Ration	191
64-A.	Daily Nutrient Intake per Individual per Day Among the Thai Military Calculated from Standard Tables--Individual Daily Values	194
65-A.	Mean Nutrient Intake per Individual per Day Among the Thai Military Calculated from Standard Tables	196
66-A.	Nutrient Intake per Individual per Day Among the Thai Military by Food Composite Analyses	197
67-A.	Plate Waste Among Thai Military Groups--Percent Discarded per Unit per Day	198
68-A.	Percent Preparation Wastes (inedible) at Various Thai Military Units	199
69-A.	Major Food Items Consumed Daily Among the Thai Military by Location	200
70-A.	Major Food Items Consumed Daily Among the Thai Military--Means for All Units Combined	201
71-A.	Major Food Sources of Individual Nutrients Among the Thai Military--Percent Means for All Units Combined	202
72-A.	Basic Daily Ration Allowance for All Thai Military Units	203
73-A.	Distribution of Rations for an Army Field Unit at Ubol, Thailand	203
74-A.	Mineral Composition of Water and Salt Samples (Military Sources)	204
75-A.	Chemical Analyses of Individual Foods Obtained from Thai Military Units	205
76-A.	Bomb Calorimetry Comparisons for Total Calories Within the Thai Military	207
77-A.	Quantities and Proportions of Nutrients Contributed by Rice Alone Within the Thai Army	207
78-A.	Mean Individual Nutrient Intakes per Man per Day--Comparison of the Thai Military with Results of ICNND Studies in Military Groups of Other Far Eastern Countries	208
79-A.	Suggested Guide to Interpretation of Nutrient Intake Data	209
	DIETARY APPENDIX--CIVILIAN	
70-A.	Nutrient Intake per Individual per Day Among the Thai Civilians, Calculated from Standard Food Tables	213
71-A.	Nutrient Intake per Individual per Day Among the Thai Civilians by Food Composite Analyses	214
72-A.	Estimated Calorie Requirements per Caput for the Thai Civilian Population Sample by Age Groups	216
73-A.	Estimated Calorie Requirements per Caput for Thai Civilian Families in Each Location Based on Requirements of Each Age Group	216
74-A.	Estimated Protein Requirement for the Thai Civilian Population Sample by Age Groups	217

LIST OF APPENDIX TABLES (Continued)

		Page
75-A.	Average Amounts of Specific Foods Consumed per Caput for Thai Civilian Families of Each Village	217
76-A.	Average Daily Consumption of Individual Foods per Caput for Thai Civilians	218
77-A.	Major Food Sources of Individual Nutrients Among the Thai Civilians--Percent Means for All Groups Combined	219
78-A.	Summary of Chemical Analyses of Rice Samples	219
79-A.	Chemical Analyses of Individual Foods Obtained from Thai Civilian Groups	220
80-A.	Essential Amino Acid Composition of Selected Proteins with FAO Reference Protein	222
81-A.	Amino Acid (A.A.) Composition of Two Thai Rice Samples and a Thai Fish Sauce Sample	223
82-A.	Mineral Composition of Thai Civilian Food Composites, Salt Samples, and Water Samples	224

PARASITOLOGY APPENDIX

83-A.	Parasitological Findings Among the Thai Military by General Areas	225
84-A.	Parasitological Findings Among the Thai Civilians by General Areas	226
85-A.	Parasitological Findings Among the Thai Military and Civilians--Relationship of Hemoglobin Values to Intestinal Infestation	227
86-A.	Parasitological Findings Among the Thai Military and Civilians--Comparison with the 1951-1955 Survey of the Thai Division of Communicable Disease Control	228

FOOD RESOURCES APPENDIX

87-A.	Shipment Distribution of Salt Through Bangkok, 1958	231

VARIOUS SURVEY FORMS APPENDIX

88-A.	Survey of Food and Nutrition Services in the Armed Forces (ICNND Form #1)	237
89-A.	Food Inventory Record (ICNND Form #2)	238
90-A.	Recipe--Food Preparation Form (ICNND Form #3)	239
91-A.	Food Waste (ICNND Form #4)	240
92-A.	Summary--Nutritional Evaluation (ICNND Form #5)	241
93-A.	Dietary Questionnaire No. 1E (ICNND)	242
94-A.	Daily Determination of Examiner Differences on Brief Examinations (Thailand Form)	245

LIST OF SPECIAL STUDIES TABLES

BANG CHAN FOLLOW-UP STUDIES

1-B.	Selected Clinical Findings Comparing 5-14 Year Old Children from Bang Chan and the General Thailand Survey	251
2-B.	Biochemical Findings Comparing 5-9 Year Old Males from Bang Chan and the General Thailand Survey	253
3-B.	Children Free from Caries of Permanent Teeth and Caries Incidence in Permanent Teeth, 1953 and 1960	254

Page

4-B. Mean Heights and Weights, by Age, of Males and Females in Bang Chan, Observations in 1952-55 Compared to Those in 1960 257

5-B. Mean Body Weight of Bang Chan School Children, Ages 8 to 13, for Three Years, 1952-1955 258

6-B. Mean Weights of Bang Chan School Children, Quarterly Observations from November 1952 through November 1955 258

7-B. Clinical Findings Among the Thai Civilians in Terms of Age and Sex Groups - Comparison of Bang Chan with the General Thailand Survey 259

8-B. Biochemical Findings Comparing Bang Chan with Civilians of the General Thailand Survey 260

STUDY OF AN INSTRUMENT FOR OBJECTIVE MEASUREMENT OF THE ACHILLES REFLEX

1-C. Mean Ankle Reflex Response 264

FOOD CONCENTRATION AND URINARY EXCRETION OF STRONTIUM^{90} IN THAILAND

1-D. Strontium^{90} in Food Composites, Urine Samples, and Rice Samples in Thailand 267

EVALUATION OF RIBOFLAVIN AND THIAMINE LOAD TESTS

1-E. Riboflavin Excretion in Students of the School of Public Health, Bangkok Before and After Oral Administration of 5 mg of Riboflavin 272

2-E. Riboflavin Excretion in Chiengmai Military Before and After Oral Administration of 8 mg of Riboflavin 273

3-E. Thiamine Excretion in 50 Pregnant or Lactating Women from Chiengmai Province Before and After Oral Administration of 5 mg of Thiamine (December 5, 1960) 274

4-E. Thiamine Excretion in 67 Pregnant or Lactating Women from the Women's Hospital, Bangkok Before and After Oral Administration of 5 mg of Thiamine (Feb. 27 and March 13, 1961) 275

BODY COMPOSITION STUDIES

1-G. Skinfold Thickness Among the Thai Military (Detailed Examinations) in Terms of Various Parameters 278

2-G. Skinfold Thickness Among the Thai Civilians (Detailed Examinations) in Terms of Various Parameters 279

E. LIST OF FIGURES

		Page
1.	The Kingdom of Thailand, Showing the 9 Provincial Regions and the General Areas of the Nutrition Survey	VI
2.	Distribution of Civilian Abbreviated Examinations as to Sex and Age	13
3.	Average Heights and Weights of Thai Children and Young Adults Compared with U.S. and Vietnamese Averages - Males	16
4.	Average Heights and Weights of Thai Children and Young Adults Compared with U.S. and Vietnamese Averages - Females	17
5.	Distribution of Heights Among Adult Thai (20+ Years)	18
6.	Distribution of Weights Among Adult Thai (20+ Years)	18
7.	Weight Changes of Civilian Adults with Age, Comparing the Averages for Thailand with Vietnam and the U.S.A. (males and females separately)	18
8.	Cumulative Mortality and Infant and Child Mortality	21
9.	Thiamine Nutrition - Thailand	32
10.	Riboflavin Nutrition - Thailand	38
11.	Anemia - Thailand	44
12.	I^{131} Uptakes Among the Thai Military	50
13.	I^{131} Uptakes Among 135 Thai School Girls	51
14.	Scattergram of the Relationship of I^{131} Uptake to I^{127} Excretion in Thai School Girls	54
15.	The Relationship of Means of I^{131} Uptake to I^{127} Excretion in Thai School Girls in Various Areas of the Country	54
16.	Protein Nutrition - Thailand	58
17.	Vitamin A Nutrition - Thailand	60
18.	Vitamin C Nutrition - Thailand	64
19.	Niacin Nutrition - Thailand	66
20.	Calcium Intake - Thailand	68
21.	Fat Intake - Thailand	70
22.	Salt Intake - Thailand	72
23.	Mean Number of Decayed, Missing, and Filled Teeth per Person by Age and Geographical Location, Males and Females Combined - Thailand, 1960	79
24.	Mean Periodontal Disease Scores by Age for Persons Examined in Thailand - 1960 - Males and Females	79
25.	Percentage of Persons with Destructive Periodontal Disease by Age and Sex - Military and Civilian - Thailand, 1960	79
26.	Mean Number of Decayed, Missing, and Filled Teeth per Person by Age - Males and Females Combined - Thailand and Baltimore, Maryland, U.S.A.	79

LIST OF APPENDIX FIGURES

1-A.	Population Densities of the 71 Provinces of the Kingdom of Thailand	101
2-A.	Comparison of Average Heights and Weights of Thai Adults with Averages from Other Countries	110
3-A.	Ministry of Public Health (administrative structure)	115
4-A.	National Nutrition Committee (administrative structure)	116
5-A.	Comparative Mortality Rates for Specific Disease Entities in Thailand and the U.S.A.	123
6-A.	Distribution of Values for a Number of Biochemical Determinations Not Presented in the Main Report (Total Serum Protein, A/G Ratio, Hematocrit, and MCHC)	178
7-A.	The ICNND Detailed Clinical Card - Front	232
8-A.	The ICNND Detailed Clinical Card - Back	233
9-A.	The ICNND Abbreviated Clinical Card	234
10-A.	The National Institute of Dental Research Dental Card - Front	235

LIST OF APPENDIX FIGURES (Continued)

		Page
11-A.	The National Institute of Dental Research Dental Card - Back	236

LIST OF SPECIAL STUDIES FIGURES

1-B.	Mean Quarterly Weights of Bang Chan School Children - Composite Curves for 1952-1955	250
2-B.	Mean Weights of Bang Chan School Children - Quarterly Observations from November 1952 through November 1955	250
1-C.	An Instrument for Objective Measurement of the Achilles Reflex	263
2-C.	Urinary Thiamine Excretion vs. Achilles Reflex Response (Male)	263
3-C.	Urinary Thiamine Excretion vs. Achilles Reflex Response (Female)	263
1-E.	Riboflavin Load Tests in 51 Students of the School of Public Health, Bangkok, Thailand	269
2-E.	Oral Riboflavin Load Test (Dose = 8 mg) Among Chiengmai Military	269
3-E.	Thiamine Load Tests (5 mg Orally - 4 Hour Excretion) in Pregnant or Lactating Women - 50 Women in Chiengmai Province and 67 in Bangkok	271
1-G.	The Relationship of Skinfold Thickness to Age Among the Thai Military and Civilians	277

829788 O - 62 - 8

F. PREFACE APPENDIX

TABLE 1-A. LOCATION AREAS OF THE SURVEY, THAILAND (ANCILLARY DATA TO TABLE 1)[1/]

Date	General Location	Specific Location
Oct. 20	Bangkok	1st Cavalry Regiment, Cavalry Division, RTA
Oct. 21	Bangkok	1st & 2nd Battalions, 11th Infantry Regiment, 1st Division, RTA, (10 km along Bangkok Airport Road)
Oct. 24	Songkhla	5th RCT and Songkhla MP, RTA, Camp Kohong (near Haadyai)
Oct. 25	Songkhla	3rd Infantry Battalion, 5th RCT, RTA, Camp Kohong (near Haadyai)
Oct. 26	Songkhla	Bang Dan (Buddhist) Village (8 km from Songkhla on the Haadyai-Songkhla Road)
Oct. 27	Songkhla	Don Kee Leg (Islam) Village (18 km from Songkhla, 4 km off the Haadyai-Songkhla Road)
Oct. 31	Chiengmai	7th RCT and Chiengmai MP, RTA, Fort Kavila (Chiengmai)
Nov. 1	Chiengmai	Field Artillery Battalion, 7th RCT, RTA (Artillery Station, 8 km NW of Chiengmai)
Nov. 2	Chiengmai	Ban Pon Village, Nong Kwai Commune, Hang Dong District (15 km SW of Chiengmai)
Nov. 3	Chiengmai	San Pong Village, San Pong Commune, Maerim District (19 km NW of Chiengmai)
Nov. 4	Chiengmai	Padad Village, Yang Lerng Commune, Sarapee District (13 km SE of Chiengmai)
Nov. 7	Lopburi	Defense Battalion, Koketbiem Air Base, RTAF (enlisted personnel) (near Lopburi)
Nov. 8	Lopburi	Ta Kae Village, Ta Kae Commune, Muang District (about 7 km from Lopburi)
Nov. 9	Lopburi	Defense Battalion and 2nd Wing, Koketbiem Air Base, RTAF (NCO personnel)
Nov. 16	Udorn	2nd & 3rd Infantry Battalions, 13th RCT, RTA (Camp 7 km from Udorn)
Nov. 17	Udorn	Rachinutis High School (provincial school in Udorn)
Nov. 17	Udorn	1st Infantry Battalion and Headquarters, 13th RCT (in Udorn)
Nov. 18	Udorn	Phon Ngam Village, Nong Harn Commune, Nong Harn District (21 km E of Udorn)
Nov. 19	Udorn	Marg Yah Village, Muang District (above 20 km W of Udorn)
Nov. 21	Ubol	6th RCT, RTA (outskirts of Ubol)
Nov. 22	Ubol	Sri Kai Village, Kumueng Commune (14 km S of Ubol)
Nov. 23	Ubol	Ban Kao Village, Kud Lard Commune (6 km E of Ubol)
Nov. 24	Ubol	Nong Manao Village, Kam Yai Commune, Muang District (10 km NNE of Ubol)
Nov. 28	Sattaheep	1st & 3rd Infantry Battalions, Artillery Battalion, and Anti-aircraft Battalion, RTN, Marine Base (Sattaheep)
Nov. 29	Sattaheep	Marine Base, RTN (mixed personnel) (Sattaheep)
Dec. 12	Bangkok	Bang Chan Village, Bang Chan Commune, Minburi District (30 km NE of Bangkok)

1/ abbreviations: RTA = Royal Thai Army; RTN = Royal Thai Navy (Marine Corps); RTAF = Royal Thai Air Force; MP = Military Province (Militia); RCT = Regimental Combat Team

POPULATION DENSITIES OF THE 71 PROVINCES

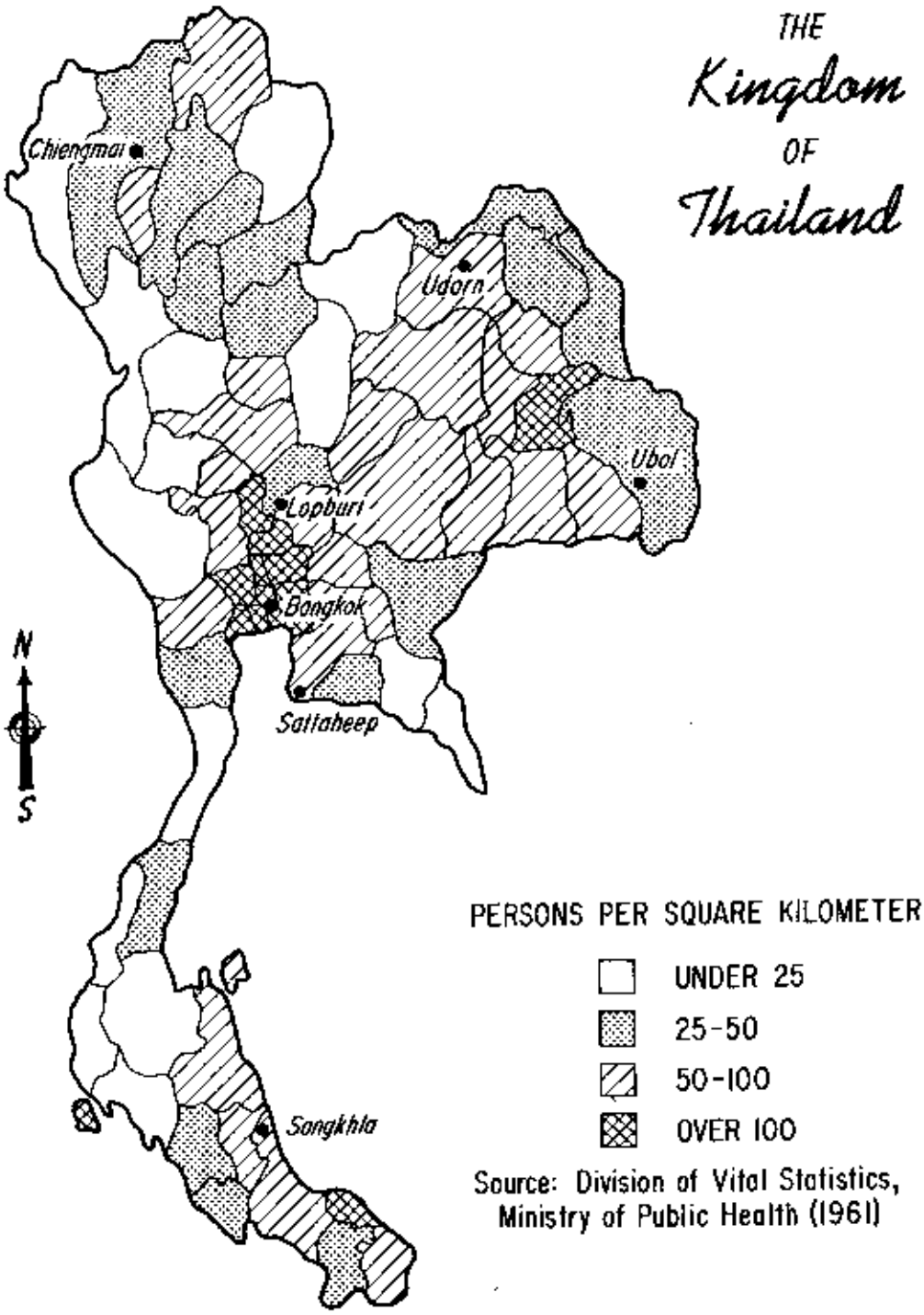


Figure 1-A.

TABLE 2-A. VARIOUS PARAMETERS AMONG THE THAI CIVILIANS (NUMBERS EXAMINED, AGES, RURAL - URBAN BACKGROUND, FAMILY ACTIVITY, RELIGION, AND AREA OF ORIGIN) BY LOCATIONS (ABBREVIATED EXAMINATION DATA)

General Area	Songkhla		Chiengmai			Lop-buri	Udorn			Ubol			
Specific Village	Bang Dan (Buddhist)	Don Keeleg (Islam)	Ban Pon	Sen Pong	Padad	Ta Kae	Rachinutis High School	Phon Ngam	Marg Yah	Sri Kai	Ban Kao	Nong Mansao	TOTAL
Nos. examined													
Males	106	69	85	68	97	75	76	118	150	63	91	109	1107
Females (all)	132	74	86	75	113	91	132	110	147	51	107	164	1282
Pregnant	7	5	2	1	4	1	-	4	17	2	4	3	50
Lactating	11	10	11	10	16	8	-	24	22	10	20	25	167
Totals	238	143	171	143	210	166	208	228	297	114	198	273	2389
						Percent Distribution							
Ages (years)													
Males													
0-4	5.5	4.9	8.8	6.3	10.0	10.2	-	14.0	9.1	7.0	10.1	12.1	8.4
5-9	9.2	7.7	7.0	9.8	8.1	10.2	-	8.8	10.1	4.4	9.1	8.4	7.9
10-14	8.4	5.6	7.6	2.8	4.3	4.2	36.5	3.9	7.1	0.9	5.6	6.2	8.2
15-19	5.0	2.1	1.8	2.8	0.5	1.8	-	3.5	3.0	-	1.5	0.7	2.0
20-29	5.9	5.6	4.1	8.4	5.7	1.8	-	5.7	6.1	3.5	3.0	1.5	4.2
30-39	2.1	10.5	7.6	6.3	6.7	6.0	-	7.4	8.4	14.9	7.1	4.0	6.3
40-49	2.1	4.2	2.3	1.4	4.8	4.2	-	4.8	3.0	9.6	6.1	1.5	3.4
50-59	3.4	4.9	8.8	3.5	1.9	4.2	-	2.6	3.0	11.4	2.5	3.7	3.7
60+	2.9	2.8	1.8	6.3	4.3	2.4	-	0.9	0.7	3.5	1.0	1.8	2.1
Totals	44.5	48.2	49.7	47.6	46.2	45.2	36.5	51.8	50.5	55.3	46.0	39.9	46.3
Females													
0-4	8.8	7.0	7.0	10.5	9.5	7.8	-	7.9	10.1	6.1	10.1	12.4	8.4
5-9	10.5	3.5	7.0	5.6	10.5	7.2	-	8.8	8.8	7.9	8.1	11.4	7.8
10-14	7.6	7.7	4.1	2.1	5.7	4.8	48.6	7.0	6.7	2.6	6.6	4.8	9.4
15-19	2.9	4.9	3.5	3.5	2.4	4.8	14.9	3.5	4.4	1.8	2.5	4.4	4.6
20-29	9.7	11.2	5.8	10.5	6.7	4.8	-	8.8	7.1	4.4	10.6	7.7	7.3
30-39	4.2	4.2	9.9	5.6	8.1	7.2	-	7.4	6.1	7.9	5.1	6.2	5.9
40-49	5.5	3.5	3.5	4.2	1.4	6.6	-	2.6	3.0	7.9	6.1	5.9	4.0
50-59	4.2	4.2	5.8	4.9	5.2	4.2	-	0.9	2.7	1.8	2.5	3.3	3.2
60+	2.1	5.6	3.5	5.9	4.3	7.2	-	1.3	0.7	4.4	2.5	4.0	3.1
Totals	55.5	51.7	50.3	52.4	53.8	54.8	63.5	48.2	49.5	44.7	54.0	60.1	53.7

(continued on next page)

ABLE 2-A. (CONTINUED - page 2) (CIVILIANS - AGE, BACKGROUND, ACTIVITY, RELIGION, AREA F ORIGIN - BY LOCATION)

eneral Area		Songkhla		Chiengmai			Lop-buri	Udorn			Ubol			
pecific illage		Bang Dan (Buddhist)	Don Kee Leg (Islam)	Ban Pou	San Pong	Padad	Ta Kae	Rachinutis High School	Phon Ngam	Marg Yah	Sri Kai	Ban Kao	Nong Manao	TOTAL
		Percent Distribution												
amily ackground														
Rural		100	100	100	100	100	74.1	38.5	99.6	99.3	100	100	100	92.7
Urban		-	-	-	-	-	25.9	61.5	0.4	0.7	-	-	-	7.3
amily ctivity														
Farming		87.4	100	100	100	100	97.0	9.6	93.4	100	100	99.5	100	90.0
Unskilled labor		8.4	-	-	-	-	-	3.8	3.5	-	-	-	-	1.5
Skilled labor		1.3	-	-	-	-	-	1.9	-	-	-	0.5	-	0.3
Shop keeping		-	-	-	-	-	-	33.2	3.1	-	-	-	-	3.2
Administrative & professional		2.9	-	-	-	-	3.0	51.4	-	-	-	-	-	5.0
eligion														
Buddhist		100	-	100	100	100	100	100	100	100	100	100	100	94.0
Moslem		-	100	-	-	-	-	-	-	-	-	-	-	6.0
rea of Origin[1/]	Region No.													
Central	I	-	-	-	-	-	98.8	1.4	-	-	-	-	-	7.0
Eastern	II	-	-	-	-	-	-	0.5	-	-	-	-	-	<0.1
Northeastern	III	-	-	-	-	-	0.6	5.8	-	-	100	100	100	25.0
Northern	IV	-	-	-	-	-	-	87.0	100	100	-	-	-	29.6
Northwestern	V	-	-	100	100	100	-	1.0	-	-	-	-	-	22.0
Western	VI	-	-	-	-	-	0.6	0.5	-	-	-	-	-	0.1
Southwestern	VII	-	-	-	-	-	-	2.4	-	-	-	-	-	0.2
Southern	VIII	-	-	-	-	-	-	1.4	-	-	-	-	-	0.1
Southern-most	IX	100	100	-	-	-	-	-	-	-	-	-	-	15.9

1/ for the boundaries of these various regions, see Figure 1.

TABLE 3-A. VARIOUS PARAMETERS AMONG THE THAI MILITARY (AGE, HEIGHT, WEIGHT, % STANDARD WEIGHT, SOURCE OF MEALS, MILITARY RANK, RELIGION, AREA OF ORIGIN, BLOOD PRESSURE AND PULSE) BY LOCATIONS

ABBREVIATED EXAMINATIONS	ARMY						AIR FORCE			NAVY	
	Bangkok	Songkhla	Chiengmai	Udorn	Ubol	TOTAL	Koketh iem (Lop-buri)(enlisted)	Koketh iem (Lop-buri)(NCO's)	TOTAL	Sattaheep (TOTAL)	COMBINED SERVICES
Number examined	553	560	736	602	466	2917	406	378	784	624	4325
					Mean Values						
Age (years)	22	22	22	22	21	22	21	28	24	22	22
Height (cm)	165	163	163	162	162	163	164	165	164	163	163
Weight (kg)	56.1	55.8	53.0	56.3	55.3	55.2	54.8	55.0	54.9	57.4	55.4
% standard weight	93.3	94.6	89.2	96.8	94.9	93.5	91.8	89.8	90.8	96.6	93.5
					Percent Prevalence						
Age (yrs.) < 21	-	-	-	-	-	-	-	0.5	0.3	0.8	0.2
21	43.2	43.9	53.0	46.8	79.8	52.4	73.6	2.4	39.3	41.2	48.4
22-24	56.6	52.3	32.6	52.7	20.0	43.1	26.4	20.9	23.7	52.1	40.8
25-29	0.2	2.9	11.5	0.5	0.2	3.6	-	54.8	26.4	4.5	7.9
30-39	-	0.7	2.7	-	-	0.8	-	14.0	6.8	1.4	2.0
> 39	-	0.2	0.1	-	-	0.1	-	7.4	3.6	-	0.7
% standard weight											
70-79	1.1	0.9	6.1	0.2	0.2	2.0	3.7	8.2	5.9	0.8	2.5
80-89	28.0	22.0	48.2	13.5	16.3	27.1	31.8	46.0	38.6	14.6	27.4
90-99	53.9	54.7	38.5	52.5	62.7	51.3	52.7	34.6	44.0	50.5	49.8
100-109	15.9	20.4	6.9	30.2	18.7	17.9	10.8	7.7	9.3	29.8	18.1
110+	1.1	2.0	0.3	3.7	2.1	1.7	1.0	3.4	2.2	4.3	2.2
Meals: at home	-	-	-	-	-	-	-	80.7	38.9	10.6	8.6
military messes	100	100	100	100	100	100	100	19.3	61.1	89.4	91.4
Military rank:											
enlisted	100	99.8	82.1	99.7	100	95.4	100	0.5	52.0	88.5	86.5
NCO's	-	0.2	17.9	0.3	-	4.6	-	99.5	48.0	11.5	13.5

(continued on next page)

ABLE 3-A. (CONTINUED-page 2) (MILITARY-AGE, HEIGHT, WEIGHT, ETC. BY LOCATION)

BBREVIATED XAMINATIONS		ARMY						AIR FORCE			NAVY	
		Bangkok	Songkhla	Chiengmai	Udorn	Ubol	TOTAL	Kokethiem (Lop-buri)(enlisted)	Kokethiem (Lop-buri)(NCO'S)	TOTAL	Sattaheep (TOTAL)	COMBINED SERVICES
		Percent Prevalence										
eligion:	Buddhist	?	50.7	99.9	99.5	100	71.4	100	100	100	99.5	80.7
	Moslem	?	48.9	-	-	-	9.4	-	-	-	0.5	6.4
	Christian	?	0.2	0.1	0.5	-	0.2	-	-	-	-	0.1
	Unknown	100	0.2	-	-	-	19.0	-	-	-	-	12.8
rea of Origin 1/	Region No.											
Central	I	52.6	0.4	0.7	-	-	10.2	99.8	64.0	82.5	3.5	22.4
Eastern	II	1.8	-	0.3	-	-	0.4	-	7.1	3.4	65.7	10.4
Northeastern	III	0.2	-	0.5	2.3	100	16.6	-	4.2	2.0	0.8	11.7
Northern	IV	-	-	0.1	97.7	-	20.2	-	3.7	1.8	0.2	14.0
Northwestern	V	0.2	-	97.0	-	-	24.5	-	1.6	0.8	-	16.7
Western	VI	0.2	-	1.2	-	-	0.3	-	7.7	3.7	0.6	1.0
Southwestern	VII	45.0	0.4	0.1	-	-	8.6	0.2	11.1	5.5	4.9	9.0
Southern	VIII	-	0.5	-	-	-	0.1	-	0.5	0.3	14.3	2.2
Southern-most	IX	-	98.8	-	-	-	19.0	-	-	-	-	12.8
ETAILED EXAMINATIONS												
umber examined		108	122	183	129	66	608	99	94	193	79	880
		Mean Values										
ystolic B.P. (mm. Hg.)		116	120	114	119	119	117	115	116	115	119	117
Diastolic B.P. (mm. Hg.)		69	74	71	77	77	73	77	74	76	77	74
Pulse (per min.)		72	72	75	77	74	74	68	73	71	66	73

1/ For boundaries of these various regions, see Figure 1.

TABLE 4-A. THE MEDICAL ACCEPTANCE AND REJECTION STANDARDS FOR ENTRANCE INTO THE ROYAL THAI MILITARY SERVICES 1/

ENLISTED PERSONNEL	NCO ELIGIBILITY
1. minimum age: 21 years (compulsory registration)	The following are grounds for rejection:
2. difference between Army, Navy, and Air Force: none	1. heart disease
3. minimum height: 146 cm	2. chronic pulmonary disease
4. minimum weight: none	3. tuberculosis (any type)
5. induction chest x-ray: none	4. chronic gastrointestinal disease (peptic ulcer, enterocolitis, hemorrhoids, etc.)
6. induction dental examination: none	5. gross deformities
7. extent of induction medical examination: classification into the following groups on basis of general impression:	6. opthalmological disorders (chronic inflammatory disease and impaired vision - less than 6/9 by Snellen test)
Grade 1: good health - accepted Grade 2: fair health - accepted 2/ Grade 3: the sick who cannot be cured in 30 days - rejected Grade 4: the invalid - rejected	7. impaired hearing, unilateral or bilateral
	8. stammer
	9. chronic tonsillitis
	10. chronic hypertrophic rhinitis
8. rejection rate in 1953:	11. abnormal voice
Grade 3: 0.95% Grade 4: 1.20% Very small men: 6.26%	12. goiter
	13. severe dermatitis
	14. inguinal hernia, varicocele, epididymitis, and other diseases of the genitalia
	15. yaws and crab yaws
	16. active venereal disease
	17. alcoholism and/or drug addiction
	18. serious nervous disorders
	19. endocrinological diseases

1/ data supplied by Directorate of Joint Logistics, Defense General Staff Department, Ministry of Defense, Bangkok.

2/ Grade 2 men are not called up unless there are insufficient numbers of men in Grade 1, and when called up, they become combat support troops only. One of the criteria for Grade 2 classification is visible goiter.

TABLE 5- A. AVERAGE HEIGHTS AND WEIGHTS OF THAI CHILDREN AND YOUNG ADULTS COMPARED WITH U.S. AND VIETNAMESE AVERAGES (see Figures 3 & 4)

		Thailand			Vietnam 1/		U.S.A. 2/	
Males	Age (Yrs.)	No. Subj.	Height (cm)	Weight (kg)	Height (cm)	Weight (kg)	Height (cm)	Weight (kg)
	< 1	35	62	6.2	62	6.0	68	8.2
	1	35	71	8.0	67	7.7	83	11.8
	2	42	79	9.8	69	8.8	92	14.0
	3	53	86	11.2	82	10.9	100	16.1
	4	35	90	12.4	93	13.0	107	18.1
	5	45	100	14.2	97	14.5	113	20.0
	6	47	104	15.9	108	17.4	118	21.8
	7	31	110	17.1	111	18.6	124	24.3
	8	26	113	18.8	116	20.0	131	27.2
	9	26	116	19.9	121	22.2	136	29.9
	10	27	124	22.8	123	23.5	141	32.9
	11	44	131	26.0	126	24.5	145	36.1
	12	53	135	28.4	131	27.0	150	39.9
	13	44	141	32.6	134	28.9	156	44.5
	14	16	144	33.7	143	33.7	162	50.8
	15	4	149	40.5	147	39.7	168	56.7
	16	9	152	41.1	152	40.8	172	60.8
	17	11	157	47.5	156	45.0	174	-
	18	5	158	46.6	156	46.1	-	-
	19	8	162	51.2	154	46.4	-	-
Females	< 1	36	63	6.4	-	4.5	66	7.5
	1	32	70	7.5	66	6.9	84	11.0
	2	33	77	9.2	71	8.3	92	13.5
	3	63	84	10.6	81	10.4	99	15.5
	4	34	92	12.5	89	12.1	106	17.7
	5	42	98	13.8	95	13.7	112	19.5
	6	40	105	15.6	104	15.7	118	21.5
	7	31	109	16.7	111	17.9	123	23.5
	8	27	113	18.4	115	19.1	128	26.5
	9	29	119	20.2	119	20.9	134	29.0
	10	31	123	22.0	126	23.7	140	32.0
	11	40	132	26.8	131	26.6	146	36.0
	12	54	137	30.4	132	27.6	153	42.0
	13	39	142	34.5	137	31.1	158	46.5
	14	37	144	36.0	143	36.6	160	50.0
	15	27	148	40.7	141	35.8	161	52.5
	16	26	150	40.4	144	40.9	161	53.5
	17	17	150	44.6	147	41.5	161	-
	18	20	154	47.7	147	43.1	-	-
	19	11	151	46.3	145	43.1	-	-

1/ Vietnam data from ICNND survey of 1959 (34).

2/ U.S. data from State University of Iowa Child Welfare Research Station.

TABLE 6-A. DISTRIBUTION OF HEIGHTS AND WEIGHTS AMONG THAI MILITARY AND ADULTS CIVILIANS (see Figures 5 & 6)

Height Means & Ranges (cm)	Combined Military Services		Civilian Males (20+ years)		Civilian Females 1/ (20+ years)	
	No. of Subjects	% of Total	No. of Subjects	% of Total	No. of Subjects	% of Total
136.0 - 138 - 139.9	-	-	-	-	3	0.9
140.0 - 142 - 143.9	-	-	-	-	18	5.2
144.0 - 146 - 147.9	5	0.1	1	0.2	49	14.1
148.0 - 150 - 151.9	56	1.3	14	3.0	110	31.6
152.0 - 154 - 155.9	260	6.0	55	11.7	95	27.3
156.0 - 158 - 159.9	720	16.7	120	25.5	53	15.2
160.0 - 162 - 163.9	1,171	27.1	123	26.2	16	4.6
164.0 - 166 - 167.9	1,201	27.8	96	20.4	3	0.9
168.0 - 170 - 171.9	627	14.5	44	9.4	1	0.3
172.0 - 174 - 175.9	220	5.1	13	2.8	-	-
176.0 - 178 - 179.9	54	1.2	4	0.8	-	-
180.0 - 182 - 183.9	8	0.2	-	-	-	-
184.0 - 186 - 187.9	2	-	-	-	-	-
Totals	4,324	100.0	470	100.0	348	100.1
Mean Height (cm)	163.2	-	161.0	-	151.3	-
Weight Means & Ranges (kg)						
30.0 - 32 - 33.9	-	-	-	-	18	5.2
34.0 - 36 - 37.9	-	-	2	0.4	38	10.9
38.0 - 40 - 41.9	4	0.1	17	3.6	74	21.3
42.0 - 44 - 45.9	71	1.6	51	10.9	95	27.3
46.0 - 48 - 49.9	382	8.8	105	22.3	60	17.2
50.0 - 52 - 53.9	1,087	25.1	134	28.5	38	10.9
54.0 - 56 - 57.9	1,342	31.0	90	19.2	10	2.9
58.0 - 60 - 61.9	896	20.7	47	10.0	9	2.6
62.0 - 64 - 65.9	374	8.7	15	3.2	3	0.9
66.0 - 68 - 69.9	123	2.9	8	1.7	2	0.6
70.0 - 72 - 73.9	32	0.7	1	0.2	1	0.3
74.0 - 76 - 77.9	9	0.2	-	-	-	-
78.0 - 80 - 81.9	4	0.1	-	-	-	-
Totals	4,324	100.0	470	100.0	348	100.0
Mean Weight (kg)	55.4	-	51.4	-	43.7	-

1/ non-pregnant, non-lactating only

TABLE 7-A. WEIGHT CHANGES OF CIVILIAN ADULTS (15+ YEARS) WITH AGE, COMPARING THE AVERAGES FOR THAILAND WITH VIETNAM AND U.S.A. GROUPS OF APPROXIMATELY THE SAME HEIGHTS (see Figure 7)

Age Groups (yrs.)	Average Weights (Kg.) - Males				Average Weights (Kg.) - Females			
	Thailand		Vietnam 1/	U.S.A.	Thailand		Vietnam 1/	U.S.A. 2/
	No. Subj.	Weight (kg)	Weight (kg)	Weight (kg)	No. Subj.	Weight (kg)	Weight (kg)	Weight (kg)
5 (15.5)	4	40.5	39.9	-	27	40.7	35.8	-
5 (16.5)	9	41.1	40.8	-	26	40.4	40.8	-
5-16(16.0)	-	-	-	48.5	-	-	-	44.0
7 (17.5)	11	47.5	44.9	-	17	44.6	41.7	-
8 (18.5)	5	46.6	46.3	-	20	47.7	43.1	-
9 (19.5)	8	51.2	46.3	-	11	46.3	43.1	-
7-19(18.5)	-	-	-	54.0	-	-	-	44.9
0-24(22.5)	44	53.0	49.0	58.1	33	46.0	43.1	46.3
5-29(27.5)	57	53.2	-	60.8	32	45.8	-	48.5
5-34(30.0)	-	-	49.0	-	-	-	43.5	-
0-34(32.5)	69	50.5	-	-	26	44.2	-	-
5-39(37.5)	80	52.0	-	-	33	46.1	-	-
0-39(35.0)	-	-	-	62.1	-	-	-	52.2
5-44(40.0)	-	-	48.5	-	-	-	42.6	-
0-44(42.5)	48	51.7	-	-	26	45.8	-	-
5-49(47.5)	32	50.1	-	-	49	44.6	-	-
0-49(45.0)	-	-	-	63.5	-	-	-	55.3
5-54(50.0)	-	-	47.2	-	-	-	42.2	
0-54(52.5)	49	51.8	-	-	44	43.0	-	-
5-59(57.5)	40	50.6	-	-	33	40.9	-	-
0-59(55.0)	-	-	-	64.4	-	-	-	56.7
5-64(60.0)	-	-	47.6	-	-	-	39.5	-
0-64(62.5)	24	49.4	-	-	32	40.8	-	-
5+ (67.5)	27	48.1	44.9	-	40	41.0	39.0	-
0-69(65.0)	-	-	-	63.1	-	-	-	57.6
Average Height (cm.)	-	161	158	158	-	151	147	147

1/ ICNND Nutrition Survey of the Republic of Vietnam (1959), July 1960 (34).

2/ Build and Blood Pressure Study, Volume I, Society of Actuaries, October 1959 (76).

COMPARISON OF AVERAGE HEIGHTS AND WEIGHTS OF THAI ADULTS WITH AVERAGES FROM OTHER COUNTRIES

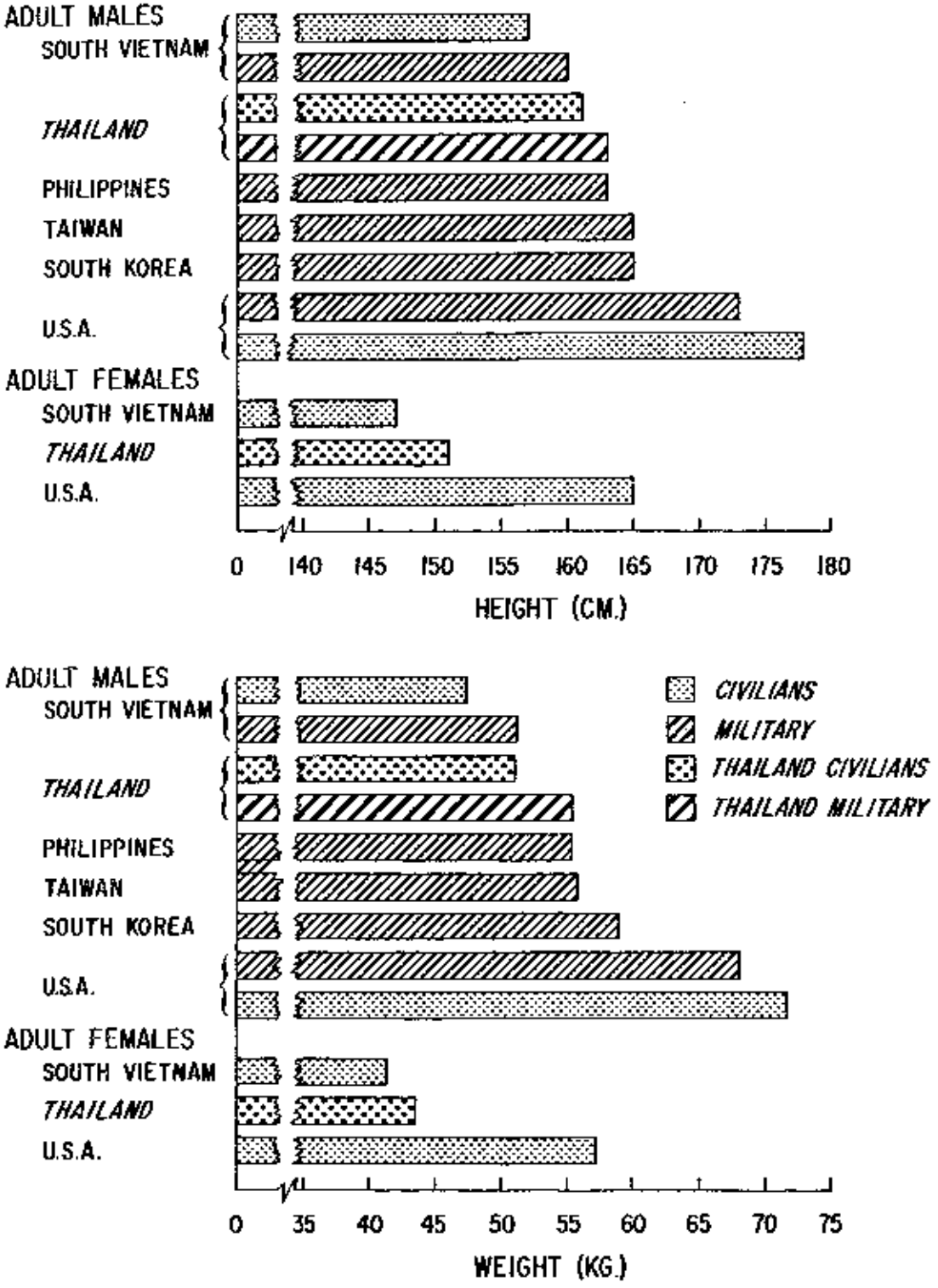


Figure 2-A.

TABLE 8-A. COMPARISON OF AVERAGE HEIGHTS AND WEIGHTS OF THAI ADULTS WITH AVERAGES FROM A NUMBER OF OTHER COUNTRIES (see Figure 2-A)[1/]

Adult Population Groups Male	Age Groups (years)	Average Weight (kg)	Average Height (cm)
Republic of Vietnam (34) (South Vietnam)			
civilians	15+	47.6	157
military forces	18+	51.3	160
Thailand			
civilians	15+	51.0	161
military forces	20-40	55.4	163
The Philippines (74)			
military forces	18+	55.3	163
Republic of China (Taiwan) (55)			
military forces	20-30	55.8	165
Republic of Korea (South Korea) (58)			
military forces	17-35	59.0	165
United States			
Army inductees (75)	-	68.0	173
civilians (76)	20-29	71.7	178
Adult Population Groups Female Civilians			
Republic of Vietnam (34) (non-pregnant, non-lactating)	15+	41.3	147
Thailand (non-pregnant, non-lactating)	15+	43.6	151
United States (76)	20-29	57.2	165

1/ Parentheses enclose reference numbers.

TABLE 9- A. EXCERPTS FROM TYPICAL EXAMPLES OF NUTRITIONAL AND PUBLIC HEALTH DATA OBTAINED FROM PROVINCES DISTANT FROM BANGKOK

SONGKHLA PROVINCIAL HOSPITAL (Southern-most Region- Region IX)

Incidence of Some Disease Entities Observed Among In-patients by Years:

	Number of Cases			
	1957	1958	1959	1960 (Jan.-Aug.)
beriberi	21	8	13	14
simple goiter	8	9	7	5
toxic goiter	5	3	11	3
adenoma of the thyroid	3	4	3	3
vesical calculi	16	16	27	11
hookworm anemia	60	23	25	17
cirrhosis of the liver	10	8	7	6
malaria	102	97	100	91
typhoid fever	38	53	70	44
TOTAL IN-PATIENTS	2,845	3,587	4,324	
TOTAL OUT-PATIENTS	26,244	27,677	28,639	

MATERNAL AND CHILD HEALTH PROJECT, CHIENGMAI (Northwestern Region - Region V)[1/]

Note: This project has been in operation since 1952, during the first 4 years under the guidance of WHO, and subsequently entirely by the Thai Government. The project covers a population area of about 180,000 persons (1/4 of Chiengmai Province), including the City of Chiengmai, and the staff consists of 6 medical officers, 13 nurses, 41 midwives, 2 clerks, 1 pharmacist, 1 sanitary inspector, and 42 employees (drivers, maids, etc.), operating on a total budget of 500,000 baht ($25,000) per year.

Approximate Causes of Infant (< 1 yr.) Mortality, as accumulated by midwives and nurses, 1959:

	% of Total
congenital malformations	1.8
birth injuries	2.8
nutritional disturbances (infantile beriberi, generalized malnutrition, and malnutrition with edema)	12.9
prematurity	12.9
gastroenteritis	15.8
pneumonia & influenza	25.6
other recognized causes	21.5
ill-defined causes	6.5

(continued on next page)

TABLE 9- A. (CONTINUED - page 2) (EXAMPLES OF NUTRITIONAL & P.H. DATA - PROVINCIAL)

MATERNAL AND CHILD HEALTH PROJECT, CHIENGMAI (continued)

Infant & Maternal Mortality by Years:

	Infant Mortality per 1000 Live Births		Maternal Mortality per 1000 Live Births	
	Chiengmai Province	MCH Project	Chiengmai Province	MCH Project
1952	132.0	117.0		
1953	131.0	91.5		
1954	117.0	82.9		
1955	110.0	71.3		
1956	95.7	75.5	4.3	3.3
1957*	97.3	81.9	3.4	3.4
1958	83.0	69.0	3.3	2.0
1959	72.2	61.7	2.7	1.8

*: influenza epidemic

Infant & Maternal Mortality by Quarters (MCH Project):

	Infant Mortality per 1000 Live Births				Maternal Mortality per 1000 Live Births			
	Jan.-Mar.	Apr.-June	July-Sept.	Oct.-Dec.	Jan.-Mar.	Apr.-June	July-Sept.	Oct.-Dec.
1956	75.3	58.9	57.9	102.9	1.6	4.3	2.6	4.6
1957	63.8	58.9	92.1	117.6	2.1	3.2	1.2	7.3
1958	73.1	53.9	59.7	88.4	3.2	1.2	2.2	1.7
1959	43.5	55.4	79.6	71.6	3.4	1.7	0.6	1.2
1960	64.2	41.8	60.6		3.2	0.5	0.6	

Examples of Activities of the Staff, MCH Project (1959):

Postpartum visits	29,748	Conduct of labor (total births = 7,197)	
Wells constructed or corrected	34,973		
School pump installation	39	MCH staff	31.2%
Public pump installation	2	"Undertrained" midwives	5.3%
Latrines constructed	25,494	Moh-Tam-Yae ("granny midwives")	41.1%
Smallpox vaccinations	9,498	Self-labor	22.1%
Diphtheria innoculations	7,019		
Diphtheria & pertussis innoculations	9,290		
Cholera innoculations	12,171		
Typhoid innoculations	1,085		

1/ We are most grateful to Dr. (Miss) Soonthara Pongspipat, Medical Officer-in-charge, Chiengmai MCH Project, for providing the above and other data, and for reviewing her work with us.

TABLE 10-A. DISTRIBUTION OF MEDICAL AND ALLIED PROFESSIONAL PERSONNEL IN THAILAND[1/] AND COMPARABLE DATA FROM THE U.S. AND VIETNAM

Area and Region No.	Population	Number in "modern or qualified groups"						Number in "ancient or traditional unqualified groups"		
		Physicians	Dentists	Dental hygienists	Pharmacists	Midwives 3/	Nurses	Physicians	Pharmacists	Midwives 3/
Central - I 4/	2,810,172	558	18	24	59	238	1,135	1,523	920	1,426
Eastern - II	1,473,568	93	4	6	22	129	145	939	530	316
Northeastern - III	4,468,906	110	5	10	17	156	361	1,104	224	3,197
Northern - IV	4,426,995	90	5	10	15	179	161	679	263	643
Northwestern - V	2,919,303	91	3	3	15	321	230	872	159	768
Western - VI	2,598,299	123	3	9	35	223	200	1,495	673	1,045
Southwestern - VII	2,187,274	128	5	20	32	188	216	963	612	962
Southern - VIII	1,469,551	82	2	7	11	148	122	1,070	406	827
Southern-most - IX	1,669,877	146	5	3	8	184	188	557	272	806
Bangkok	1,597,020	2,106	192	589	702	4,867	5,689	65	29	75
Total (except Bangkok)	24,023,945	1,421	50	92	214	1,766	2,758	9,202	4,059	9,990
Total	25,620,965	3,527	242	681	916	6,633	8,447	9,267	4,088	10,065

Group	Total in Thailand (1961)	Percent in Bangkok (1961)	Approximate Number per 100,000 Population: Thailand except Bangkok (1961)	Bangkok Thailand (1961)	United States (1959)	Republic of Vietnam 2/ (1959)
"Modern or qualified"						
Physicians	3,527	60	5.9	132	127	3.0
Dentists	242	79	0.2	12	59	0.4
Dental hygienists	681	86	0.4	37	-	?
Pharmacists	916	77	0.9	44	31	1.6
Midwives	6,633	73	7.4	305	-	1.4
Nurses	8,447	67	11.5	356	268	?
"Ancient or traditional-unqualified"						
Physicians	9,267	<1	38.3	4	-	?
Pharmacists	4,088	<1	16.9	2	-	?
Midwives 3/	10,065	<1	41.6	5	-	?

1/ data supplied by the Division of Vital Statistics, Ministry of Public Health, Bangkok, March 1961.
2/ ?: data not available
3/ incomplete data
4/ excluding Bangkok

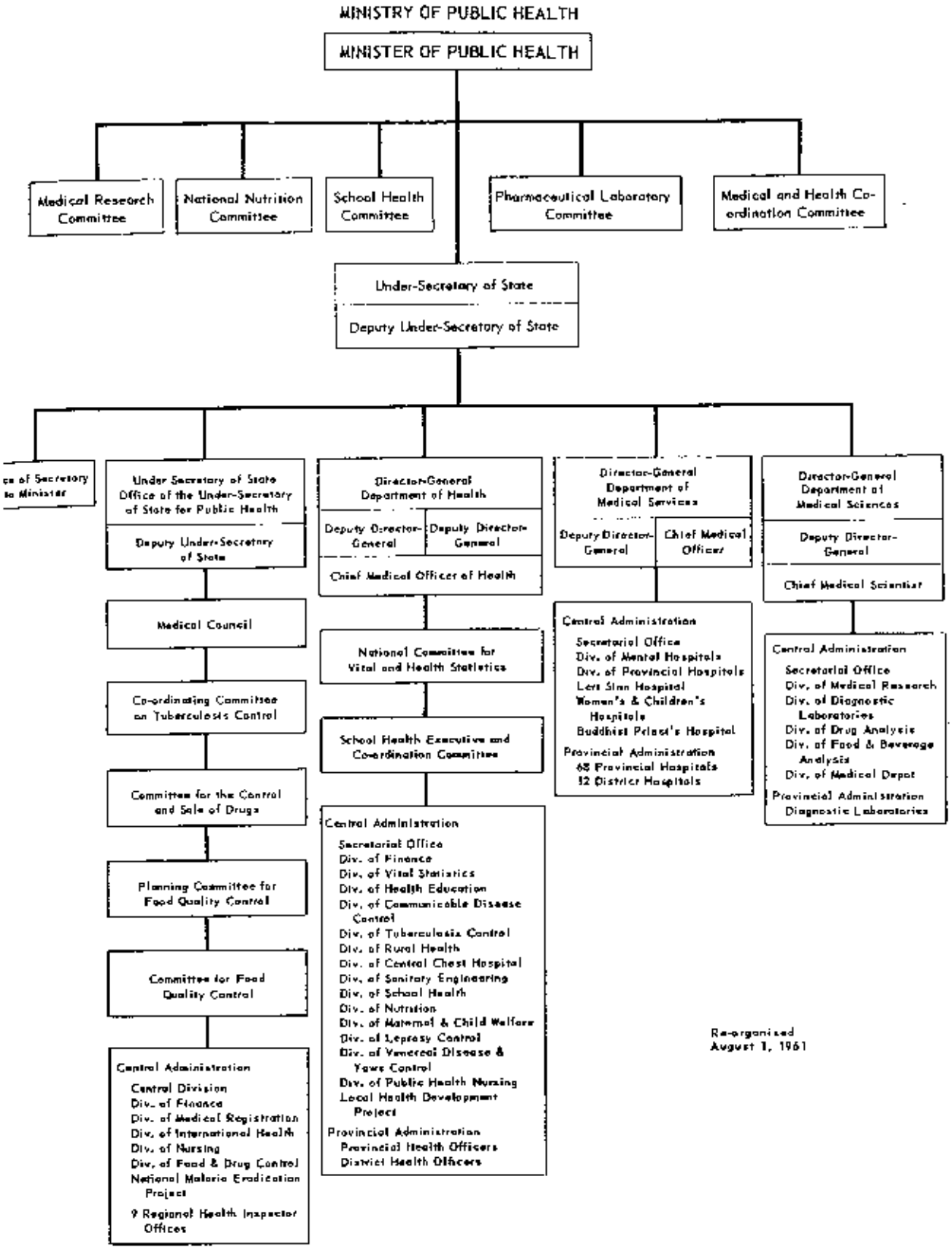

MINISTRY OF PUBLIC HEALTH
MINISTER OF PUBLIC HEALTH
Medical Research Committee
National Nutrition Committee
School Health Committee
Pharmaceutical Laboratory Committee
Medical and Health Co-ordination Committee
Under-Secretary of State
Deputy Under-Secretary of State
ce of Secretary to Minister
Under Secretary of State Office of the Under-Secretary of State for Public Health
Deputy Under-Secretary of State
Medical Council
Co-ordinating Committee on Tuberculosis Control
Committee for the Control and Sale of Drugs
Planning Committee for Food Quality Control
Committee for Food Quality Control
Central Administration
Central Division
Div. of Finance
Div. of Medical Registration
Div. of International Health
Div. of Nursing
Div. of Food & Drug Control
National Malaria Eradication Project
9 Regional Health Inspector Offices
Director-General Department of Health
Deputy Director-General
Deputy Director-General
Chief Medical Officer of Health
National Committee for Vital and Health Statistics
School Health Executive and Coordination Committee
Central Administration
Secretariat Office
Div. of Finance
Div. of Vital Statistics
Div. of Health Education
Div. of Communicable Disease Control
Div. of Tuberculosis Control
Div. of Rural Health
Div. of Central Chest Hospital
Div. of Sanitary Engineering
Div. of School Health
Div. of Nutrition
Div. of Maternal & Child Welfare
Div. of Leprosy Control
Div. of Venereal Disease & Yaws Control
Div. of Public Health Nursing
Local Health Development Project
Provincial Administration
Provincial Health Officers
District Health Officers
Director-General Department of Medical Services
Deputy Director-General
Chief Medical Officer
Central Administration
Secretariat Office
Div. of Mental Hospitals
Div. of Provincial Hospitals
Lee Sian Hospital
Women's & Children's Hospitals
Buddhist Priest's Hospital
Provincial Administration
68 Provincial Hospitals
12 District Hospitals
Director-General Department of Medical Sciences
Deputy Director-General
Chief Medical Scientist
Central Administration
Secretariat Office
Div. of Medical Research
Div. of Diagnostic Laboratories
Div. of Drug Analysis
Div. of Food & Beverage Analysis
Div. of Medical Depot
Provincial Administration
Diagnostic Laboratories
Re-organised August 1, 1961

Figure 3-A

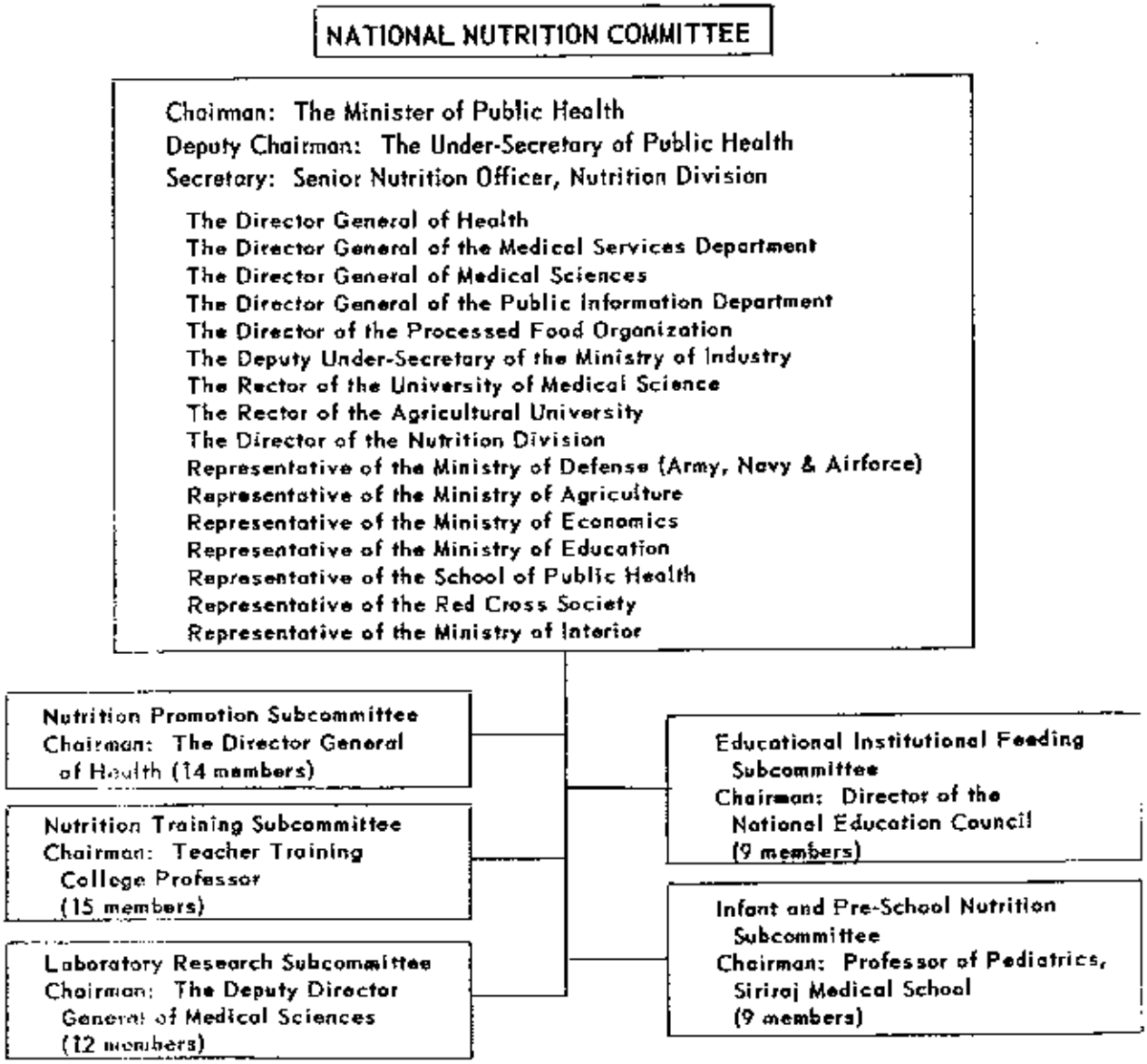

NATIONAL NUTRITION COMMITTEE
Chairman: The Minister of Public Health
Deputy Chairman: The Under-Secretary of Public Health
Secretary: Senior Nutrition Officer, Nutrition Division
The Director General of Health
The Director General of the Medical Services Department
The Director General of Medical Sciences
The Director General of the Public Information Department
The Director of the Processed Food Organization
The Deputy Under-Secretary of the Ministry of Industry
The Rector of the University of Medical Science
The Rector of the Agricultural University
The Director of the Nutrition Division
Representative of the Ministry of Defense (Army, Navy & Airforce)
Representative of the Ministry of Agriculture
Representative of the Ministry of Economics
Representative of the Ministry of Education
Representative of the School of Public Health
Representative of the Red Cross Society
Representative of the Ministry of Interior
Nutrition Promotion Subcommittee
Chairman: The Director General of Health (14 members)
Nutrition Training Subcommittee
Chairman: Teacher Training College Professor (15 members)
Laboratory Research Subcommittee
Chairman: The Deputy Director General of Medical Sciences (12 members)
Educational Institutional Feeding Subcommittee
Chairman: Director of the National Education Council (9 members)
Infant and Pre-School Nutrition Subcommittee
Chairman: Professor of Pediatrics, Siriraj Medical School (9 members)

Figure 4-A.

TABLE 11-A. NUTRITIONAL AND RELATED DISEASE EXPERIENCE IN THE CHILDREN'S HOSPITAL, BANGKOK FROM JANUARY THROUGH JUNE, 1960 1/

otal patients (0-13 yrs.)	2,821
otals deaths	679
thnic groups:	
Thai	83.02%
Chinese	13.01%
Other	3.97%
ocality of residence:	
Bangkok	71.7%
Immediately adjacent provinces	21.5%
Other areas	6.8%

isease Entities:

ICD 2/	Disease	Deaths	Totals
46	amoebiasis	3	7
80	beriberi	1	22
6.1	vitamin A deficiency	-	2
6.2	vitamin B deficiency, except beriberi & pellagra	-	1
6.5	malnutrition, unqualified	9	32
6.6	kwashiorkor	-	1
6.7	other & multiple deficiency states	-	-
4.1	congestive heart failure (non-rheumatic)	7	8
02	calculi of kidney & ureter	-	2
04	calculi of other parts of urinary system	-	5
2.0	nutritional maladjustment, without mention of immaturity	2	10
2.5	nutritional maladjustment, with immaturity	-	1

Incidence of Several Disease Groups by Sex and Age 3/

		Avitaminosis & other deficiency states	Anemias	Calculi of the urinary system	Ill-defined diseases peculiar to early infancy
ICD # 2/		A-64	A-65	A-111	A-135
Both sexes	D	10	3	-	93
	T	59	29	7	324
Males	-D	5	1	-	60
	-T	37	18	7	182
Females	D	5	2	-	33
	-T	22	11	-	142
Age:					
0-6d.	- D	-	-	-	82
	- T	-	-	-	287
7-27d.	- D	-	-	-	8
	- T	-	-	-	28
1-2 mos.	D	3	-	-	-
	- T	11	-	-	5
3-5 mos.	D	-	-	-	2
	- T	11	-	-	3
6-11 "	- D	1	-	-	1
	- T	5	3	-	1
1 yr.	- D	5	2	-	-
	- T	15	6	3	-
2 yrs.	- D	1	-	-	-
	- T	11	-	-	-
3 yrs.	- D	-	-	-	-
	- T	1	3	2	-
4 yrs.	- D	-	-	-	-
	- T	3	3	-	-
5-9 yrs.	D	-	1	-	-
	- T	2	11	2	-
10-14 yrs.	- D	-	-	-	-
	- T	-	3	-	-

1/ data extracted from: "Semi-annual Report, January 1 - June 30, 1960, Children's Hospital, Bangkok (Director: Dr. Sem Pring Puang-geo)(prepared as part of the Thailand-WHO Cooperative Project on Hospital Statistics, by L.A. Woodbury, Saluay Terayanont, Ratri Sribhoga, and Sukon Jakabhiromya) (77)

2/ "International Classification of Diseases", (ICD), 1955 edition, and its Intermediate List of 150 Causes for Tabulation of Morbidity and Mortality (78) (D = deaths; T = totals)

3/ Note that 3 of these 4 groups account for 16% of all deaths.

TABLE 12-A. NUTRITIONAL AND RELATED DISEASE EXPERIENCE IN THE WOMAN'S HOSPITAL, BANGKOK FROM JANUARY THROUGH JUNE, 1960 1/

DEATHS AND DISCHARGES BY HOSPITAL SERVICES (adult females):	Deaths	Totals
Obstetrics and Gynecology	20	8,277
Medicine	77	751
Surgery	17	323
Others	1	3
Totals	115	9,354

Locality of Residence:	
Bangkok	81.4%
Immediately adjacent provinces	11.8%
Other areas	6.8%

INCIDENCE OF SEVERAL DISEASE GROUPS BY AGE:

		Age Groups (years)											
		15-24		25-44		45-64		65-74		75+		Total	
ICD # 2/	DISEASE GROUPS 3/	D	T	D	T	D	T	D	T	D	T	D	T
A-61	non-toxic goiter	-	9	-	18	-	10	-	-	-	-	-	37
A-64	avitaminoses & other deficiency states	-	1	-	3	-	1	-	-	-	-	-	5
A-65	anemias	1	1	-	2	1	3	-	-	-	-	2	6
A-81	arterio-sclerotic and degenerative heart disease	2	2	-	-	1	2	1	2	-	-	4	6
A-83	hypertension with heart disease	-	-	1	1	1	1	-	2	-	-	2	4
A-84	hypertension without mention of heart disease	-	-	1	7	1	7	2	4	-	-	4	18
A-85	diseases of arteries	-	-	-	-	-	1	-	4	-	-	-	5
A-116	toxemias of pregnancy & puerperium	-	8	-	11	-	2	-	-	-	-	-	21
	TOTAL (all causes)	(16	4014	31	4795	38	385	16	81	5	28	107	9311

1/ data extracted from: "Semi-annual Report, January 1-June 30, 1960, Women's Hospital, Bangkok (Director: Dr. Sem Pring Puang-geo)(prepared as part of the Thailand-WHO Cooperative Project on Hospital Statistics, by L.A. Woodbury, Saluay Terayamont, Ratri Sribhoga, and Sukon Jakabhiromya)(64)

2/ "International Classification of Diseases", (ICD), 1955 edition, and its Intermediate List of 150 causes for Tabulation of Morbidity and Mortality (D = deaths; T = totals) (78)

3/ Note the strikingly low contribution by these disease groups to total mortality (11%)

TABLE 13-A. COMPARATIVE CUMULATIVE MORTALITY DATA

(see Figure 8)

Age Groups (years)	Cumulative Mortality (%)				
	Thailand 1/		U.S.A.		Vietnam
	1953	1957	1900 2/	1958 3/	1958 4/
<1	21.7	22.4	-	6.9	18
1	27.6	28.9	-	-	-
2	31.4	33.6	-	-	-
3	35.0	37.6	-	-	-
4	37.4	40.3	-	-	-
1-4	-	-	-	8.0	38
<5	-	-	44.9	-	-
5-9	43.0	46.1	-	-	-
10-14	45.9	48.6	-	-	-
5-14	-	-	46.9	8.9	48
15-19	48.8	51.2	-	-	-
20-24	52.8	54.6	-	-	-
15-24	-	-	49.5	10.4	53
25-29	56.5	57.8	-	-	-
30-34	60.2	61.1	-	-	-
25-34	-	-	52.4	12.5	59
35-39	64.2	64.6	-	-	-
40-44	68.3	68.3	-	-	-
35-44	-	-	55.1	16.8	68
45-49	72.5	72.0	-	-	-
50-54	76.8	76.1	-	-	-
45-54	-	-	57.8	25.9	77
55-59	80.7	80.0	-	-	-
60-64	85.1	84.3	-	-	-
55-64	-	-	60.9	41.9	86
65+	-	-	100.1	-	-
65-69	88.6	88.0	-	-	-
70-74	92.3	91.9	-	-	-
65-74	-	-	-	66.5	94
75-79	95.2	95.0	-	-	-
80-84	97.5	97.6	-	-	-
75-84	-	-	-	89.8	97
85+	100.0	100.4	-	100.1	100

1/ Division of Vital Statistics, Ministry of Public Health, Bangkok (65)

2/ Historical Statistics of the United States - Colonial Times to 1957, p. 10 & 29 (79)

3/ Vital Statistics of the United States, 1958, Vol. 2, p. 132-133 (80)

4/ National Institute of Statistics, Saigon

TABLE 14-A. INFANT AND CHILD MORTALITY BY AGE GROUPS (see Figure 8)

Age Groups	% of total deaths during first year		Age Groups	% of total deaths during first 5 years	
	Thailand - 1957 1/	U.S.A. - 1958 2/		Thailand 1957 1/	U.S.A. 1958 2/
< 1 day	3.1	37.7			
1-6 days	9.6	25.6			
7-27 days	14.9	8.6			
28-59 "	16.6	6.5	< 1 yr.	54.8	86.6
2 months	11.4	5.1	1 "	16.4	5.6
3 months	9.1	3.9	2 yrs.	11.9	3.3
4 "	6.3	2.9	3 "	10.1	2.5
5 "	5.2	2.3	4 "	6.8	2.0
6 "	4.8	1.9			
7 "	3.9	1.4			
8 "	3.6	1.2			
9 "	3.3	1.1			
10 "	2.5	0.9			
11 "	2.3	0.9			
Not stated	3.4	-			
Totals (%)	100.0	100.0		100.0	100.0
Total deaths	47,962	113,789		84,549	131,350

TABLE 15-A. THE PRINCIPAL CAUSES OF INFANT (< 1 YR.) MORTALITY IN THAILAND COMPARED WITH THEIR INCIDENCE IN THE U.S.A.

Principal Causes of Death 3/	Death Rate /1000 Live Births	
	Thailand - 1957 1/	U.S.A. - 1958 2/
Nutritional maladjustment and ill-defined diseases peculiar to early infancy	22.6	1.6
Pneumonia	5.5	2.3
Diarrhea of the newborn	5.0	0.1
Acute upper respiratory infections	1.9	0.1
Influenza	1.0	0.1
Malaria	0.8	-
Dysentery	0.5	-
Measles	0.3	-
Others	24.6	
Total (all causes)	62.2	27.1

1/ data from Division of Vital Statistics, Ministry of Public Health, Bangkok (65)
2/ data from Vital Statistics of the United States, 1958, Vol. 1, p. 360-361, p. 6-38, 6-39, and Vol. 2, p. 132-133. (80)
3/ classifications of the Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death (7th Revision, 1955) (78)

TABLE 16-A. THE LEADING KNOWN CAUSES OF DEATH IN THAILAND AND THE U.S.A.

International List No. 1/	Leading Causes of Death - Thailand - 1957 2/	Death Rate/100,000 Population
760-776	Certain diseases of early infancy	81.4
571	Diarrhea and enteritis	56.6
490-493	Pneumonia	54.1
001-008	Tuberculosis of the respiratory system	48.6
110-117	Malaria	45.7
800-E936	Accidents	17.3
640-689	Diseases of pregnancy, childbirth and the puerperium	16.8
410-434	Diseases of the heart	16.4
045-048	Dysentery	13.2
280	Beriberi	7.7
540-545	Diseases of the stomach and duodenum	7.2
040-041	Typhoid fever	6.8
120-138	Parasitic diseases	1.4
	All Others	579.9
	All causes	953.2
	Leading Causes of Death - U.S.A. - 1958 3/	
400-402,410-443	Diseases of the heart	367.9
140-205	Malignant neoplasms	146.9
330-334	Vascular lesions affecting the central nervous system	110.1
E800-E962	Accidents	52.3
E810-E835	Motor vehicle accidents	21.3
800-E802;E840-E962	Other accidents	31.0
760-776	Certain diseases of early infancy	39.8
760-762	Birth injuries, postnatal asphixia, and atelectasis	18.2
763-768	Infections of the newborn	3.2
769-776	Other diseases peculiar to early infancy, and immaturity, unqualified	18.4
480-493	Influenza and pneumonia, except pneumonia of the newborn	33.2
450	General arteriosclerosis	19.9
260	Diabetes mellitus	15.9
750-759	Congenital malformations	12.4
581	Cirrhosis of the liver	10.8
E963,E970-E979	Suicide	10.7
451-468	Other diseases of the circulatory system	9.9
592-594	Chronic and unspecified nephritis and other renal sclerosis	8.0
444-447	Other hypertensive disease	8.0
001-019	Tuberculosis, all forms	7.1
	All other causes	98.5
	All causes	951.3

/ International Statistical Classification of Diseases, Injuries, and Causes of Death (7th Revision, 1955) (78)
/ data from the Division of Vital Statistics, Ministry of Public Health, Bangkok (65)
/ data from Vital Statistics of the United States, 1958, Vol. 1, p. 6-18 (80)

THESE ARE TO THAILAND	DEATH RATES/100,000 THAILAND 1957	U.S.A. 1958	WHAT THESE ARE TO THE U.S.A.
Certain Diseases of Early Infancy	81.4	110.1	Vascular Lesions Affecting the Central Nervous System
Diarrhea and Enteritis	56.6	52.3	Accidents
Pneumonia	54.1	50.9	Malignant Neoplasms of the Digestive Organs and Peritoneum
Tuberculosis of the Respiratory System	48.6	39.8	Certain Diseases of Early Infancy
Malaria	45.7	42.7	Hypertensive Heart Disease
Accidents	17.3	19.9	General Arteriosclerosis
Diseases of Pregnancy, Childbirth, and the Puerperium	16.8	15.9	Diabetes Mellitus
Diseases of the Heart	16.4	22.2	Malignant Neoplasms of the Genital Organs
Dysentery, All Forms	13.2	12.4	Congenital Malformations
Beriberi	7.7	7.1	Tuberculosis, All Forms
Diseases of the Stomach and Duodenum	7.2	6.2	Ulcer of the Stomach and Duodenum
Typhoid Fever	6.8	6.9	Leukemia and Aleukemia
Parasitic Diseases	1.4	1.1	Appendicitis

Note: All classifications based on The Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death (7th Revision, 1955)

THESE ARE TO THAILAND TODAY	THAILAND 1957	U.S.A.	WHAT THEY WERE TO THE U.S.A. IN
Gastroenteritis	77.0	75.5	1916
Tuberculosis, All Forms	49.1	49.1	1938
Pneumonia and Influenza	54.1	55.7	1942
Typhoid and Paratyphoid Fever	6.8	6.7	1923

Sources of Data: Thailand: Division of Vital Statistics, Ministry of Public Health, Bangkok
U.S.A.—1916–1942: Historical Statistics of the United States—Colonial times to 1957
U.S.A.—1958: Vital Statistics of the United States, 1958

Figure 5-A. Comparative Mortality Rates for Specific Disease Entities in Thailand and the U.S.A.

H. CLINICAL APPENDIX

Comments on Clinical Methodology

Of immense value to the day-to-day operations of this (and any other) survey were he activities of the liaison officer (Major Pravat Sacholvijarana) and the transportation officer (Capt. Cheowchan Charumas). These two men preceded the team to each general area by three or four days, arranging transportation, setting up meetings immediately following the team's arrival with appropriate military and civilian authorities, and orienting them first-hand as to the activities of the survey team. At these meetings nd in the orientation efforts, emphasis was laid on random selection of military units nd civilian villages. Villages were not chosen by the local authorities in advance, ut rather by the team director, totally unfamiliar with the local situations, by randomly selecting villages on the map, the only elements of deliberate selection being: 1) villages at least five km from the town from which the team operated, (2) villages ccessible by jeep and truck within a two-hour drive but preferably not on a main transportation artery, and (3) villages sufficiently small so that at least one fifth of the otal population could be examined in a day, i.e., of less than 1,000 total population. uite complete current population records and village maps showing each household were ept by the district governments, allowing a specific arbitrarily selected geographical ortion of a village to be selected for study, and the preparation of complete family osters prior to the arrival of the team in the village. As each individual subject ntered the examining area, he was checked against the roster, and at the end of the day fforts were made to get those people missed to the examining area or they were sought ut in their homes and examined there. As a result, the team was approximately 75 percent uccessful in examining complete families, i.e., of the families expected from the roster, 5 percent of them arrived in their entirety. On the basis of the number of subjects xpected, the detailed : abbreviated examination ratio was set at 1:3 to 1:5 and not ltered thereafter that day, and the detailed : laboratory ratio was set to provide 18 o 22 blood, urine, and stool collections daily. Village examinations were conducted ither in the village school or the communal hall of the wats. The factor of modesty ecessitated extensive screening of the examining areas in both civilian and military ituations, and the elimination of scrotal examinations except in the detailed examinations. The degree of cooperation by the villagers, school teachers, priests and monks, ocal government officials, and members of the district and provincial health departments as nothing short of superlative. As to be expected, setting up examination arrangements ith military groups was much simpler, and consistently functioned very smoothly with he whole-hearted support of the commanders, messing and medical officers, medical orpsmen, and the men themselves. Words of commendation are due particularly to the edical corpsmen whom commanders assigned to the team to take heights and weights in oth military units and civilian villages. Although it may be repetitious, the team annot overemphasize how impressed we were with the transportation facilities made availble by the military services, often at considerable inconvenience to the military uthorities.

To narrow discrepancies between clinicians, a listing of all positive clinical findngs and totals examined by examiner for the abbreviated examinations (and for the etailed examinations intermittently) was made and discussed at the end of each day (see able 94-A). During the examinations, relatively unusual findings (e.g., Bitot's spots, oss of deep tendon reflexes, etc.) were always confirmed by at least two and usually ore examiners, and whenever doubt existed for any findings, the subject was examined by t least two examiners.

Ages were recorded in the Western manner (i.e., the child between 24 and 36 months ld is two-years old, not three, as would be the case with Chinese recording). Heights

were determined without shoes. The weights of infants and small children were recorded by weighing the parent with and without the child in her arms. No correction factors for clothing have been applied to the weight data. Data were collected however on clothing weights (see Table 17-A below). Military personnel were weighed in khaki shorts (occasionally long khaki trousers), undershorts, and belts, and civilian males similarly; civilian females and children were weighed in their usual light clothing without shoes.

TABLE 17-A. WEIGHTS OF CLOTHING OF THAI SUBJECTS[1/]

	No. of subjects	Range (kg)	Mean (kg)
Military: in shorts	8	0.5 - 1.1	0.8
: in long trousers	10	0.8 - 1.2	0.9
Civilians - males: 5-6 years	3	0.1 - 0.2	0.2
: 10 "	2	0.3	0.3
: 18+ "	2	0.3 - 0.4	0.4
- females: 5-6 "	2	0.3	0.3
: 10 "	1	0.5	0.5
: 18+ "	2	0.5 - 0.6	0.6

1/ Determined by weighing subjects clothed and nude.

Blood pressures, heights, weights, and collection of laboratory samples were performed by nurses and medical corpsmen. The drawing of blood presented few problems among the Thai, and ice was always made available for storing and shipping of samples, in spite of the remoteness of some areas visited.

Criteria somewhat more specific than those of the IGNND Manual for some clinical entities were established and adhered to, as outlined in Table 18-A.

TABLE 18-A. DESCRIPTION OF CLINICAL CRITERIA USED FOR A NUMBER OF CLINICAL ENTITIES

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 (S.R.F.)-localized	more than one papilla involved, but not all
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 next page)
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
Motor weakness	no difficulty rising from the squatting position

n the detailed examinations, knee jerks, malleolar vibratory sense, and motor weakness ere routinely examined. Skinfold thicknesses were determined at two sites: (a) a longiudinal fold midway between the olecranon and the head of the humerus on the dorsal surace of the brachium, with the arm flexed across the chest, and (b) a horizontal-to-blique fold just below the tip of the scapula, with the arms relaxed at the sides. The aliper described by Best (81) was utilized.

The WHO criteria (41) for grading goiter are briefly outlined below:

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

Grade I: persons with palpable goiters. The thyroid is considered to be more than our to five times enlarged although not visible with the head in normal position. Most f 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 visble with the head in normal position but which are smaller than those in Grade III. Palpaion 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 catecory can be recognized at a considerable distance. They are grossly disfiguring and may e of such size as to cause mechanical difficulties with respiration and in the wearing f clothes.

TABLE 19-A. MAJOR CLINICAL FINDINGS AMONG THE THAI MILITARY AND CIVILIANS BY GENERAL LOCATIONS - FOR ALL GROUPS (SEX, AGE, AND PL) COMBINED[1/] [2/] (ABBREVIATED EXAMINATIONS)

General Areas	Total Subjects Examined	Bilateral Ankle Jerk Loss		Angular Lesions		Filiform Papillary Atrophy - All Grades	
MILITARY		No. of Cases	% Prevalence	No. of Cases	% Prevalence	No. of Cases	% Prevalence
Chiengmai	736	5	0.7	67	9.1	8	1.1
Udorn	602	2	0.3	77	12.8	20	3.3
Ubol	466	5	1.1	47	10.1	4	0.9
Lopburi	784	2	0.3	7	0.9	9	1.1
Bangkok	553	3	0.5	19	3.4	24	4.3
Sattaheep	624	4	0.6	22	3.5	36	5.8
Songkhla	560	6	1.1	3	0.5	7	1.2
Total	4,325	27	0.6	242	5.6	108	2.5
CIVILIANS							
Chiengmai	524	14	2.7	52	9.9	21	4.0
Udorn	525	4	0.8	51	9.7	12	2.3
Ubol	585	6	1.0	26	4.4	34	5.8
Lopburi	166	8	4.8	5	3.0	13	7.8
Songkhla	381	1	0.3	10	2.6	19	5.0
Total	2,181	33	1.5	144	6.6	99	4.5

1/ The only group omitted from the civilian data is Rachinutis High School, Udorn; military data are for the combined services.
2/ See appropriate graphs in main report

TABLE 20-A. CLINICAL FINDINGS AMONG THE THAI MILITARY AND CIVILIANS WITH NEGLIGIBLE 1/ OR ZERO PREVALENCE - DETAILED EXAMINATIONS

Sex and Age Groups 2/	Number of Cases Observed				
	Combined Military Services	M < 15	M 15+	F < 15	F 15+ NPNL
Totals examined	884	140	230	146	159
NEGLIGIBLE PREVALENCE					
1. history of trachoma	1	-	-	-	-
2. history of tuberculosis	3	-	1	-	-
3. depigmentation of hair	-	1	-	-	-
4. thickened opaque bulbar conjunctiva	-	-	1	-	-
5. circumcorneal injection (bilateral)	-	-	-	-	1
6. conjunctival injection (bilateral)	3	-	-	-	2
7. blepharitis	-	1	-	-	-
8. seborrhea other than nasolabial	2	-	2	-	-
9. malar pigmentation	2	1	2	-	1
10. angular scars	3	2	-	1	1
11. cheilosis	1	-	-	-	1
12. swollen red interdental papillae (S.R.P.), diffuse	3	-	2	-	1
13. gingival bleeding	6	1	-	1	1
14. fungiform papillary atrophy, slight 3/	2	-	1	-	4
15. papillary hypertrophy or hyperemia, slight	-	1	-	1	1
16. papillary hypertrophy or hyperemia, moderate or severe	-	-	-	1	-
17. geographic tongue	3	-	-	-	-
18. lingual fissures, erosions, or ulcers	4	-	1	-	-
19. red tongue (tip &/or lateral margins only)	-	-	-	-	1
20. enlarged parotid	1	-	-	-	-
21. follicular hyperkeratosis, any skin area	1	1	1	1	-
22. dry or scaling skin (xerosis)	-	-	-	1	-
23. hepatomegaly	-	1	-	-	-
24. calf tenderness	1	-	-	-	-
25. loss of malecolar vibratory sense	2	-	3	-	-
26. motor weakness	-	-	1	-	1
27. bowlegs	2	-	-	-	-

(table continued on next page)

TABLE 26-A. (CONTINUED - CLINICAL FINDINGS AMONG THE THAI MILITARY AND CIVILIANS WITH NEGLIGIBLE 1/ OR ZERO PREVALENCE - DETAILED EXAMINATIONS

ZERO PREVALENCE

1. xerosis conjunctiva
2. fungiform papillary atrophy, moderate or severe
3. lingual serrations or swellings
4. glossitis (red, scarlet, beefy tongue)
5. magenta colored tongue
6. perifolliculosis
7. crackled skin
8. thickened pressure points
9. purpura or petechiae
10. hyperpigmentation of the hands
11. pellagrous dermatitis
12. bilateral edema of the lower extremities
13. costochondral beading
14. epiphyseal enlargement
15. cardiac murmurs

1/ none of the findings considered "negligible" above tended to occur in any particular village or area except fungiform papillary atrophy (slight), the locations corresponding to the distribution of filiform atrophy (FPA)

2/ see preface for abbreviations used

3/ Among all the above, the only lesion observed among the 97 pregnant or lactating women examined was 1 case of fungiform papillary atrophy (slight)

TABLE 21-A. LOW-PREVALENCE CLINICAL FINDINGS LARGELY CONFINED TO MILITARY AND ADULT CIVILIAN (15+ YRS.) MALES (accounts for all cases of these lesions observed, except as indicated)

General Area		Chiengmai	Udorn	Ubol	Lopburi	Songkhla	Bangkok	Sattaheep	TOTALS
DETAILED EXAMINATIONS									
Totals Examined	Mil.	184	129	66	194	122	109	80	884
	Civ.	76	38	37	19	60	-	-	230
		Percent Prevalence							
Pingueculae	Mil.	1.1	-	-	0.5	4.1	5.5	-	1.6
	Civ.	1.3	-	-	-	5.0			1.7
Acneform eruption 1/	Mil.	3.3	4.7	8.0	9.8	8.2	26.6	2.5	8.6
	Civ.	-	7.9	-	-	1.7			1.7
Scrotal dermatitis	Mil.	2.7	1.6	-	0.5	0.8	5.5	-	1.7
	Civ.	-	-	-	-	1.7			0.4
Splenomegaly	Mil.	2.2	-	-	-	0.8	-	1.3	0.7
	Civ.	2.6	-	-	-	-			0.9
Unilateral knee jerk loss	Mil.	1.1	1.6	-	1.5	1.6	3.7	-	1.5
	Civ.	-	-	-	-	1.7			0.4
Bilateral knee jerk loss 2/	Mil.	-	0.8	1.5	0.5	4.1	5.5	-	1.6
	Civ.	1.3	2.6	-	-	-			0.9
Unilateral ankle jerk loss	Mil.	0.5	1.6	-	-	1.6	3.7	-	1.0
	Civ.	-	2.6	-	-	3.3			1.3
Bilateral ankle jerk loss	Mil.	0.5	0.8	1.5	-	0.8	2.8	-	0.8
	Civ.	-	5.3	2.7	-	-			1.3
ABBREVIATED EXAMINATIONS (for comparison with the above)									
Totals Examined	Mil.	736	602	466	784	560	553	624	4325
	Civ.	136	129	127	34	94	-	-	520
Unilateral ankle jerk loss 3/	Mil.	-	0.2	0.4	-	0.5	-	0.5	0.2
	Civ.	0.7	0.8	1.6	-	2.1			1.2
Bilateral ankle jerk loss 4/	Mil.	0.7	0.3	1.1	0.2	1.1	0.5	0.6	0.6
	Civ.	1.5	1.6	1.6	8.8	-			1.7

1/ 1 case in a female < 15 years.
2/ 1 case in a female < 15 years, 1 case in a pregnant or lactating female, 15+ years.
3/ 2 cases in females < 15 years, 2 cases in non-pregnant, non-lactating females, 15+ years.
4/ see Table 29-A. for breakdown by age and sex.

TABLE 22-A. CLINICAL FINDINGS AMONG THE THAI MILITARY BY LOCATIONS 1/
ABBREVIATED EXAMINATIONS 2/

General Area	ARMY						AIR FORCE			NAVY	
	Bangkok	Songkhla	Chiengmai	Udorn	Ubol	TOTAL	Koketthiem (Lopburi - enlisted)	Koketthiem (Lopburi - WOCs)	TOTAL	Sattaheep (TOTAL)	COMBINED SERVICES
Number examined	553	560	736	602	466	2917	406	378	784	624	4325
	Percent Prevalence										
Bitot's spots	0.4	0.2	0.1	0.2	-	0.2	-	-	-	0.3	0.2
Nasolabial seborrhea	8.7	8.6	7.3	5.3	2.6	6.6	3.7	1.9	2.8	2.6	5.4
Angular lesions	3.4	0.5	9.1	12.8	10.1	7.3	1.7	-	0.9	3.5	5.6
Angular scars	2.2	1.1	0.7	-	1.3	1.0	0.7	-	0.4	0.3	0.8
Cheilosis	0.4	-	-	0.2	0.2	0.1	-	-	-	0.2	0.1
S.R.P., - localized	2.0	3.4	3.4	1.7	2.1	2.6	0.7	1.0	0.9	0.5	2.0
S.R.P., - diffuse	-	0.2	-	-	-	<0.1	-	-	-	-	<0.1
PPA, slight	3.1	1.1	0.8	2.5	0.6	1.6	1.5	0.3	0.9	3.5	1.7
PPA, moderate	1.3	0.2	0.3	0.8	0.2	0.5	0.2	0.3	0.3	2.2	0.7
Goiter, Grade I	? 3/	? 3/	? 3/	13.0	20.2	16.1	11.3	4.8	8.2	18.1	14.1
Goiter, Grade II	1.3	-	3.3	1.2	3.0	1.8	2.0	0.5	1.3	3.3	2.0
Follicular hyperkeratosis, any skin area	-	0.2	-	0.2	-	0.1	-	-	-	-	<0.1
Unilateral AJ loss	-	0.5	-	0.2	0.4	0.2	-	-	-	0.5	0.2
Bilateral AJ loss	0.5	1.1	0.7	0.3	1.1	0.7	0.2	0.2	0.2	0.6	0.6
Calf tenderness	-	-	-	0.2	-	<0.1	-	-	-	-	<0.1

1/ see Table 1-A for specific units examined in each area
2/ none of the following clinical entities were observed: PPA, severe; glossitis; magenta colored tongue; pellagrous dermatitis; bilateral edema of lower extremities; scrotal dermatitis was examined for only in the detailed examinations
3/ not examined for (totals apply only to those examined)

TABLE 23-A. CLINICAL FINDINGS AMONG THE THAI MILITARY BY LOCATIONS 1/
DETAILED EXAMINATIONS

General Area	ARMY						AIR FORCE			NAVY	
	Bangkok	Songkhla	Chiengmai	Udorn	Ubol	TOTAL	Korathiem (Lopburi enlisted)	Korathiem (Lopburi M&W's)	TOTAL	Sattaheep (TOTAL)	COMBINED SERVICES
Number examined	109	122	184	129	66	610	100	94	194	80	884
	Percent Prevalence										
History of:											
Malaria	20.2	19.7	8.2	24.8	9.1	16.2	28.0	29.8	28.9	2.8	19.7
Diarrhea	14.7	13.1	8.2	7.8	4.5	9.8	12.0	4.2	8.2	11.2	9.6
Beriberi	4.6	5.7	4.3	4.7	-	4.3	1.0	1.1	1.0	2.5	3.4
Vesical calculus	0.9	1.6	1.1	3.1	-	1.5	-	-	-	-	1.0
Bitot's spots	-	-	0.5	-	-	0.2	-	-	-	-	0.1
Nasolabial seborrhea	10.1	18.8	9.2	9.3	3.0	10.6	7.0	3.2	5.2	7.5	9.2
Angular lesions	2.8	-	5.4	11.6	9.1	5.6	2.0	-	1.0	5.0	4.5
Gingival:											
Marginal redness	14.7	23.0	8.7	11.6	3.0	12.6	27.0	5.3	16.5	1.2	12.4
Marginal swelling	12.8	25.4	9.2	3.9	7.6	11.8	11.0	-	5.7	3.8	9.7
Papillary atrophy	1.8	9.0	-	-	-	2.1	-	-	-	-	1.5
Recession	21.1	38.5	31.0	25.6	15.2	27.9	16.0	1.1	8.8	5.0	21.6
S.R.P. - localized	7.3	10.6	1.1	-	4.5	4.3	10.0	4.2	7.2	2.5	4.8
FPA - slight	1.8	3.3	1.1	3.1	1.5	2.1	1.0	-	0.5	3.8	1.9
FPA - M/S	2.8	-	1.6	-	1.5	1.1	-	-	-	5.0	1.2
Lingual furrows	8.3	1.6	10.3	3.9	-	5.7	7.0	-	3.6	2.5	5.0
Goiter - Grade I	† 2/	† 2/	† 2/	10.8	33.3	5.9	19.0	5.3	12.4	33.8	9.8
Goiter - Grade II	4.6	-	4.9	-	1.5	2.5	3.0	-	1.5	2.5	2.3

1/ see Table 1-A for specific units examined in each area, and Tables 20-A and 21-A for other clinical entities of the detailed examinations; see preface for abbreviations used.

2/ not examined for (totals apply only to those examined)

62y788 O - 62 - 10

TABLE 24-A. CLINICAL FINDINGS AMONG THE THAI MILITARY (COMBINED SERVICES) IN TERMS OF AGE AND PERCENT STANDARD WEIGHT 1/

ABBREVIATED EXAMINATIONS	Age (years)				% Standard Weight				
	21-24	25-29	30-34	35+	70-79	80-89	90-99	100-109	110+
Number examined	3868	341	64	52	109	1183	2155	781	97
	Percent Prevalence								
Bitot's spots	0.2	-	-	-	-	0.1	0.2	0.2	-
Nasolabial seborrhea	5.7	2.9	-	-	2.8	4.9	5.2	6.8	5.2
Angular lesions	6.2	0.6	-	-	4.6	4.8	5.7	6.6	6.2
Angular scars	0.9	-	-	-	-	0.8	0.7	1.0	-
Cheilosis	0.1	-	-	-	-	-	0.2	-	-
S.R.P. - localized	2.0	1.8	1.6	-	-	2.3	2.1	1.5	-
FPA - slight	1.9	0.6	-	-	-	1.4	2.0	1.8	2.1
FPA - moderage	0.8	0.3	-	-	0.9	0.5	0.6	1.0	3.1
Goiter, Grade II 2/	1.2	0.3	1.6	-	1.8	1.0	1.3	0.8	1.0
Unilateral AJ loss	0.2	0.3	-	-	-	0.2	0.3	0.1	-
Bilateral AJ loss	0.6	0.3	-	1.9	-	0.8	0.6	0.5	1.0
DETAILED EXAMINATIONS									
Number examined	770	83	19	12	24	274	425	140	21
	Percent Prevalence								
History of:									
malaria	18.3	25.3	47.4	25.0	12.5	29.8	19.0	20.7	19.0
diarrhea	9.9	9.6	5.3	-	8.3	9.1	10.1	9.3	9.5
beriberi	3.8	-	5.3	-	-	3.6	3.3	3.6	4.8
vesical calculus	1.0	-	5.3	-	-	1.4	0.7	1.4	-
Pingueculae	1.8	-	-	-	8.3	0.7	2.1	0.7	-
Bitot's spots	0.1	-	-	-	-	0.4	-	-	-
Nasolabial seborrhea*	10.1	3.6	-	-	8.3	6.6	10.1	12.8	-
Angular lesions*	5.2	-	-	-	4.2	2.9	5.2	5.7	4.8
Gingiva: marginal redness	13.6	3.6	10.5	-	8.3	15.0	11.3	12.8	4.8
marginal swelling	10.5	3.6	5.3	8.3	12.5	8.4	10.8	9.3	4.8
papillary atrophy	1.6	1.2	-	-	-	0.4	1.9	1.4	9.5
recession	21.8	25.3	5.3	8.3	29.2	19.0	22.8	21.4	23.8
S.R.P. - localized	5.1	1.2	5.3	8.3	8.3	5.5	4.5	4.3	-
FPA - slight	2.2	-	-	-	-	2.9	1.6	1.4	-
FPA - M/S	1.4	-	-	-	-	1.8	1.4	-	-
Lingual furrows	4.9	7.2	-	-	8.3	5.8	4.2	5.0	4.8
Goiter, Grade II 2/*	3.6	1.2	-	-	8.3	3.6	1.9	-	-
Acneform eruption	8.1	13.2	10.5	8.3	8.3	6.6	10.4	6.4	14.3

(continued on next page)

TABLE 2A. A. (CONTINUED - page 2) (CLINICAL FINDINGS - MILITARY - BY AGE AND % STANDARD WEIGHT

DETAILED EXAMINATIONS	Age (years)				% Standard Weight				
	21-24	25-29	30-34	35+	70-79	80-89	90-99	100-109	110+
	Percent Prevalence								
Scrotal dermatitis	1.9	-	-	-	4.2	1.1	2.6	-	-
Splenomegaly	0.8	-	-	-	-	0.7	0.7	0.7	-
Bilateral AJ loss	0.9	-	-	-	-	0.7	0.9	0.7	-
Bilateral KJ loss	1.7	1.2	-	-	-	1.1	2.4	0.7	-
	Mean Values								
Systolic B.P. (mm. Hg.)	117	115	118	115	116	114	117	120	120
Diastolic B.P. (mm. Hg.)	74	72	76	73	74	74	74	76	78
Pulse (per min.)	72	74	78	73	74	73	72	74	73

1/ see Table 2B- A for other clinical entities with negligible or zero prevalence.

2/ no goiters above Grade II were observed. Grade I goiters are not considered above because they were not examined for in the early part of the survey.

*: data suggests relationship to age.

TABLE 25-A. HEIGHT, WEIGHT, AND % STANDARD WEIGHT AMONG THE THAI MILITARY AS RELATED TO AGE

ABBREVIATED EXAMINATIONS	Age (years)						
	19	20	21	22-24	25-29	30-39	40+
Number examined:							
Army	-	-	1529	1255	106	26	-
Air Force	-	2	308	186	207	53	28
Navy	2	3	257	325	28	9	-
COMBINED SERVICES	2	5	2094	1766	341	88	28
Height (cm)							
Army	-	-	163	163	163	164	-
Air Force	-	164	164	165	165	163	163
Navy	164	167	163	163	164	167	-
COMBINED SERVICES	164	166	163	163	164	164	163
Weight (kg)							
Army	-	-	55.0	55.5	53.5	55.7	-
Air Force	-	55.5	54.8	55.1	54.8	54.2	57.9
Navy	54.0	59.0	57.8	57.1	56.2	60.7	-
COMBINED SERVICES	54.0	57.6	55.3	55.8	54.5	55.3	57.9
% Standard Weight							
Army	-	-	93.9	93.6	88.5	90.4	-
Air Force	-	94.0	91.8	90.9	88.8	90.0	96.1
Navy	94.0	97.0	97.7	96.2	91.2	96.4	-
COMBINED SERVICES	94.0	95.8	94.0	93.8	88.7	90.8	96.1

TABLE 26-A. CLINICAL FINDINGS AMONG THE THAI MILITARY (COMBINED SERVICES) IN TERMS OF RURAL VERSUS URBAN BACKGROUND AND DURATION OF MILITARY SERVICE 1/

ABBREVIATED EXAMINATIONS	Family Background		Duration of Military Service (mos.)						
	Rural	Urban	< 1	1-2	2-3	3-6	6-12	12-24	24+
Number examined	3174	1151	219	467	242	649	1180	988	580
			Percent Prevalence						
Bitot's spots	0.2	-	-	-	0.8	0.6	-	0.1	-
Nasolabial seborrhea	5.2	5.7	5.9	5.1	10.3	7.6	5.3	4.9	1.9
Angular lesions	6.0	4.6	7.3	7.1	4.5	8.8	6.1	5.3	0.2
Angular scars	0.9	0.5	2.3	0.2	0.4	1.5	0.8	0.8	-
Cheilosis	0.2	-	-	-	-	0.2	0.2	0.2	-
S.R.P. - localized	2.1	1.5	1.8	1.9	5.4	2.3	1.8	1.7	1.0
FPA - slight	1.7	1.8	0.9	1.5	2.5	0.6	2.2	2.8	0.5
FPA - moderate	0.7	0.9	0.9	0.2	0.4	0.9	0.8	1.1	0.2
Goiter, Grade II 2/	2.0	1.6	4.1	2.4	-	1.7	1.9	2.3	0.5
Unilateral AJ loss	0.2	0.1	-	0.2	0.4	0.2	0.2	0.4	-
Bilateral AJ loss	0.7	<0.1	1.8	1.1	0.8	0.6	0.4	0.5	0.3
DETAILED EXAMINATIONS									
Number examined	637	247	50	94	54	117	247	184	138
			Percent Prevalence						
History of:									
Malaria	19.9	19.0	8.0	23.4	16.7	22.2	15.4	22.8	23.9
Diarrhea	9.7	9.3	10.0	13.8	13.0	8.5	7.7	12.0	6.5
Beriberi	3.0	4.4	6.0	2.1	3.7	6.8	2.0	4.9	0.7
Vesical calculus	1.1	0.8	-	-	1.8	0.8	0.8	2.7	-
Pinguecalae	1.4	2.0	-	1.1	-	1.7	2.8	1.6	0.7
Bitot's spots	0.2	-	-	-	1.8	-	-	-	-
Nasolabial seborrhea	10.4	6.1	14.0	8.5	24.1	12.0	8.9	7.1	2.9
Angular lesions	4.9	3.6	4.0	4.2	1.8	6.8	7.3	3.8	-
Gingival: Marginal redness	12.6	12.1	14.0	18.1	24.1	12.0	13.4	10.9	4.3
Marginal swelling	10.0	8.9	10.0	8.5	27.8	11.1	10.5	8.7	2.2
Papillary atrophy	2.0	-	-	-	7.4	0.8	1.6	2.2	-
Recession	23.2	17.4	28.0	23.4	18.5	33.3	23.9	13.6	15.9
S.R.P. - localized	4.6	5.3	8.0	5.3	14.8	2.6	4.0	4.3	2.9
FPA - slight	2.0	1.6	4.0	-	-	2.6	2.0	3.8	-
FPA - M/S	1.4	0.8	4.0	-	-	1.7	1.6	1.6	-
Lingual furrows	4.9	5.3	6.0	7.4	7.4	2.6	6.1	3.8	3.6
Goiter, Grade II 2/	2.2	2.4	2.0	3.2	3.7	1.7	1.6	2.7	2.2
Acneform eruption	8.0	10.1	4.0	6.4	13.0	9.4	7.3	8.7	11.6

(continued on next page)

TABLE 26-A (CONTINUED - page 2) (CLINICAL FINDINGS-MILITARY-RURAL VERSUS URBAN BACKGROUND AND DURATION OF MILITARY SERVICE)

DETAILED EXAMINATIONS	Family Background		Duration of Military Service (mos.)						
	Rural	Urban	< 1	1-2	2-3	3-6	6-12	12-24	24+
			Percent Prevalence						
Scrotal dermatitis	2.0	0.8	6.0	1.1	5.6	3.4	0.8	1.1	-
Splenomegaly	0.9	-	-	-	1.8	2.6	0.8	-	-
Bilateral AJ loss	0.6	1.2	2.0	1.1	3.7	0.8	0.4	0.5	-
Bilateral KJ loss	1.7	1.2	2.0	2.1	3.7	3.4	0.8	1.1	0.7

1/ see Table 29-A for other clinical entities with negligible or zero prevalence. Care must be taken in attaching significance to the above concerning duration of military service because of the wide variations in individual locations (see Table 27-A).

2/ no goiters above Grade II were observed. Grade I goiters are not considered above because they were not examined for in the early part of the survey.

TABLE 27-A. VARIOUS PARAMETERS AMONG THE THAI MILITARY (LOCATIONS, AGE, WEIGHT, % STANDARD WEIGHT, HEIGHT, AND AREA OF ORIGIN) AS RELATED TO RURAL-URBAN BACKGROUND AND DURATION OF MILITARY SERVICE

LOCATIONS	Family Background		Duration of Military Service (mos.)						
	Rural	Urban	< 1	1-2	2-3	3-6	6-12	12-24	24+
			Percent Prevalence						
Army:									
Bangkok	65.6	34.4	-	-	19.9	15.4	38.5	26.2	-
Songkhla	73.6	26.4	15.9	0.2	10.0	15.2	37.3	20.4	1.1
Chiengmai	74.7	25.3	17.7	0.3	8.8	14.4	26.2	14.9	17.7
Udorn	72.4	27.6	-	10.3	-	22.3	27.6	39.5	0.3
Ubol	90.1	9.9	-	38.6	2.4	30.5	13.1	15.4	-
Total	74.8	25.2	7.5	8.4	8.3	18.9	28.9	23.3	4.7
Air Force (Lopburi):									
Koketheim (enlisted)	76.1	23.9	-	54.7	-	-	27.8	17.5	-
Koketheim (NCO's)	55.8	44.2	-	-	-	-	-	0.5	99.4
Totals	66.3	33.7	-	28.3	-	-	14.4	9.3	47.9
Navy: Sattaheep	75.8	24.2	-	-	-	15.5	36.0	37.8	10.6
COMBINED SERVICES	73.4	26.6	5.1	10.8	5.6	15.0	27.3	22.8	13.4

(continued on next page)

TABLE 27-A. (CONTINUED - page 2) MILITARY-VARIOUS PARAMETERS AS RELATED TO RURAL-URBAN BACKGROUND AND DURATION OF MILITARY SERVICE

LOCATIONS	Family Background		Duration of Military Service (mos.)						
	Rural	Urban	< 1	1-2	2-3	3-6	6-12	12-24	24+
AGE					Mean Values (years)				
Army	21.8	22.0	21.2	21.0	21.1	21.1	21.7	22.2	27.2
Air Force	24.1	25.3	-	21.0	-	-	21.2	22.2	27.9
Navy	22.0	22.4	-	-	-	21.0	21.3	22.2	25.5
COMBINED SERVICES	22.2	22.8	21.2	21.0	21.1	21.1	21.6	22.2	27.5
WEIGHT					Mean Values (kg)				
Army	55.2	55.2	53.6	55.2	54.3	55.9	55.4	55.4	53.5
Air Force	54.9	55.0	-	54.3	-	-	55.5	55.5	55.0
Navy	57.3	57.8	-	-	-	57.4	57.8	57.3	56.3
COMBINED SERVICES	55.4	55.4	53.6	54.8	54.3	56.1	55.9	55.9	54.8
% STANDARD WEIGHT					Mean Values (%)				
Army	93.7	93.1	90.8	94.7	91.4	95.4	93.8	93.9	88.0
Air Force	91.2	90.1	-	91.0	-	-	93.5	91.4	89.8
Navy	96.9	95.6	-	-	-	98.0	97.4	96.2	93.0
COMBINED SERVICES	93.8	92.7	90.8	92.9	91.4	95.8	94.5	94.3	89.8

		ARMY			AIR FORCE			NAVY			COMBINED SERVICES		
		Rural	Urban	TOTAL	Rural	Urban	TOTAL	Rural	Urban	TOTAL	Rural	Urban	TOTAL
HEIGHT						Mean Values (cm)							
		163	163	163	164	165	164	163	165	163	163	164	163
AREA OF ORIGIN[1/]	REGION NO.					Percent Prevalence							
Central	I	7.6	18.1	10.2	86.0	75.8	82.5	3.0	5.3	3.5	19.7	29.6	22.4
Eastern	II	0.4	0.5	0.4	2.7	4.9	3.4	64.3	70.2	65.7	10.3	10.7	10.4
Northeastern	III	19.7	7.5	16.6	1.5	3.0	2.0	0.8	0.7	0.8	13.9	5.6	11.7
Northern	IV	19.7	21.6	20.2	1.0	3.4	1.8	0.2	-	0.2	13.7	14.6	14.0
Northwestern	V	24.6	24.2	24.5	0.2	1.9	0.8	-	-	-	17.0	15.9	16.7
Western	VI	0.2	0.7	0.3	3.6	3.8	3.7	0.4	1.3	0.6	0.8	1.5	1.0
Southwestern	VII	9.0	7.6	8.6	4.8	6.8	5.5	13.1	20.5	14.9	8.9	9.1	9.0
Southern	VIII	0.1	-	0.1	0.2	0.4	0.2	18.2	2.0	14.3	2.8	0.3	2.2
Southern-most	IX	18.7	19.8	19.0	-	-	-	-	-	-	12.8	12.7	12.8

1/ for boundaries of these various regions, see Figure 1.

TABLE 28-A. COMPARISON OF NON-COMMISSIONED OFFICERS (NCO's) WITH ENLISTED MEN (EM's) IN TERMS OF VARIOUS CLINICAL PARAMETERS

ABBREVIATED EXAMINATIONS 1/	ARMY		AIR FORCE		NAVY		COMBINED SERVICES	
	EM's	NCO's	EM's	NCO's	EM's	NCO's	EM's	NCO's
Number examined	2782	135	408	376	552	72	3742	583
	Percent Prevalence							
Bitot's spots	0.2	-	-	-	0.4	-	0.2	-
Nasolabial seborrhea	6.8	3.0	3.7	1.9	2.9	-	5.9	1.9
Angular lesions	7.6	0.7	1.7	-	3.8	1.4	6.4	0.3
Angular scars	1.0	-	0.7	-	0.4	-	0.9	-
Cheilosis	0.1	-	-	-	0.2	-	0.1	-
S.R.P. - localized	2.6	0.7	0.7	1.1	0.5	-	2.1	0.8
FPA - slight	1.6	0.7	1.5	0.3	3.6	2.8	1.9	0.7
FPA - moderate	0.6	-	0.5	-	2.5	-	0.8	-
Goiter - Grade I	6.2	-	11.3	4.8	19.0	11.1	8.6	4.4
Goiter - Grade II	1.8	1.5	2.0	0.5	3.6	1.4	2.0	0.8
Follicular hyperkeratosis, any skin area	0.1	-	-	-	-	-	<0.1	-
Unilateral AJ loss	0.2	-	-	-	0.5	-	0.2	-
Bilateral AJ loss	0.8	-	0.2	0.3	0.5	1.4	0.7	0.3
Family background								
rural	75.7	54.8	76.2	55.6	76.8	68.0	75.9	56.9
urban	24.3	45.2	23.8	44.4	23.2	31.9	24.0	43.0
Source of meals								
home	-	-	-	81.1	-	91.7	-	63.6
military messes	100	100	100	18.9	100	8.3	100	36.4
Religion								
Buddhist	70.0	100	100	100	99.4	100	77.6	100
Moslem	9.8	-	-	-	0.5	-	7.4	-
Christian	0.2	-	-	-	-	-	0.1	-
Not determined	19.9	-	-	-	-	-	14.8	-
	Mean Values							
Height (cm)	163	164	164	164	163	164	163	164
Weight (kg)	55.2	53.4	54.8	55.0	57.6	56.4	55.5	54.6
% standard weight (%)	93.8	87.8	91.7	89.9	97.0	93.2	94.0	89.8
Age (yrs.)	21.6	27.0	21.3	27.9	21.6	25.1	21.6	27.3

1/ Includes all clinical findings observed except 1 case of S.R.P. - diffuse and 1 case of calf tenderness in the Army.

TABLE 29-A. CLINICAL FINDINGS AMONG THE THAI CIVILIANS BY AGE GROUPS AND LOCATIONS - ABBREVIATED EXAMINATIONS 1/

General Area	Songkhla		Chiengmai			Lop-buri	Udorn			Ubol			
Specific Village	Bang Dan (Buddhist)	Dan Kee Lag (Islam)	Ban Fon	San Pong	Padad	Ta Kae	Rachinutis High School	Phon Ngam	Marg Yah	Sri Kai	Ban Kao	Nong Manao	TOTAL
Number Examined													
M < 15	55	26	40	27	47	41	76	61	78	14	49	73	587
M 15+	51	43	45	41	50	34	-	57	72	49	42	36	520
F < 15	64	26	31	26	54	33	101	54	76	19	49	78	611
F 15+,NPNL	50	33	42	38	39	49	31	28	32	20	34	58	454
F 15+,PL	18	15	13	11	20	9	-	28	39	12	24	28	217
Totals	238	143	171	143	210	166	208	228	297	114	198	273	2389
						Percent Prevalence							
Bitot's spots													
M < 15	-	7.7	-	-	-	-	-	-	-	-	-	-	0.3
M 15+	-	7.0	-	-	-	-	-	1.8	-	-	-	-	0.8
F < 15	-	-	-	-	-	-	-	-	-	-	-	-	-
F 15+,NPNL	-	3.0	-	-	-	-	-	-	-	5.0	-	-	0.4
F 15+,PL	-	-	-	-	-	-	-	-	-	-	-	-	-
Totals	-	4.2	-	-	-	-	-	0.4	-	0.9	-	-	0.3
Nasolabial seborrhea													
M < 15	-	-	-	-	-	-	-	-	-	-	-	-	-
M 15+	9.8	11.6	2.2	9.8	6.0	-	-	1.8	4.2	-	4.8	5.6	5.0
F < 15	-	-	-	-	-	-	-	-	-	-	-	-	-
F 15+,NPNL	-	3.0	7.1	5.3	2.6	-	-	-	3.1	-	-	-	1.8
F 15+,PL	5.6	6.7	-	-	-	-	-	3.6	2.6	-	4.2	-	2.3
Totals	2.5	4.9	2.3	4.2	1.9	-	-	0.9	1.7	-	1.5	0.7	1.6
Angular lesions													
M < 15	1.8	3.8	22.5	11.1	8.5	7.3	1.3	8.2	14.1	7.1	8.2	9.6	8.5
M 15+	-	2.3	4.4	7.3	14.0	-	-	10.5	8.3	2.0	-	-	5.0
F < 15	-	-	22.6	3.8	11.1	-	1.0	22.2	7.9	10.5	-	9.0	6.9
F 15+,NPNL	8.0	6.1	4.8	2.6	10.2	2.0	-	7.1	-	-	-	3.4	4.0
F 15+,PL	5.6	-	7.7	-	10.0	11.1	-	7.1	2.6	8.3	4.2	-	4.6
Totals	2.5	2.8	12.3	5.6	11.0	3.0	1.0	11.8	8.1	4.4	2.5	5.9	6.1

(Continued on next page)

TABLE 29-A. (CONTINUED) (2nd page) (CLINICAL FINDINGS - CIVILIANS - ABBREVIATED EXAMINATIONS)

General Area	Songkhla		Chiengmai			Lop-buri	Udorn			Ubol			
Specific Village	Bang Dam (Buddhist)	Don Kee Leg (Islam)	Ban Fon	San Pong	Padad	Ta Kae	Rachinutis High School	Phom Ngam	Marg Yah	Sri Kai	Ban Kao	Nong Manao	TOTAL
	Percent Prevalence												
S.R.P. - localized													
M < 15	-	-	12.5	-	4.2	-	5.3	1.6	2.6	-	4.1	6.8	3.6
M 15+	5.9	7.0	2.2	7.3	4.0	5.9	-	7.0	19.4	24.5	14.3	13.9	10.6
F < 15	-	7.7	6.4	3.8	3.7	-	3.0	1.8	-	-	4.1	2.6	2.4
F 15+,NPNL	20.0	3.0	7.1	2.6	-	4.1	-	3.6	9.4	5.0	11.8	3.4	6.2
F 15+,PL	11.1	6.7	7.7	9.1	-	-	-	14.3	7.7	16.7	20.8	28.6	12.4
Totals	6.3	4.9	7.0	4.2	2.9	2.4	3.4	4.8	7.4	13.2	9.6	8.1	6.1
FPA - slight													
M < 15	1.8	3.8	-	7.4	2.1	2.4	-	-	-	-	-	1.4	1.2
M 15+	-	4.6	-	2.4	6.0	2.9	-	-	4.2	-	-	-	1.9
F < 15	1.6	-	-	3.8	-	-	-	1.8	-	-	-	2.6	0.8
F 15+,NPNL	4.0	9.1	16.7	2.6	2.6	10.2	-	-	-	-	5.9	8.6	5.7
F 15+,PL	-	6.7	-	9.1	5.0	11.1	-	10.7	5.1	16.7	16.7	7.1	7.8
Totals	1.7	4.9	4.1	4.2	2.9	4.8	-	1.8	1.7	1.8	3.0	3.7	2.7
FPA - M/S													
M < 15	1.8	-	-	3.7	-	-	1.3	-	-	-	2.0	1.4	0.8
M 15+	-	-	-	-	-	-	-	-	1.4	2.0	-	-	0.4
F < 15	-	3.8	-	-	-	-	-	-	-	-	-	-	0.2
F 15+,NPNL	4.0	6.1	-	2.6	-	10.2	-	-	3.1	5.0	8.8	10.3	4.6
F 15+,PL	-	13.3	-	-	-	-	-	-	2.6	16.7	-	3.6	2.8
Totals	1.3	3.5	-	1.4	-	3.0	0.5	-	1.0	3.5	2.0	2.9	1.5
Goiter - Grade I 2/													
M < 15	?	?	22.5	3.7	19.1	2.4	1.3	1.6	9.0	21.4	24.5	19.2	9.9
M 15+	?	?	22.2	4.9	12.0	11.8	-	8.8	9.7	24.5	23.8	30.6	12.9
F < 15	?	?	32.2	19.2	16.7	3.0	9.9	5.6	6.6	21.0	18.4	24.4	12.3
F 15+,NPNL	?	?	23.8	10.5	17.9	30.6	22.6	7.1	12.5	5.0	32.4	31.0	17.8
F 15+,PL	?	?	38.5	27.3	40.0	55.6	-	14.3	28.2	25.0	16.7	46.4	27.6
Totals	?	?	25.7	10.5	18.6	15.7	8.7	6.6	11.4	20.2	23.2	27.5	14.3

(Continued on next page)

TABLE 29-A. (CONTINUED - 3rd page) (CLINICAL FINDINGS - CIVILIANS ABBREVIATED EXAMINATIONS

General Area	Songkhla		Chiengmai			Lop-buri	Udorn			Ubol			
Specific Village	Bang Dan (Buddhist)	Don Kea Lag (Islam)	Ban Fon	San Pong	Padad	Ta Kae	Rachinutis High School	Phon Ngam	Marg Yah	Sri Kad	Ban Kao	Nong Manao	TOTAL
	Percent Prevalence												
Goiter - Grade II+													
M < 15	-	-	35.0	-	-	-	-	-	1.3	35.7	6.1	23.3	6.8
M 15+	-	-	20.0	2.4	-	-	-	1.8	-	32.6	19.0	11.1	7.5
F < 15	-	-	22.6	-	3.7	3.0	5.0	1.8	1.3	31.6	20.4	9.0	6.5
F 15+,NPNL	2.0	3.0	61.9	21.0	15.4	8.2	16.1	10.7	3.1	75.0	14.7	32.8	20.3
F 15+,PL	16.7	6.7	61.5	27.3	35.0	11.1	-	10.7	17.9	75.0	45.8	32.1	26.7
Totals	1.7	1.4	37.4	8.4	7.1	3.6	4.8	3.5	3.4	44.7	18.7	20.5	11.3
Bilateral loss of A.J.													
M < 15	-	-	-	-	4.2	-	-	-	1.3	-	-	-	0.5
M 15+	-	-	-	2.4	2.0	8.8	-	1.8	1.4	2.0	2.4	-	1.7
F < 15	-	3.8	-	-	1.8	-	1.0	-	-	-	-	-	0.5
F 15+,NPNL	-	-	2.4	-	12.8	10.2	-	3.6	-	-	-	1.7	2.9
F 15+,PL	-	-	-	9.1	10.0	-	-	3.6	-	8.3	-	3.6	2.8
Totals	-	0.7	0.6	1.4	5.2	4.8	0.5	1.3	0.7	1.8	0.5	0.7	1.4
TOTALS ONLY													
Angular scars	-	-	0.6	0.7	-	-	-	0.9	-	-	1.0	1.1	0.4
Unilateral loss of A.J.	1.3	0.7	0.6	-	-	-	0.5	-	0.3	0.9	0.5	0.4	0.4
Cheilosis (2 cases)													<0.1
Swollen red interdental papillae (S.R.P.) - diffuse (1 case)													<0.1
Follicular hyperkeratosis, any skin area (1 case)													<0.1
Calf tenderness (2 cases)													<0.1
Goiter - Grade III	-	-	1.8	0.7	-	-	-	-	-	0.9	-	-	0.2

1/ omitting glossitis, magenta colored tongue, follicular hyperkeratosis of arms and thighs, and pellagrous dermatitis, which were not observed; see preface for abbreviations used.

2/ The incidence of Grade I goiter was not determined in the Songkhla area.

TABLE 30-A. CLINICAL FINDINGS AMONG THE THAI CIVILIANS BY AGE GROUPS AND LOCATIONS - DETAILED EXAMINATIONS 1/

General Area	Songkhla		Chiengmai			Lop-buri	Udorn			Ubol			
Specific Village	Bang Dan (Buddhist)	Don Kee Leg (Islam)	Ban Fon	San Pong	Padad	Ta Kae	Rachinutis High School	Phon Ngam	Marg Yah	Sri Kai	Ban Kao	Mong Manao	TOTAL
Number Examined													
M < 15	17	2	12	7	11	11	19	17	17	4	9	14	140
M 15+	25	35	32	21	23	19	-	26	12	22	10	5	230
F < 15	10	5	11	7	8	6	26	19	19	12	13	10	146
F 15+,NPNL	17	18	19	26	14	17	7	7	4	14	8	8	159
F 15+,PL	10	12	11	8	13	7	-	7	7	5	9	8	97
Totals	79	72	85	69	69	60	52	76	59	57	49	45	772
						Percent Prevalence							
History of malaria													
M < 15	11.8	-	-	-	9.1	9.1	5.3	17.6	17.6	-	11.1	7.1	9.3
M 15+	4.0	8.6	12.5	-	26.1	47.4	-	11.5	33.3	22.7	30.0	20.0	17.0
F < 15	-	-	9.1	14.3	-	16.7	11.5	-	5.3	16.7	7.7	10.0	7.5
F 15+,NPNL	-	16.7	5.3	-	-	23.5	-	-	25.0	21.4	12.5	12.5	8.8
F 15+,PL	10.0	16.7	-	12.5	15.4	-	-	14.3	57.1	-	44.4	12.5	16.5
Totals	5.1	11.1	7.1	2.9	13.0	25.0	7.7	9.2	22.0	17.5	20.4	11.1	12.0
History of diarrhea													
M < 15	11.8	-	8.3	-	-	9.1	-	-	5.9	25.0	11.1	-	5.0
M 15+	4.0	8.6	6.2	4.8	4.3	5.3	-	7.7	-	-	-	-	4.8
F < 15	10.0	-	9.1	-	-	-	3.8	-	-	-	-	-	2.0
F 15+,NPNL	-	11.1	-	11.5	-	-	14.3	-	-	-	-	-	3.8
F 15+,PL	10.0	8.3	-	12.5	-	-	-	-	14.3	-	-	12.5	5.2
Totals	6.3	8.3	4.7	7.2	1.4	3.3	3.8	2.6	3.4	1.8	2.0	2.2	4.1
History of beriberi													
M 15+	4.0	-	3.1	-	21.7	5.3	-	7.7	8.3	-	10.0	20.0	5.6
F < 15	-	-	-	-	12.5	-	-	-	5.3	-	-	-	1.4
F 15+,NPNL	-	-	15.8	-	14.3	23.5	-	-	-	-	-	-	5.7
F 15+,PL	-	-	27.3	12.5	23.1	-	-	-	-	-	-	-	7.2
Totals	1.3	-	8.2	1.4	15.9	8.3	-	2.6	3.4	-	2.0	2.2	4.0
History of vesical calculus													
M < 15	-	-	-	-	-	-	-	-	5.9	-	-	-	0.7
M 15+	-	2.8	-	-	8.7	-	-	-	-	4.5	-	-	1.7
F < 15	-	-	-	-	12.5	-	-	-	-	-	-	-	0.7
F 15+,NPNL	5.9	-	-	-	-	-	-	-	-	-	-	-	0.6
F 15+,PL	-	8.3	-	-	-	14.3	-	-	14.3	-	-	-	3.1
Totals	1.3	2.8	-	-	4.3	1.7	-	-	3.4	1.8	-	-	1.3

(Continued on next page)

TABLE 30-A. (CONTINUED - page 2)(CLINICAL FINDINGS - CIVILIANS - DETAILED EXAMINATIONS)

General Area	Songkhla		Chiengmai			Lop-buri	Udorn			Ubol			
Specific Village	Bang Dan (Buddhist)	Don Kee Leg (Islam)	Ban Fon	San Pong	Padad	Ta Kae	Rachinutis High School	Phon Ngam	Marg Yah	Sri Kai	Ban Kao	Nong Manao	TOTAL
	Percent Prevalence												
Bitot's spots													
M 15+	-	8.6	-	-	-	-	-	3.8	-	-	-	-	1.7
Totals	-	4.2	-	-	-	-	-	1.3	-	-	-	-	0.5
Nasolabial seborrhea													
M < 15	-	-	-	-	-	9.1	-	-	-	-	-	-	0.7
M 15+	8.0	11.4	9.4	19.0	13.0	10.5	-	-	-	4.5	-	20.0	8.7
F 15+,NPNL	5.9	11.1	5.3	7.7	14.3	-	-	-	-	-	-	-	5.0
F 15+,PL	-	8.3	-	-	-	-	-	-	-	-	-	-	1.0
Totals	3.8	9.7	4.7	8.7	7.2	5.0	-	-	-	1.8	-	2.2	3.9
Angular lesions													
M < 15	-	-	25.0	-	18.2	-	-	5.9	23.5	25.0	33.3	21.4	12.1
M 15+	4.0	5.7	9.4	14.3	13.0	-	-	3.8	-	-	-	-	5.6
F < 15	-	-	36.4	14.3	12.5	-	3.8	26.3	5.3	16.7	-	20.0	11.6
F 15+,NPNL	5.9	-	-	11.5	21.4	-	-	-	-	-	-	-	4.4
F 15+,PL	-	-	18.2	-	7.7	14.3	-	14.3	-	40.0	-	-	7.2
Totals	2.5	2.8	14.1	10.1	14.5	1.7	1.9	10.5	8.5	8.8	6.1	11.1	7.9
Gingival marginal redness													
M < 15	11.8	50.0	-	14.3	18.2	-	-	11.8	-	-	-	14.3	7.1
M 15+	28.0	31.4	6.2	-	8.7	5.3	-	3.8	8.3	36.4	50.0	-	16.5
F < 15	20.0	-	-	14.3	-	-	3.8	5.3	-	-	15.4	-	4.8
F 15+,NPNL	58.8	44.4	5.3	7.7	7.1	-	14.3	-	-	7.1	12.5	-	15.7
F 15+,PL	50.0	41.7	18.2	-	15.4	-	-	14.3	-	-	55.6	12.5	21.6
Totals	32.9	34.7	5.9	5.8	10.1	1.7	3.8	6.6	1.7	15.8	26.5	6.7	13.1
Gingival marginal swelling													
M < 15	11.8	50.0	-	14.3	-	-	-	29.4	-	-	-	-	6.4
M 15+	28.0	37.1	3.1	-	4.3	-	-	3.8	-	-	20.0	-	10.9
F < 15	10.0	-	-	14.3	-	-	-	-	-	-	7.7	-	2.0
F 15+,NPNL	58.8	38.9	5.3	-	-	-	-	-	-	-	12.5	-	11.9
F 15+,PL	50.0	33.3	9.1	-	7.7	-	-	28.6	-	-	11.1	12.5	15.5
Totals	31.6	34.7	3.5	2.9	2.9	-	-	10.5	-	-	10.2	2.2	9.2

(Continued on next page)

TABLE 30-A. (CONTINUED - page 3) (CLINICAL FINDINGS - CIVILIANS - DETAILED EXAMINATIONS)

General Area	Songkhla		Chiengmai			Lop-buri	Udorn			Ubol			
Specific Village	Bang Dan (Buddhist)	Don Kae Lae (Islam)	Ban Pon	Ban Pong	Padad	Ta Kae	Rachinutis High School	Phon Ngam	Nang Yah	Sri Kai	Ban Kao	Nong Mamao	TOTAL
	Percent Prevalence												
Gingival papillary atrophy													
M 15+	28.0	25.7	18.8	19.0	4.3	5.3	-	3.8	-	4.5	-	-	13.0
F 15+,NPNL	47.0	27.8	15.8	23.1	7.1	11.8	-	-	-	-	-	-	15.7
F 15+,PL	40.0	8.3	-	-	-	-	-	14.3	-	-	-	-	6.0
Totals	24.0	20.8	10.6	14.5	2.9	5.0	-	2.6	-	1.8	-	-	7.9
Gingival recession													
M < 15	5.9	-	25.0	14.3	-	9.1	15.8	47.0	-	-	-	-	12.1
M 15+	28.0	60.0	78.1	61.9	26.1	47.4	-	61.5	41.7	4.5	20.0	20.0	46.1
F < 15	-	-	18.2	14.3	-	33.3	19.2	15.8	-	8.3	7.7	10.0	11.0
F 15+,NPNL	70.6	44.4	63.2	50.0	7.1	47.0	28.6	42.8	-	7.1	12.5	12.5	39.0
F 15+,PL	60.0	50.0	54.5	62.5	15.4	42.8	-	42.8	14.3	-	22.2	-	34.0
Totals	32.9	48.6	56.5	47.8	13.0	38.3	19.2	43.4	10.2	5.3	12.2	6.7	30.4
S.R.P. - localized													
M < 15	5.9	-	-	-	-	-	-	5.9	-	-	11.1	7.1	2.8
M 15+	28.0	14.3	3.1	-	4.3	5.3	-	-	16.7	4.5	50.0	20.0	10.4
F < 15	-	-	-	28.6	-	-	3.8	-	-	-	7.7	-	2.7
F 15+,NPNL	41.2	16.7	10.5	3.8	-	5.9	-	14.3	-	21.4	12.5	-	11.9
F 15+,PL	40.0	8.3	9.1	-	-	-	-	-	28.6	-	22.2	25.0	12.0
Totals	24.0	12.5	4.7	4.3	1.4	3.3	1.9	2.6	6.8	7.0	20.4	8.9	8.2
PPA - slight													
M < 15	5.9	-	-	-	-	-	-	5.9	-	-	-	-	1.4
M 15+	4.0	11.4	3.1	-	-	-	-	3.8	-	-	-	-	3.0
F < 15	-	-	-	-	-	-	-	-	-	-	7.7	-	0.9
F 15+,NPNL	17.6	5.6	-	11.5	7.1	5.9	-	-	-	-	-	-	5.7
F 15+,PL	20.0	-	-	12.5	-	-	-	-	-	-	-	-	3.0
Totals	8.9	6.9	1.2	5.8	1.4	1.7	-	2.6	-	-	2.0	-	2.8
PPA - M/S													
M 15+	-	-	-	4.8	-	-	-	-	-	-	-	-	0.4
F 15+,NPNL	-	5.6	-	3.8	-	-	-	-	-	-	12.5	-	1.9
F 15+,PL	-	25.0	9.1	-	-	-	-	-	-	20.0	-	-	5.0
Totals	-	5.6	1.2	2.9	-	-	-	-	-	1.8	2.0	-	1.2

(Continued on next page)

TABLE 30-A. (CONTINUED - page 4) (CLINICAL FINDINGS - CIVILIANS - DETAILED EXAMINATIONS)

General Area	Songkhla		Chiengmai			Lop-buri	Udorn			Ubol			
Specific Village	Bang Dan (Buddhist)	Don Kee Leg (Islam)	Ban Pon	San Pong	Padad	Ta Kae	Rachinutis High School	Phon Ngam	Marg Yah	Sri Kai	Ban Kao	Nong Manao	TOTAL
	Percent Prevalence												
Lingual furrows													
M < 15	5.9	-	-	-	-	-	5.3	-	-	-	-	-	1.4
M 15+	12.0	25.7	3.1	-	8.7	5.3	-	-	-	4.5	-	-	7.4
F < 15	-	-	-	-	-	-	-	-	-	-	-	10.0	0.7
F 15+,NPNL	17.6	11.1	5.3	3.8	-	-	-	-	25.0	-	12.5	-	5.7
Totals	8.9	15.3	2.4	1.4	2.9	1.7	1.9	-	1.7	1.8	2.0	2.2	3.8
Goiter Grade I													
M < 15	-	-	50.0	-	-	9.1	5.3	17.6	-	25.0	22.2	14.3	11.4
M 15+	-	-	12.5	14.3	-	-	-	7.7	25.0	4.5	50.0	-	7.8
F < 15	-	-	54.5	42.8	-	-	11.5	10.5	-	8.3	46.2	-	14.4
F 15+,NPNL	-	-	31.6	38.5	21.4	11.8	14.3	28.6	25.0	21.4	37.5	-	19.5
F 15+,PL	20.0	8.3	27.3	37.5	30.8	28.6	-	14.3	14.3	20.0	11.1	50.0	23.7
Totals	2.5	1.4	29.4	27.5	10.1	8.3	9.6	13.2	8.5	12.3	34.7	13.3	14.1
Goiter Grade II													
M < 15	-	-	8.3	-	-	-	-	-	-	-	11.1	21.4	3.6
M 15+	-	-	9.4	-	-	5.3	-	-	-	4.5	10.0	20.0	3.0
F < 15	-	-	9.1	-	37.5	33.3	7.7	5.3	-	16.7	-	30.0	9.6
F 15+,NPNL	-	-	47.4	3.8	28.6	23.5	-	-	-	50.0	12.5	37.5	18.2
F 15+,PL	-	-	36.4	-	23.1	28.6	-	14.3	14.3	40.0	44.4	25.0	19.6
Totals	-	-	21.2	1.4	14.5	15.0	3.8	2.6	1.7	21.1	14.3	26.7	9.6

1/ omitting those findings of negligible or zero prevalence (these are listed in Table 29-A); see preface for abbreviations used; in the above table, one must keep in mind the small number of subjects in each sex-age group.

TABLE 31-A. CLINICAL FINDINGS AMONG THE THAI CIVILIANS IN TERMS OF AGE AND SEX GROUPS 1/

ABBREVIATED EXAMINATIONS	Age (yrs.) Males					Age (yrs.) Females (NPNL)				
	0-4	5-9	10-14	15-44	45+	0-4	5-9	10-14	15-44	45+
Number examined	202	189	196	348	172	200	186	225	254	200
	Percent Prevalence					Percent Prevalence				
Bitot's spots	-	1.0	-	1.1	-	-	-	-	-	1.0
Nasolabial seborrhea*	-	-	-	6.6	1.7	-	-	-	2.4	1.0
Angular lesions*	3.0	12.2	10.7	6.3	2.3	4.5	12.4	4.4	4.3	3.5
Angular scars	-	0.5	0.5	0.3	0.6	-	-	-	0.8	1.0
Cheilosis	-	-	-	-	-	-	-	-	0.4	0.5
S.R.P. - localized*	-	2.1	8.7	12.1	7.6	-	2.2	4.9	5.9	6.5
FPA - slight*	-	3.2	0.5	1.7	2.3	1.5	1.1	-	3.1	9.0
FPA - M/S*	0.5	1.0	1.0	0.3	0.6	-	0.5	-	2.4	7.5
Goiter, Grade I 2/*	3.3	18.6	13.7	19.4	8.4	4.1	19.2	19.4	27.4	14.5
Goiter, Grade II+*	2.0	9.0	9.7	8.3	5.8	2.0	10.2	7.6	24.4	15.0
Unilateral AJ loss	-	-	-	0.9	1.7	0.5	-	0.4	-	1.0
Bilateral AJ loss*	-	1.0	0.5	0.6	4.1	-	0.5	0.9	2.4	3.5
DETAILED EXAMINATIONS										
Number examined	18	60	62	169	61	23	58	65	104	55
	Percent Prevalence					Percent Prevalence				
History of:										
malaria	5.6	10.0	9.7	18.3	13.1	4.3	6.9	9.2	7.7	10.9
diarrhea	11.1	3.3	4.8	5.9	1.6	4.3	-	3.1	5.8	-
beriberi	-	-	-	4.7	8.2	4.3	1.7	3.1	4.8	7.3
vesical calculus	-	1.7	-	1.2	3.3	4.3	-	-	1.0	-
Pingueculae	-	-	-	1.2	3.3	-	-	-	-	-
Bitot's spots	-	-	-	2.4	-	-	-	-	-	-
Nasolabial seborrhea*	-	1.7	-	8.9	8.2	-	-	-	4.8	5.4
Angular lesions*	11.1	8.3	16.1	5.9	4.9	4.3	22.4	4.6	3.8	5.4
Gingiva:										
marginal redness*	5.6	8.3	6.4	16.6	16.4	-	5.2	6.2	14.4	18.2
marginal swelling	5.6	10.0	3.2	11.2	9.8	-	1.7	3.1	10.6	14.5
papillary atrophy*	-	-	-	7.7	27.9	-	-	-	6.7	32.7
recession*	-	8.3	19.4	43.2	54.1	-	10.3	15.4	28.8	58.2
S.R.P. - localized*	-	3.3	3.2	9.5	13.1	-	5.2	1.5	12.5	10.9
FPA - slight*	-	3.3	-	4.1	-	-	1.7	-	1.9	12.7
FPA - M/S*	-	-	-	0.6	-	-	-	-	1.0	3.6
Lingual furrows*	-	-	3.2	7.1	8.2	-	1.7	-	3.8	9.1
Goiter, Grade I 2/	6.2	11.1	17.6	12.1	6.5	5.3	20.0	15.8	31.0	12.5
Goiter, Grade II+*	5.6	5.0	1.6	3.0	3.3	-	8.6	13.8	20.2	14.5

(continued on next page)

TABLE 31-A. (CONTINUED - page 2) (CLINICAL FINDINGS - CIVILIANS - BY AGE AND SEX)

DETAILED EXAMINATIONS	Age (yrs.) Males					Age (yrs.) Females (NPNL)				
	0-4	5-9	10-14	15-44	45+	0-4	5-9	10-14	15-44	45+
	Percent Prevalence					Percent Prevalence				
Acneform eruption	-	-	-	2.4	*	-	-	1.5	-	-
Scrotal dermatitis	-	-	-	0.6	-					
Splenomegaly	-	-	-	0.6	1.6	-	-	-	-	-
Bilateral AJ loss	-	-	-	1.2	1.6	-	-	-	-	-
Bilateral KJ loss	-	-	-	1.2	*	-	1.7	-	*	-

1/ see Table 20-A for other clinical entities with negligible or zero prevalence.

2/ excluding the 2 villages in the Songkhla area, where Grade I goiter was not determined.

*: data suggests relationship to age &/or sex.

TABLE 32-A. CLINICAL FINDINGS AMONG THE THAI CIVILIANS IN TERMS OF % STANDARD WEIGHT BY SEX GROUPS

ABBREVIATED EXAMINATIONS		% Standard Weight Males					% Standard Weight Females, NPNL				
		< 80	80-89	90-99	100-109	110+	< 80	80-89	90-99	100-109	110+
Number examined	Age 6-14 years	14	89	162	43	5	26	106	148	43	7
	Age 15+ years	85	237	144	37	4	152	163	38	31	14
		Percent Prevalence					Percent Prevalence				
Age 6-14 years:											
Angular lesions		7.1	12.4	13.0	11.6	-	15.4	7.5	8.1	2.3	-
S.R.P. - localized		-	7.9	4.3	16.3	-	7.7	5.7	2.7	-	-
FPA - slight		-	4.5	0.6	-	-	-	-	0.7	-	-
FPA - M/S		-	-	-	2.3	-	-	-	0.7	-	-
Goiter, Grade I 1/		10.0	18.9	14.7	14.6	20.0	21.0	20.4	20.3	7.7	42.8
Goiter, Grade II+		7.1	11.2	7.4	11.6	40.0	23.1	12.3	6.1	11.6	-
Bilateral AJ loss		-	-	0.6	-	-	-	0.9	1.4	-	-
Age 15+ years:											
Nasolabial seborrhea		9.4	3.8	4.9	5.4	-	2.0	2.4	1.1	-	-
Angular lesions		7.1	4.2	3.5	10.8	25.0	4.6	5.5	1.1	3.2	-
S.R.P. - localized		8.2	13.5	8.3	8.1	-	4.6	6.7	6.8	6.4	14.3
FPA - slight		4.7	1.3	0.7	2.7	25.0	6.6	5.5	4.5	3.2	-
FPA - M/S		1.2	0.4	-	-	-	6.6	4.9	3.4	-	-
Goiter, Grade I 1/		6.8	16.2	19.5	14.8	33.0	19.7	24.5	22.7	13.0	50.0
Goiter, Grade II+		7.1	6.3	10.4	2.7	25.0	15.8	27.0	18.2	19.4	7.1
Unilateral AJ loss		1.2	1.7	0.7			-	0.6	1.1	-	-
Bilateral AJ loss		2.4	1.7	1.4	2.7	-	4.6	1.8	3.4	-	-

1/ excluding the 2 villages in the Songkhla area, where Grade I goiter was not determined.

(continued on next page)

TABLE 32-A. (CONTINUED - page 2)(CLINICAL FINDINGS - CIVILIANS - BY % STANDARD WEIGHT AND SEX)

DETAILED EXAMINATIONS 1/	% Standard Weight Males					% Standard Weight Females, NPNL				
	< 80	80-89	90-99	100-109	110+	< 80	80-89	90-99	100-109	110+
Number examined Age 6-14 years	6	34	47	13	2	12	31	49	11	1
Age 15+ years	41	112	51	17	3	51	54	37	10	6
	Percent Prevalence					Percent Prevalence				
Age 6-14 years:										
Nasolabial seborrhea	-	-	2.1	-	-	-	-	-	-	-
Angular lesions	-	20.6	10.6	23.1	-	25.0	12.9	12.2	9.1	-
Gingiva:										
marginal redness	-	5.9	6.4	7.7	50.0	8.3	12.9	-	9.1	-
marginal swelling	-	5.9	8.5	-	-	8.3	6.4	-	-	-
recession	16.7	5.9	19.1	23.1	-	8.3	9.7	10.2	18.2	-
S.R.P. - localized	-	5.9	2.1	-	-	8.3	3.2	2.0	9.1	-
FPA - slight	-	2.9	2.1	-	-	-	-	-	-	-
Lingual furrows	-	2.9	2.1	-	-	-	-	-	-	-
Goiter, Grade I 2/	-	25.0	-	-	-	25.0	39.3	6.5	9.1	-
Goiter, Grade II+	-	2.9	13.9	15.4	50.0	8.3	9.7	12.2	18.2	-
Acneform eruption	-	-	-	-	-	-	-	2.0	-	-
Age 15+ years:										
Pingueculae	-	1.8	2.0	-	33.3	-	-	-	-	-
Bitot's spots	-	1.8	2.0	-	-	-	-	-	-	-
Nasolabial seborrhea	24.4	5.4	5.9	5.9	-	2.0	9.2	5.4	-	-
Angular lesions	9.8	4.5	5.9	5.9	-	5.9	7.4	-	-	-
Gingiva:										
marginal redness	9.8	19.6	20.0	11.8	-	13.7	11.1	18.9	30.0	33.3
papillary atrophy	17.1	11.6	17.6	-	33.3	21.6	11.1	8.1	40.0	16.7
marginal swelling	12.2	10.7	11.8	11.8	-	7.8	3.7	21.6	30.0	33.3
recession	58.5	48.2	35.3	41.2	33.3	49.0	35.2	24.3	50.0	50.0
S.R.P. - localized	-	12.5	17.6	-	33.3	7.8	11.1	13.5	20.0	33.3
FPA - slight	4.9	1.8	-	11.8	33.3	9.8	1.8	5.4	10.0	-
FPA - M/S	-	0.9	-	-	-	5.9	-	-	-	-
Lingual furrows	7.3	9.8	2.0	11.8	-	7.8	-	8.1	20.0	-
Goiter, Grade I 2/	5.9	7.1	13.9	11.8	-	24.4	21.7	21.6	40.0	-
Goiter, Grade II+	7.3	1.8	3.9	-	-	19.6	20.4	18.9	-	16.7
Acneform eruption	-	0.9	3.9	5.9	-	-	-	-	-	-
Scrotal dermatitis	-	-	-	5.9	-	-	-	-	-	-
Splenomegaly	-	0.9	2.0	-	-	-	-	-	-	-
Bilateral AJ loss	-	2.7	-	-	-	-	-	-	-	-
Bilateral KJ loss	2.4	0.9	-	-	-	-	-	-	-	-

1/ excluding medical history data, and excluding entirely negative entities from the 6-14 year groups.

2/ excluding the 2 villages in the Songkhla area where Grade I goiter was not determined.

629788 O - 62 - 11

TABLE 33-A. CLINICAL FINDINGS AMONG PREGNANT AND LACTATING WOMEN 1/

ABBREVIATED EXAMINATIONS	Pregnant	Lactating
Number examined	50	167
	Percent Prevalence	
Nasolabial seborrhea	2.0	2.4
Angular lesions	6.0	4.2
Angular scars	-	0.6
S.R.P. - localized	14.0	12.0
FPA - slight	10.0	7.2
FPA - M/S	2.0	3.0
Goiter, Grade I	18.0	30.5
Goiter, Grade II+	34.0	24.6
Bilateral AJ loss	2.0	3.0
DETAILED EXAMINATIONS		
Number examined	21	76
History of:		
malaria	14.3	17.1
diarrhea	-	6.6
beriberi	-	9.2
vesical calculus	9.5	1.3
Nasolabial seborrhea	-	1.3
Angular lesions	9.5	6.6
Gingiva:		
marginal redness	19.0	22.4
marginal swelling	14.3	15.8
papillary atrophy	4.8	6.6
recession	23.8	38.2
S.R.P. - localized	14.3	11.8
FPA - slight	4.8	2.6
FPA - M/S	-	6.6
Fungiform papillary atrophy - slight	-	1.3
Goiter, Grade I	23.8	23.7
Goiter, Grade II	19.0	19.7
Bilateral KJ loss	-	1.3

1/ These 2 groups are combined in all other tables; the above includes all lesions observed.

TABLE 34-A. AGE, HEIGHT, WEIGHT, AND % STANDARD WEIGHT 1/ AMONG THAI CIVILIAN ADULTS (15+ YEARS) BY LOCATION

General Area	Songkhla		Chiengmai			Lop-buri	Udorn			Ubol			
Specific Village	Bang Dan (Buddhist)	Don Kee Lag (Islam)	Ban Fon	San Pong	Padad	Ta Kae	Rachinutis High School	Phon Ngam	Marg Yah	Sri Kai	Ban Kao	Nong Mamao	TOTAL
MALES, 15+ YRS.					Mean Values								
No. examined	51	43	45	41	50	34	-	57	72	49	42	36	520
Age (years)	35.8	38.5	41.5	40.0	41.0	42.9	-	35.0	34.5	44.3	37.2	43.0	38.9
Height (cm)	162	159	162	161	163	162	-	157	160	161	161	159	161
Weight (kg)	52.1	50.9	51.3	47.6	51.7	49.5	-	49.6	52.1	50.7	52.7	51.1	51.0
% standard weight	89.3	88.8	86.6	80.7	86.5	82.9	-	88.1	89.6	85.8	89.4	89.0	87.2
FEMALES, 15+ YRS., NPNL													
No. examined	50	33	42	38	39	49	31	28	32	20	34	58	454
Age (years)	39.3	41.3	42.1	43.6	44.6	44.1	15.4	35.8	37.2	45.0	38.6	41.6	39.5
Height (cm)	150	150	151	153	153	154	149	148	151	152	150	150	151
Weight (kg)	47.9	43.5	41.3	41.6	43.3	43.6	42.8	42.7	44.0	45.2	44.6	42.7	43.6
% standard weight	93.1	84.6	79.0	78.6	81.9	82.1	89.4	84.7	84.3	86.1	86.6	83.7	84.5
CHILDREN - MALES, 6-14 YRS.													
No. examined	36	15	22	15	19	24	76	27	44	6	25	30	339
% standard weight	90.8	85.8	91.7	87.3	92.3	90.1	94.6	92.4	95.2	93.0	93.0	93.4	92.5
CHILDREN - FEMALES, 6-14 YRS.													
No. examined	38	15	14	9	30	18	101	33	40	12	24	35	369
% standard weight	92.0	79.2	85.0	80.1	90.2	89.6	93.6	93.3	92.1	89.1	91.9	92.1	91.2

1/ % standard weight for ages 6-14 derived from standards of the Baldwin-Wood Tables, and for ages 15+ from the Medico-Actuarial Mortality Investigation, 1912 (82).

TABLE 35-A. HEIGHT, WEIGHT, AND % STANDARD WEIGHT AMONG THAI CIVILIANS IN TERMS OF AGE AND SEX GROUPS (ABBREVIATED EXAMINATIONS)

Age (years) MALES	No. of Subjects	Height Means (cm)	S.E.	Weight Means (kg)	S.E.	% Standard Weight 1/ Means (%)	S.E.
< 1	35	62.3	1.2	6.2	0.3		
1	35	71.4	0.8	8.0	0.3		
2	42	79.4	0.9	9.8	0.2		
3	53	85.7	0.9	11.2	0.2		
4	35	90.0	1.0	12.4	0.4		
5	45	99.7	0.9	14.2	0.3		
6	47	104.1	0.9	15.9	0.3	92.4	1.2
7	31	109.7	1.0	17.1	0.5	90.2	2.0
8	26	113.0	1.2	18.8	0.4	92.9	1.9
9	26	116.4	0.8	19.9	0.3	92.2	1.3
10	27	123.9	1.1	22.8	0.5	92.4	1.8
11	44	130.6	0.9	26.0	0.5	92.1	0.9
12	53	134.6	1.0	28.4	0.6	92.4	1.0
13	44	140.6	1.0	32.6	0.7	94.9	1.4
14	16	143.5	1.4	33.7	1.2	92.0	2.4
15	4	148.8	2.9	40.5	3.8	89.5	10.4
16	9	151.9	1.7	41.1	1.5	85.4	2.6
17	11	157.3	2.0	47.5	1.9	91.1	3.1
18	5	157.6	2.4	46.6	2.1	87.6	2.0
19	8	161.6	3.2	51.2	1.8	91.1	2.6
20-24	44	162.6	0.8	53.0	0.8	89.6	1.0
25-29	57	161.9	0.8	53.2	0.8	89.1	1.3
30-34	69	159.3	0.6	50.5	0.7	87.2	1.0
35-39	80	161.4	0.7	52.0	0.7	87.8	1.1
40-44	49	162.2	1.0	51.7	0.8	86.3	0.9
45-49	32	159.0	1.0	50.1	1.0	86.5	1.7
50-54	49	161.4	1.0	51.8	1.0	87.2	1.5
55-59	40	160.3	0.9	50.6	0.9	86.3	1.4
60-64	24	160.7	1.3	49.4	1.1	83.8	1.8
65+	27	160.5	1.3	48.1	0.9	82.1	1.3
AGE (years) - FEMALES (NPML)							
< 1	36	63.1	0.9	6.4	0.2		
1	32	70.2	0.9	7.5	0.3		
2	33	77.0	0.9	9.2	0.2		
3	63	83.5	0.9	10.6	0.2		
4	34	92.4	1.1	12.5	0.4		
5	42	97.9	1.0	13.8	0.3		
6	40	104.8	0.7	15.6	0.3	91.0	1.7
7	31	109.2	1.2	16.7	0.5	90.5	2.4
8	27	113.2	0.8	18.4	0.4	92.0	1.6
9	29	118.6	1.0	20.2	0.4	90.0	1.6

(continued on next page)

TABLE 35-A. (CONTINUED-- page 2) (HEIGHT, WEIGHT, AND % STANDARD WEIGHT - CIVILIANS - BY AGE AND SEX)

Age (yrs.) FEMALES (NPNL)	No. of Subjects	Height		Weight		% Standard Weight 1/	
		Means (cm)	S.E.	Means (kg)	S.E.	Means (%)	S.E.
10	31	123.3	1.7	22.0	0.7	88.1	1.8
11	40	131.6	1.2	26.8	0.5	91.1	1.1
12	54	137.0	1.2	30.4	0.8	92.1	1.4
13	39	141.8	1.2	34.5	0.9	93.7	1.6
14	37	144.5	1.2	36.0	1.0	90.8	1.8
15	27	147.5	1.3	40.7	0.9	86.9	0.2
16	26	150.0	1.1	40.4	1.0	83.2	1.9
17	17	149.7	1.7	44.6	1.4	90.8	2.4
18	20	154.2	1.4	47.7	1.5	92.0	2.9
19	11	150.9	1.3	46.3	2.4	91.6	0.4
20-24	33	150.1	0.9	46.0	1.0	89.9	2.0
25-29	32	152.2	1.0	45.8	1.1	86.4	1.8
30-34	26	152.7	1.0	44.2	0.9	83.3	1.9
35-39	33	151.9	1.0	46.1	1.5	87.5	2.7
40-44	26	151.6	1.2	45.8	1.0	86.7	1.9
45-49	49	152.1	0.8	44.6	1.0	84.7	1.8
50-54	44	151.5	0.9	43.0	1.1	81.3	1.6
55-59	33	151.0	0.8	40.9	1.0	78.2	1.8
60-64	32	150.0	1.3	40.8	1.2	78.6	2.4
65+	40	149.8	1.0	41.0	1.0	79.2	2.0

1/ % standard weight for ages 6-14 derived from standards of the Baldwin-Wood Tables, and for ages 15+ from the Medio-Actuarial Mortality Investigation, 1912 (82).

TABLE 36 -A. BLOOD PRESSURE, PULSE, AND TOTAL SERUM CHOLESTEROLS AMONG THE THAI CIVILIANS IN TERMS OF SEX, AGE, AND WEIGHT

General Area	Songkhla		Chiengmai			Lop-buri	Udorn			Ubol			
Specific Village	Bang Dan (Buddhist)	Don Kee Leg (Islam)	Ban Fon	San Pong	Padad	Ta Kae	Rachinutis High School	Phon Ngam	Marg Yeh	Sri Kai	Ban Kao	Nong Manao	TOTAL
Number examined													
M + F < 15	27	7	23	14	19	17	45	36	36	16	22	24	286
M + F 15+ (NPNL)	42	53	51	47	37	36	7	33	16	36	18	13	389
						Mean Values							
Systolic B.P. (mm. Hg.)													
M + F < 15	101	115	102	101	108	101	106	97	100	102	98	95	102
M + F 15+ (NPNL)	123	123	122	116	120	113	108	110	112	118	114	117	118
Diastolic B.P. (mm. Hg.)													
M + F < 15	63	73	66	64	68	63	68	65	63	66	67	63	66
M + F 15+ (NPNL)	79	74	76	69	73	70	70	69	67	75	74	76	73
Pulse (per min.)													
M + F < 15	101	97	100	102	100	93	89	100	103	105	103	102	99
M + F 15+ (NPNL)	78	77	84	87	84	76	84	80	87	74	81	81	81

AGE GROUPS (years)	Males				Females (NPNL)			
	No. of Subj.	Mean Values			No. of Subj.	Mean Values		
		Systolic B.P.	Diastolic B.P.	Pulse		Systolic B.P.	Diastolic B.P.	Pulse
0-4	18	95	59	113	23	95	62	106
5-9	60	97	63	101	58	100	66	103
10-14	62	103	66	89	65	108	70	98
15-19	24	108	66	88	35	116	72	87
20-29	53	122	73	80	31	117	73	84
30-39	70	116	72	79	28	115	73	85
40-49	34	118	73	76	27	119	74	82
50-59	34	120	75	72	21	118	77	83
60-69	10	119	75	74	13	122	75	79
70-79	5	142	81	81	4	134	82	79

(Continued on next page)

TABLE 36 - A. (CONTINUED - page 2) (BLOOD PRESSURE, PULSE, AND CHOLESTEROLS - CIVILIANS)

WEIGHT GROUPS (kg.)	Males 15+ years				Females 15+ years (NPNL)			
	No. of Subj.	Mean Values			No. of Subj.	Mean Values		
		Systolic B.P.	Diastolic B.P.	Pulse		Systolic B.P.	Diastolic B.P.	Pulse
20-29	5	94	61	90	0	-	-	-
30-39	5	112	68	94	40	118	73	88
40-49	89	117	72	79	93	116	73	83
50-59	117	120	74	76	17	120	77	82
60+	14	120	73	80	9	123	81	79
Pregnant females					21	112	68	87
Lactating females					76	113	72	84

SERUM CHOLESTEROL IN TERMS OF VARIOUS PARAMETERS

	No. of subjects	Mean Value (mg %)
LOCATIONS		
M + F < 15 yrs.		
Padad	3	150
Ta Kae	4	148
Phon Ngam	6	120
Sri Kai	3	94
Ban Kao	1	90
Nong Manao	7	135
Total	24	128
M + F (NPNL) 15+ years		
Ban Fon	2	116
San Pong	1	120
Padad	3	154
Ta Kae	11	150
Phon Ngam	9	122
Sri Kai	3	114
Ban Kao	2	130
Nong Manao	7	119
Total	38	132
BLOOD PRESSURE M + F (NPNL) 15+ years Diastolic:		
50-59	3	130
60-69	8	124
70-79	17	129
80-89	7	149
90+	2	136

	No. of subjects	Mean Value (mg %)
BLOOD PRESSURE M + F (NPNL) 15+ years Systolic:		
90-99	1	130
100-109	13	124
110-119	10	122
120-129	7	159
130-139	5	138
140+	1	120
AGE GROUPS (years)		
Males		
5-9	8	110
10-14	4	138
15-44	13	119
45+	6	139
Females (NPNL)		
5-9	6	139
10-14	6	136
15-44	11	140
45+	8	134
Pregnant	3	144
Lactating	9	157

Note: Of the 62 serum cholesterols done, only 1 was in excess of 200 mg %, and that was in a female child 5-9 years of age (240 mg %).

I. BIOCHEMICAL APPENDIX

Scope - For the general survey the biochemical sample was taken from approximately 550 civilians and military personnel. The sample was about equally divided between these two groups and represented approximately 30 percent of the subjects who received the detailed physical examinations. Since the important biochemical parameters under consideration yielded uniform and consistent findings for the most part, this sample size was entirely adequate. With the present results at hand, it is now possible to re-examine the sample and to point up specific areas for future concern. In view of the uniformly high levels of vitamin C in the plasma, the high excretion of N'-methylnicotinamide, and the uniformly low level of riboflavin excretion, the decision could have been reached early in the survey to restrict analyses for these components to a minimum and allow the laboratory personnel to spend a maximum amount of time on training in methodology and special studies to give chemical support to important dietary or clinical observations.

In retrospect one would desire a larger sample from special age groups. For instance, the immediate post-weaning age group of children and pregnant and lactating mothers. Since the military group is relatively more homogeneous, this increased load might have been compensated for by decreasing the size of the military sample. In most respects, however, this criticism of the sample does not detract from the general conclusions to be drawn from the findings as they are characteristic of the entire population when evaluated with respect to the dietary and clinical results.

Sampling Techniques - For the most part the procedures for taking, holding, and evaluating the blood and urine specimens conformed to the recommendations to be found in the ICNND Manual. Thus, the significant departures from the procedures in the Manual will be discussed and justified as far as possible and will be emphasized out of proportion to their importance.

With increasing emphasis upon the civilian sample, it has become a necessity to re-evaluate the techniques for the blood sampling procedure. In many cases it is advisable to draw a minimum sample and even limit this to capillary amounts in small children. The procedures in the Manual suggest a 20 ml tube and a 7 ml separate tube of blood which is easy enough to achieve in most military groups. However, it is messy and particularly difficult with children and civilians as it requires a skilled technician and a disinterested subject, especially for two critical phases of the procedure: (a) puncturing the vein, and (b) changing the tubes. The availability of satisfactory micromethods adds a new dimension to this procedure and in particular negates the second of the problems mentioned above; namely, that of changing tubes. It is easily possible to perform all the desired analyses on one 7 ml sample of anticoagulated blood. It is further possible to determine vitamin C in the capillary blood in the serum resulting from the hematocrit determination. With these facts in mind, the following procedures were employed for the survey. When possible, a 7 ml sample of blood was taken in the oxalated tubes. In the few cases when this was not feasible, capillary samples of blood were drawn. In the latter case from one to four tubes were taken to insure enough for duplication. After labeling and packaging for shipment, they were immediately chilled in ice. For the bulk of the field work disposable vacutainer needles were employed with highly satisfactory results. While this procedure negated the usual problems of functional clean, sharp and sterile needles that can be a source of difficulty, it did not train the Thai personnel in the perfectly satisfactory proper sanitary and handling procedures for the regular nondisposable vacutainer or syringe-type needles. This limitation was recognized and discussed. For the routine field surveys, the disposable needles are vastly superior because of the precautions which people do not often take with the regular equipment.

The urine was collected in brown glass bottles and acidified with hydrochloric acid. Because of variations in sample size and buffering capacity, it was found to be necessary to use "pH" paper on every sample to determine the adequacy of this procedure.

Three difficulties were encountered with the blood procedure: (a) inadequate vacuum on some of the tubes, (b) a tendency for clotting traceable to inadequate mixing of the sample, and (c) hemolysis of some samples. The first problem was solved simply by testing the vacuum on every tube with a regular 20 ml syringe and needle. The second was most easily rectified by stopping the flow of blood before the tube was completely full and immediately mixing the sample by gentle multiple inversion of the tubes. The third was traceable to vigorous mixing in the field and it was also found that after storage during transit to the laboratory the red cells became sufficiently more friable to cause hemolysis upon performing the necessary mixing to insure a homogeneous sample for the aliquot for hematocrit and hemoglobin determinations.

The transit time was kept to a minimum. Usually the analyses were begun within 24 hours. However, because of the changes which the blood in particular undergoes, it was considered appropriate to make measurements of some of the factors as a function of storage time.

Procedures for analysis of the blood and urine are such that it seemed advantageous to center these two basically distinct operations in two different areas. In many respects it was convenient to segregate the equipment. The spectrophotometer and centrifuges are more an integral part of the blood analysis; the photofluorometer is used as an end point for the urinary procedures only.

After careful mixing of the blood, aliquots were first removed for the determination of hemoglobin and hematocrit. Then after centrifugation, aliquots of the plasma were removed for total protein, albumin, vitamin C and vitamin A and in some cases cholesterol. The remainder of the sample was then stored in the refrigerator for repeat analysis which was possible on some scale with most samples for everything except, of course, hemoglobin and hematocrit.

The urine was first aliquoted for the creatinine determination and then when convenient, riboflavin, thiamine and N'-methylnicotinamide determination completed. During the interval the urine specimens were held in the refrigerator. There was less concern for deterioration of the urine in the acid environment in the dark. Analyses for the vitamins or their derivatives in the urine were completed within one to seven days after the blood analysis.

Methods Employed - Most of the laboratory procedures are described in the ICNND Manual. The method of choice for hemoglobin was cyanomethemoglobin. For hematocrit determinations both the Wintrobe method and capillary tubes were used early in the survey. After sufficient experience was gained with the latter, only the capillary method was used because it spared both time and sample. The capillary tubes were often filled in duplicate or triplicate to lend confidence to the values obtained. Total plasma protein and albumin estimations were made by the biuret procedure. Vitamin A and carotene were estimated on a 2 ml aliquot of the plasma exactly as described in the ICNND Manual but ascorbic acid was determined by a micro procedure (83). A model DU Beckman equipped with a photomultiplier, pinhole filter and micro cuvettes was available to estimate the color produced in this determination.

Creatinine was determined in all urine specimens by the Folin and Wu picrate method except that the reagent was altered to reduce the sensitivity and make the readings over a broader range of values fall within a suitable range on the spectrophotometer.

The thiamine and N'-methylnicotinamide methods were used without essential alteration as described in the Manual except in the latter case the adjustment of volume and aliquoting was such as to eliminate one operational procedure. Riboflavin was estimated by the Morrell Slater technique (84).

Storage of Blood - With the uncertainty of transportation for return of the samples to the base laboratory, the question arose about the effect of holding the samples at the temperature of melting ice. For the most part it was possible to begin the analyses within 24 hours after taking the sample; however, in a few cases it was necessary to hold the samples for 48 hours. To appreciate the effects of this variable upon the results, two types of observations were available: (a) Eleven samples were taken in duplicate and returned to the laboratory where analyses on one of each pair were begun within 24 hours. The duplicate was held for an additional 24 hours before the determinations were made; (b) Samples were available from villages which were similar in many respects except for the time of holding the sample, namely, 24 and 48 hours. In both cases the conclusions are similar but perhaps more valid in the former although the numbers are few. There was no consistent effect upon any of the components measured except vitamins A and C. In both these cases there was a noticeable decrease in values which on the average ranged from 10 to 15 percent of the total value.

TABLE 37-A. EFFECT OF STORAGE OF BLOOD ON SERUM LEVELS OF VITAMIN A AND VITAMIN C

Storage Time (hours)	24	48
	mcg/100 ml plasma	
Vitamin A - a	32	26
b	26	22
Vitamin C - a	470	390
b	860	770

As the vitamin C values are practically all in the "acceptable" or "high" category, the storage time had no material effect upon the interpretation. In practically all cases in which the analyses were either begun the same day or within 24 hours the problem in interpreting the vitamin A results is minimized; however, these results do add a note of caution and emphasize the necessity to consider further the effects of this parameter upon the analyses for vitamins A and C. In general the vitamin A values tended to be low regardless of holding time of the sample.

TABLE 38-A. SUGGESTED GUIDE TO INTERPRETATION OF BLOOD AND URINE DATA (based primarily on the young adult male)[1/]

BLOOD	"Deficient"	"Low"	"Acceptable"	"High"
Total serum protein (gms/100 ml)	≤ 6.0	6.0-6.4	6.5-6.9	> 6.9
Serum albumin (gms/100 ml)	< 2.5	2.5-3.4	3.5-5.0	> 5.0
Serum globulin (gms/100 ml)	< 1.0	1.0-1.9	2.0-2.9	3.0-3.5[2/]
Hemoglobin (gms/100 ml)	< 12.0	12.0-13.9	14.0-14.9	> 14.9
Hematocrit (%)	< 36	36-41	42-45	> 45
Mean corpuscular hemoglobin concentration (MCHC)(%)[3/]	< 28.0	28.0-29.9	30.0-31.9	> 31.9
Serum vitamin A (mcg/100 ml)	< 10	10-19	20-49	> 49
Serum carotene (mcg/100 ml)	< 20[4/]	20-39	40-99	> 99
Serum vitamin C (mg/100 ml)	< 0.10	0.10-0.19	0.20-0.39	> 0.39
URINE (values per gm creatinine)				
Thiamine (mcg)	< 27	27-65	66-129	> 129
Riboflavin (mcg)	< 27	27-79	80-269	> 269
N'- methylnicotinamide (N'MN) (mg)	< 0.50	0.50-1.59	1.60-4.29	> 4.29

1/ Standards of the ICNND Manual, except for serum albumin, globulin, and MCHC based on the personal interpretations of a team member (Forbes)

2/ Values > 3.5 gms/100 ml interpreted as "very high," clearly indicating hyperglobulinemia

3/ $\text{MCHC} = \frac{\text{hemoglobin}}{\text{hematocrit}} \times 100$

4/ A deficient range for carotene is not well established.

TABLE 39-A. BIOCHEMICAL FINDINGS AMONG THE THAI MILITARY BY LOCATIONS[1] - MEAN AND MEDIAN VALUES

General Area	ARMY						AIR FORCE			NAVY	
	Bangkok	Songkhla	Chiengmai	Udorn	Ubol	TOTAL	Koke thiem + Lopburi (enlisted)	Koke thiem + Lopburi (NCO's)	TOTAL	Sattahaep (TOTAL)	COMBINED SERVICES
BLOOD						Means					
TOTAL SERUM PROTEIN (gms/100 ml)											
Mean	7.1	6.9	7.3	7.2	8.4	7.4	7.3	7.4	7.3	7.5	7.4
S.E.	0.07	0.07	0.07	0.06	0.09	0.05	0.07	0.10	0.06	0.10	0.04
No. of subjects	32	36	41	38	28	175	25	24	49	32	256
SERUM ALBUMIN (gms/100 ml)											
Mean	4.3	4.1	4.2	4.0	4.5	4.2	3.9	4.0	4.0	4.0	4.1
S.E.	0.07	0.07	0.08	0.06	0.08	0.04	0.13	0.06	0.07	0.06	0.03
No. of subjects	31	36	41	38	28	174	25	24	49	32	255
SERUM GLOBULIN (gms/100 ml)											
Mean	2.8	2.9	3.1	3.3	3.9	3.2	3.3	3.3	3.3	3.5	3.2
S.E.	0.08	0.08	0.10	0.08	0.12	0.05	0.13	0.09	0.08	0.10	0.04
No. of subjects	31	36	41	38	28	174	25	24	49	32	255
ALBUMIN/GLOBULIN RATIO											
Mean	1.62	1.49	1.56	1.29	1.21	1.44	1.34	1.26	1.30	1.17	1.38
S.E.	0.09	0.07	0.66	0.34	0.06	0.04	0.14	0.03	0.07	0.04	0.03
No. of subjects	31	36	41	38	28	174	25	24	49	32	255
HEMOGLOBIN (gms/100 ml)											
Mean	14.6	13.1	14.5	11.2	13.1	13.3	12.4	14.8	13.6	12.3	13.3
S.E.	0.31	0.27	0.33	0.53	0.37	0.18	0.51	0.30	0.34	0.71	0.17
No. of subjects	32	36	41	35	28	172	24	24	48	32	252
HEMATOCRIT[2] (%)											
Mean	44.9	38.9	42.4	34.8	41.6	40.5	43.6	44.5	44.1	36.2	40.6
S.E.	0.62	0.90	0.97	1.77	1.06	0.57	1.00	0.82	0.64	1.70	0.48
No. of subjects	32	36	41	35	28	172	24	24	48	32	252
MCHC[2]											
Mean	32.0	33.6	34.2	33.8	31.0	33.1	28.4	32.7	30.6	34.3	32.8
S.E.	0.27	0.57	0.67	1.75	0.42	0.42	1.42	0.58	0.82	1.90	0.41
No. of subjects	32	36	41	35	28	172	24	24	48	32	252
SERUM VITAMIN A (mcg/100 ml)											
Mean	37.8	34.2	31.8	22.9	29.3	31.0	30.7	35.8	33.2	30.0	31.3
S.E.	1.8	1.8	1.1	1.4	1.6	0.8	1.9	1.2	1.2	1.3	0.6
No. of subjects	30	36	41	38	28	173	25	24	49	32	254

(Continued on next page)

TABLE 39-A. (CONTINUED - page 2) (BIOCHEMICAL FINDINGS - MILITARY - BY LOCATIONS - MEANS)

General Area	ARMY						AIR FORCE			NAVY	
	Bangkok	Songkhla	Chiengmai	Udorn	Ubol	TOTAL	Koke thiem - Lopburi (enlisted)	Koke thiem - Lopburi (NCO's)	TOTAL	Sattaheep (TOTAL)	COMBINED SERVICES
BLOOD						Means					
SERUM CAROTENE (mcg/100 ml)											
Mean	69	50	76	29	68	58	74	104	88	48	62
S.E.	5	2	3	2	4	2	4	7	4	4	2
No. of subjects	30	36	41	38	28	173	25	24	49	32	254
SERUM VITAMIN C (mg/100 ml)											
Mean	0.56	0.50	0.54	0.24	0.41	0.45	0.41	0.49	0.45	0.39	0.44
S.E.	0.09	0.04	0.04	0.02	0.03	0.02	0.03	0.06	0.03	0.04	0.02
No. of subjects	32	36	41	38	28	175	25	24	49	32	256
URINE						Medians (per gm creatinine)					
THIAMINE (mcg)											
Median	258	266	144	90	400	188	1108	61	225	250	204
No. of subjects	31	35	41	38	28	173	24	24	48	32	253
RIBOFLAVIN (mcg)											
Median	36	23	24	24	14	25	4	51	21	15	24
No. of subjects	32	34	41	37	28	172	24	24	48	32	252
N'-METHYLNICOTINAMIDE (mg)											
Median	3.8	3.7	3.3	3.5	5.6	3.8	6.1	3.8	4.9	5.4	4.0
No. of subjects	32	34	40	38	28	172	24	24	48	32	252

1/ See Table 1-A for specific units examined in each area.
2/ Hematocrit values are somewhat low and MCHC values somewhat high compared with true values because of intermittent hemolysis.

TABLE 40-A. BIOCHEMICAL FINDINGS AMONG THE THAI MILITARY BY LOCATIONS[1/] - DISTRIBUTION OF VALUES

General Area		ARMY						AIR FORCE			NAVY	
		Bangkok	Songkhla	Chiengmai	Udorn	Ubol	TOTAL	Koketh'em (Lopburi enlisted)	Koketh'em (Lopburi NCO's)	TOTAL	Sattahaep (TOTAL)	COMBINED SERVICES
BLOOD												
TOTAL SERUM PROTEIN (gms/100 ml)												
6.0-6.4	No.	1	3	1	--	--	5	--	1	1	--	6
6.5-6.9	No.	10	17	6	6	--	39	3	2	5	2	46
> 6.9	No.	21	16	34	32	28	131	22	21	43	30	204
"Low"	%	3.1	8.3	2.4	--	--	2.8	--	4.2	2.0	--	2.3
SERUM ALBUMIN (gms/100 ml)												
< 2.5	No.	--	--	--	--	--	--	--	--	--	--	--
2.5-3.4	No.	--	--	1	2	--	3	3	--	3	1	7
3.5-5.0	No.	28	34	35	35	24	156	20	24	44	31	231
> 5.0	No.	3	2	5	1	4	15	2	--	2	--	17
"Deficient"	%	--	--	--	--	--	--	--	--	--	--	--
"Low"	%	--	--	2.4	5.3	--	1.7	12.0	--	6.1	3.1	2.7
"Deficient + Low"	%	--	--	2.4	5.3	--	1.7	12.0	--	6.1	3.1	2.7
SERUM GLOBULIN (gms/100 ml)												
1.0-1.9	No.	2	2	2	--	--	6	1	--	1	--	7
2.0-2.9	No.	16	17	15	10	3	61	6	6	12	4	77
3.0-3.5	No.	13	16	15	19	4	67	8	13	21	17	105
> 3.5	No.	--	1	9	9	21	40	10	5	15	11	66
"High"	%	41.9	44.4	36.6	50.0	14.3	38.5	32.0	54.2	42.8	53.1	41.2
"Very High"	%	--	2.8	22.0	23.7	75.0	23.0	40.0	20.8	30.6	34.4	25.9
"High + Very High"	%	41.9	47.2	58.6	73.7	89.3	61.5	72.0	75.0	73.4	87.5	67.1
ALBUMIN/GLOBULIN RATIO												
0.5-0.9	No.	--	--	2	6	5	13	4	2	6	4	23
1.0-1.4	No.	13	21	23	20	16	93	16	19	35	27	155
1.5-1.9	No.	14	11	10	11	6	52	3	3	6	1	59
> 1.9	No.	4	4	6	1	1	16	2	--	2	--	18
HEMOGLOBIN (gms/100 ml)												
< 12.0	No.	1	9	4	22	4	40	8	1	9	15	64
12.0-13.9	No.	7	13	10	9	13	52	9	7	16	5	73
14.0-14.9	No.	12	11	8	1	7	39	4	3	7	2	48
> 14.9	No.	12	3	19	3	4	41	3	13	16	10	67
"Deficient"	%	3.1	25.0	9.8	62.8	14.3	23.2	33.3	4.2	18.7	46.9	25.4
"Low"	%	21.9	36.1	24.4	25.7	46.4	30.2	37.5	29.2	33.3	15.6	29.0
"Deficient + Low"	%	25.0	61.1	34.2	88.5	60.7	53.4	70.8	33.4	52.0	62.5	54.4

(Continued on next page)

TABLE 40-A. (CONTINUED - page 2) (BIOCHEMICAL FINDINGS - MILITARY - BY LOCATIONS - DISTRIBUTION)

General Area		ARMY						AIR FORCE			NAVY	
		Bangkok	Songkhla	Chiengmai	Udorn	Ubol	TOTAL	Koketh iem (Lopburi - enlisted)	Koketh iem (Lopburi - NCO's)	TOTAL	Sattaheep (TOTAL)	COMBINED SERVICES
BLOOD												
HEMATOCRIT (%)[2/]												
< 36	No.	1	12	5	21	2	41	--	--	--	13	54
36-41	No.	5	12	5	4	8	34	9	5	14	8	56
42-45	No.	12	8	18	5	12	55	7	8	15	5	75
> 45	No.	14	4	13	5	6	42	8	11	19	6	67
"Deficient"	%	3.1	33.3	12.2	60.0	7.1	23.8	--	--	--	40.6	21.4
"Low"	%	15.6	33.3	12.2	11.4	28.6	19.8	37.5	20.8	29.2	25.0	22.2
"Deficient + Low"	%	18.7	66.6	24.4	71.4	35.7	43.6	37.5	20.8	29.2	65.6	43.6
MCHC (%)[2/]												
< 28.0	No.	--	--	--	9	3	12	8	1	-9	6	27
28.0-29.9	No.	1	3	5	7	2	18	5	3	8	4	30
30.0-31.9	No.	9	6	5	--	12	32	4	3	7	6	45
> 31.9	No.	22	27	31	19	11	110	7	17	24	16	150
"Deficient"	%	--	--	--	25.7	10.7	7.0	33.3	4.2	18.8	18.8	10.7
"Low"	%	3.1	8.3	12.2	20.0	7.1	10.5	20.8	12.5	16.7	12.5	11.9
"Deficient + Low"	%	3.1	8.3	12.2	45.7	17.8	17.5	54.1	16.7	35.5	31.3	22.6
"High"	%	68.8	75.0	75.6	54.3	39.3	64.0	29.2	70.8	50.0	50.0	59.5
SERUM VITAMIN A (mcg/100 ml)												
< 10	No.	--	--	--	--	--	--	--	--	--	--	--
10-19	No.	1	3	1	17	4	26	3	--	3	3	32
20-49	No.	26	30	40	21	24	141	21	24	45	29	215
> 49	No.	3	3	--	--	--	6	1	--	1	--	7
"Deficient"	%	--	--	--	--	--	--	--	--	--	--	--
"Low"	%	3.3	8.3	2.4	44.7	14.3	15.0	12.0	--	6.1	9.4	12.6
"Deficient + Low"	%	3.3	8.3	2.4	44.7	14.3	15.0	12.0	--	6.1	9.4	12.6
SERUM CAROTENE (mcg/100 ml)												
< 20	No.	--	--	--	7	--	7	--	--	--	2	9
20-39	No.	3	8	1	25	3	40	2	--	2	12	54
40-99	No.	22	28	35	6	23	114	20	11	31	17	162
> 99	No.	5	--	5	--	2	12	3	13	16	1	29
"Deficient"	%	--	--	--	18.4	--	4.0	--	--	--	6.2	3.5
"Low"	%	10.0	22.2	2.4	65.8	10.7	23.1	8.0	--	4.1	37.5	21.2
"Deficient + Low"	%	10.0	22.2	2.4	84.2	10.7	27.1	8.0	--	4.1	43.7	24.7

(Continued on next page)

TABLE 40-A. (CONTINUED - page 3) (BIOCHEMICAL FINDINGS - MILITARY - BY LOCATIONS - DISTRIBUTION)

General Area		ARMY						AIR FORCE			NAVY	
		Bangkok	Songkhla	Chiengmai	Udorn	Ubol	TOTAL	Koketh'em (Lopburi - enlisted)	Koketh'em (Lopburi - NCO's)	TOTAL	Sattaheep (TOTAL)	COMBINED SERVICES
BLOOD												
SERUM VITAMIN C (mg/100 ml)												
< 0.10	No.	--	1	--	2	--	3	--	--	--	1	4
0.10-0.19	No.	7	2	2	16	--	27	2	3	5	7	39
0.20-0.39	No.	6	7	12	15	16	56	8	9	17	10	83
> 0.39	No.	19	26	27	5	12	89	15	12	27	14	130
"Deficient"	%	--	2.8	--	5.3	--	1.7	--	--	--	3.1	1.6
"Low"	%	21.9	5.6	4.9	42.1	--	15.4	8.0	12.5	10.2	21.9	15.2
"Deficient + Low"	%	21.9	8.4	4.9	47.4	--	17.1	8.0	12.5	10.2	25.0	16.8
URINE (per gm creatinine)												
THIAMINE (mcg)												
< 27	No.	1	--	4	5	1	11	--	5	5	2	18
27-65	No.	1	--	3	8	--	12	--	8	8	2	22
66-130	No.	5	7	12	16	1	41	1	7	8	4	53
> 130	No.	24	28	22	9	26	109	23	4	27	24	160
"Deficient"	%	3.2	--	9.8	13.2	3.6	6.4	--	20.8	10.4	6.2	7.1
"Low"	%	3.2	--	7.3	21.0	--	6.9	--	33.3	16.7	6.2	8.7
"Deficient + Low"	%	6.4	--	17.1	34.2	3.6	13.3	--	54.1	27.1	12.4	15.8
RIBOFLAVIN (mcg)												
< 27	No.	8	23	23	20	18	92	19	5	24	18	134
27-79	No.	22	9	18	16	7	72	4	12	16	12	100
80-270	No.	1	2	--	1	--	4	1	7	8	2	14
> 270	No.	1	--	--	--	3	4	--	--	--	--	4
"Deficient"	%	25.0	67.6	56.1	54.0	64.3	53.5	79.2	20.8	50.0	56.2	53.2
"Low"	%	68.8	26.5	43.9	43.2	25.0	41.9	16.7	50.0	33.3	37.5	39.7
"Deficient + Low"	%	93.8	94.1	100.0	97.2	89.3	95.4	95.9	70.8	83.3	93.7	92.9
NIACIN (mg)												
0.50-1.59	No.	--	1	--	1	1	3	--	--	--	--	3
1.60-4.30	No.	22	23	31	25	7	108	5	15	20	11	139
> 4.30	No.	10	10	9	12	20	61	19	9	28	21	110
"Low"	%	--	2.9	--	2.6	3.6	1.7	--	--	--	--	1.2
"High"	%	31.2	29.4	22.5	31.6	71.4	35.5	79.2	37.5	58.3	65.6	43.6

1/ See Table 1-A for specific units examined in each area.
2/ Hematocrit values are somewhat low and MCHC values somewhat high compared with true values because of intermittent hemolysis.

TABLE 41-A. BIOCHEMICAL FINDINGS[1/] AMONG THE THAI MILITARY (COMBINED SERVICES) IN TERMS OF AGE, PERCENT STANDARD WEIGHT, AND DURATION OF MILITARY SERVICE

BLOOD	Age (years)			% Standard Weight				Duration of Military Service (mos.)					
	21-22	23-24	25+	80-89	90-99	100-109	110+	<1	1-2	2-3	3-6	6-12	12+
TOTAL SERUM PROTEIN													
No. of subjects	204	24	28	83	125	41	7	12	29	13	33	75	94
Mean (gms/100 ml)	7.4	7.3	7.3	7.4	7.3	7.4	7.8	7.5	7.7	7.4	7.4	7.3	7.3
% "Low"	1.5	4.2	7.1	-	4.0	-	14.3	-	-	-	6.1	1.3	3.2
SERUM ALBUMIN													
No. of subjects	204	23	28	82	125	41	7	12	29	12	33	75	94
Mean (gms/100 ml)	4.2	4.1	4.0	4.1	4.2	4.1	3.9	4.2	4.1	4.3	4.2	4.1	4.1
% "Low"	2.9	4.3	-	4.8	0.8	2.4	14.3	8.3	10.3	-	-	1.3	2.1
SERUM GLOBULIN													
No. of subjects	204	23	28	82	125	41	7	12	29	12	33	75	94
Mean (gms/100 ml)	3.2	3.2	3.2	3.2	3.2	3.2	3.8	3.3	3.5	3.2	3.2	3.2	3.2
% "High"	38.2	69.6	39.3	32.9	47.2	43.9	14.3	16.7	34.5	33.3	30.3	44.0	48.9
% "Very High"	27.4	13.0	25.0	30.5	20.8	26.8	57.1	41.7	41.4	25.0	30.3	24.0	19.1
ALBUMIN/GLOBULIN RATIO													
No. of subjects	204	23	28	82	125	41	7	12	29	12	33	75	94
Mean	1.40	1.32	1.29	1.36	1.41	1.38	1.08	1.58	1.26	1.47	1.38	1.40	1.36
HEMOGLOBIN													
No. of subjects	200	24	28	82	123	40	7	12	28	13	31	74	94
Mean (gms/100 ml)	13.0	14.0	14.8	13.6	13.0	13.3	14.1	13.6	12.1	14.2	13.2	13.0	13.7
% "Deficient"	29.5	16.7	3.6	18.3	30.9	25.0	14.3	16.7	32.1	7.7	19.4	29.7	25.5
% "Low"	29.5	25.0	28.6	34.1	24.4	32.5	28.6	33.3	35.7	30.8	41.9	29.7	21.3
HEMATOCRIT[2/]													
No. of subjects	200	24	28	82	123	40	7	12	28	13	31	74	94
Mean (%)	39.9	42.5	44.3	42.0	39.9	39.8	42.1	38.6	39.8	42.9	38.7	40.2	41.7
% "Deficient"	25.0	16.7	-	12.2	25.2	30.0	14.3	41.7	14.3	7.7	29.0	25.7	17.0
% "Low"	24.0	12.5	17.8	24.4	24.4	7.5	42.8	16.7	32.1	23.1	38.7	18.9	17.0
MCHC[2/]													
No. of subjects	200	24	28	82	123	40	7	12	28	13	31	74	94
Mean (%)	32.7	32.9	32.9	32.2	32.8	33.6	33.3	35.3	30.8	32.5	34.1	32.6	32.7
% "Deficient"	12.5	8.3	-	8.5	14.6	5.0	-	-	17.8	-	16.1	14.9	6.4
% "Low"	11.5	16.7	10.7	18.3	8.9	10.0	-	-	17.8	-	3.2	9.4	18.1
% "High"	57.5	58.3	75.0	57.3	62.6	52.5	71.4	91.7	39.3	61.5	64.5	55.4	62.8

(Continued on next page)

429788 O - 62 - 12

TABLE 41-A. (CONTINUED - page 2) (BIOCHEMICAL FINDINGS - MILITARY - BY AGE, PERCENT STANDARD WEIGHT, AND DURATION OF MILITARY SERVICE)

	Age (years)			% Standard Weight				Duration of Military Service (mos.)					
BLOOD	21-22	23-24	25+	80-89	90-99	100-109	110+	< 1	1-2	2-3	3-6	6-12	12+
SERUM VITAMIN A													
No. of subjects	202	24	28	83	123	41	7	12	29	12	33	74	94
Mean (mcg/100 ml)	30.1	35.7	35.9	32.5	30.4	31.7	28.5	35.3	31.2	35.0	28.0	31.0	31.6
% "Low"	15.3	4.2	-	12.0	12.2	14.6	14.3	-	17.2	8.3	18.2	8.1	14.8
SERUM CAROTENE													
No. of subjects	202	24	28	83	123	41	7	12	29	12	33	74	94
Mean (mcg/100 ml)	57	72	95	72	57	59	66	61	57	72	54	61	68
% "Deficient"	4.0	-	3.6	4.8	3.2	-	14.3	-	3.4	-	3.0	4.0	4.2
% "Low"	23.8	16.7	7.1	10.8	23.6	39.0	-	8.3	27.6	8.3	21.2	18.9	24.5
SERUM VITAMIN C													
No. of subjects	204	24	28	83	125	41	7	12	29	13	33	75	94
Mean (mg/100 ml)	0.43	0.53	0.44	0.45	0.45	0.41	0.50	0.49	0.38	0.45	0.44	0.49	0.42
% "Deficient"	1.5	4.2	-	1.2	1.6	2.4	-	-	-	-	-	2.7	2.1
% "Low"	16.7	4.2	14.3	12.0	16.0	17.1	28.6	-	6.9	15.4	18.2	20.0	14.9
URINE													
THIAMINE													
No. of subjects	202	23	28	81	124	41	7	12	29	12	33	74	93
Median (mcg/gm C)	239	191	61	175	209	275	225	249	462	266	281	213	110
% "Deficient"	4.4	8.7	25.0	8.6	4.8	9.8	14.3	-	10.3	-	-	4.0	12.9
% "Low"	5.4	13.0	28.6	11.1	8.1	7.3	-	-	6.9	-	6.1	4.0	16.1
RIBOFLAVIN													
No. of subjects	200	24	28	82	123	40	7	12	29	13	32	73	93
Median (mcg/gm C)	22	41	36	24	25	26	15	26	11	18	22	23	33
% "Deficient"	57.5	37.5	35.7	51.2	53.6	52.5	71.4	41.7	69.0	76.9	56.2	57.5	41.9
% "Low"	38.5	33.3	53.6	45.1	36.6	40.0	28.6	58.3	27.6	15.4	40.6	41.1	43.0
NIACIN													
No. of subjects	201	24	27	81	123	41	7	12	29	13	33	73	92
Median (mg/gm C)	4.2	4.0	2.2	3.9	4.1	4.0	4.7	4.1	5.9	3.8	4.1	3.9	3.8
% "Low"	1.0	4.3	-	1.2	0.8	-	14.3	-	13.4	-	3.0	1.4	-
% "High"	46.3	41.7	25.9	40.7	45.5	41.5	57.1	41.7	75.9	30.8	45.4	36.9	40.2

1/ When % "Low" only is cited, no cases occurred in the "Deficient" range.
2/ Hematocrit values are somewhat low and MCHC values somewhat high compared with true values because of intermittent hemolysis.

TABLE 42-A. BIOCHEMICAL FINDINGS[1/] AMONG THE THAI CIVILIANS (SEX, AGE, AND PL GROUPS COMBINED) BY GENERAL AREAS[2/] - MEAN AND MEDIAN VALUES

General Area	Songkhla	Chiengmai	Lopburi	Udorn[2/]	Ubol	TOTAL[2/]
BLOOD			Means			
TOTAL SERUM PROTEIN (gms/100 ml)	7.4 (45)	7.3 (46)	7.3 (17)	7.3 (37)	7.5 (66)	7.4 (211)
SERUM ALBUMIN (gms/100 ml)	3.8 (45)	3.9 (46)	3.7 (16)	3.4 (37)	3.4 (66)	3.6 (210)
SERUM GLOBULIN (gms/100 ml)	3.6 (45)	3.4 (46)	3.6 (17)	3.8 (37)	4.1 (66)	3.8 (211)
ALBUMIN/GLOBULIN RATIO	1.09 (45)	1.24 (46)	1.12 (17)	0.91 (37)	0.88 (66)	1.03 (211)
HEMOGLOBIN (gms/100 ml)	12.4 (45)	11.6 (46)	11.7 (15)	11.8 (37)	11.0 (66)	11.6 (209)
HEMATOCRIT[3/] (%)	36.7 (49)	36.3 (55)	28.8 (18)	35.7 (55)	34.2 (74)	35.1 (251)
MCHC[3/] (%)	32.3 (44)	30.7 (45)	38.3 (15)	30.8 (37)	31.0 (66)	31.7 (207)
SERUM VITAMIN A (mcg/100 ml)	24.3 (43)	27.6 (45)	21.1 (17)	22.3 (37)	22.1 (66)	23.7 (208)
SERUM CAROTENE (mcg/100 ml)	72 (43)	111 (45)	74 (17)	49 (37)	46 (66)	68 (208)
SERUM VITAMIN C (mg/100 ml)	0.82 (45)	0.85 (46)	0.84 (17)	0.73 (55)	0.63 (74)	0.74 (237)
URINE			Medians (per gm creatinine)			
THIAMINE (mcg)	94 (41)	48 (52)	98 (16)	145 (42)	58 (64)	71 (215)
RIBOFLAVIN (mcg)	22 (42)	26 (53)	36 (16)	42 (41)	29 (62)	30 (214)
N'-METHYLNICOTINAMIDE (mg)	4.5 (46)	4.4 (55)	5.1 (16)	4.7 (39)	4.2 (62)	4.5 (218)

1/ Figures in parentheses are numbers of individuals studied.
2/ Omitting Rachinutis High School, Udorn, from the Udorn and Total columns
3/ Hematocrit values are somewhat low and MCHC values somewhat high compared with true values because of intermittent hemolysis.

TABLE 43-A. BIOCHEMICAL FINDINGS AMONG THE THAI CIVILIANS (SEX, AGE, AND PL GROUPS COMBINED) - BY GENERAL AREAS[1/] - DISTRIBUTION OF VALUES

General Area		Songkhla	Chiengmai	Lopburi	Udorn[1/]	Ubol	TOTAL[1/]
BLOOD							
TOTAL SERUM PROTEIN (gms/100 ml)							
6.0-6.4	No.	1	--	--	1	--	2
6.5-6.9	No.	9	7	2	4	11	33
> 6.9	No.	35	39	15	32	55	176
"Low"	%	2.2	--	--	2.7	--	0.9
SERUM ALBUMIN (gms/100 ml)							
< 2.5	No.	--	--	--	--	--	--
2.5-3.4	No.	6	6	3	11	35	61
3.5-5.0	No.	39	38	13	26	31	147
> 5.0	No.	--	2	--	--	--	2
"Deficient"	%	--	--	--	--	--	--
"Low"	%	13.3	13.0	18.8	29.7	53.0	29.0
"Deficient + Low"	%	13.3	13.0	18.8	29.7	53.0	29.0
SERUM GLOBULIN (gms/100 ml)							
1.0-1.9	No.	--	2	--	1	--	3
2.0-2.9	No.	3	7	2	--	2	14
3.0-3.5	No.	24	16	7	10	15	72
> 3.5	No.	18	21	8	26	49	122
"High"	%	53.3	34.8	41.2	27.0	22.7	34.1
"Very High"	%	40.0	45.6	47.0	70.3	74.2	57.8
"High+ Very High"	%	93.3	80.4	88.2	97.3	96.9	91.9
ALBUMIN/GLOBULIN RATIO							
0.5-0.9	No.	12	11	2	22	44	91
1.0-1.4	No.	30	27	13	15	21	106
1.5-1.9	No.	3	4	2	--	1	10
> 1.9	No.	--	4	--	--	--	4
HEMOGLOBIN (gms/100 ml)							
< 12.0	No.	20	27	8	12	43	110
12.0-13.9	No.	14	14	2	18	17	65
14.0-14.9	No.	6	4	1	3	1	15
> 14.9	No.	5	1	4	4	5	19
"Deficient"	%	44.4	58.7	53.3	32.4	65.2	52.6
"Low"	%	31.1	30.4	13.3	48.6	25.8	31.1
"Deficient + Low"	%	75.5	89.1	66.6	81.0	91.0	83.7

(Continued on next page)

ABLE 43 - A. (CONTINUED - page 2) (BIOCHEMICAL FINDINGS - CIVILIANS - BY GENERAL AREAS - DISTRIBUTION)

eneral Area		Songkhla	Chiengmai	Lopburi	Udorn[1/]	Ubol	TOTAL[1/]
LOOD							
EMATOCRIT (%)[2/]							
< 36	No.	18	16	15	19	33	101
36-41	No.	16	27	2	22	30	97
42-45	No.	13	9	--	12	6	40
> 45	No.	2	3	1	2	5	13
"Deficient"	%	36.7	29.1	83.3	34.5	44.6	40.2
"Low"	%	32.6	49.1	11.1	40.0	40.5	38.6
"Deficient + Low"	%	69.3	78.2	94.4	74.5	85.1	78.8
MCHC (%)[2/]							
< 28.0	No.	2	4	1	4	8	19
28.0-29.9	No.	1	11	4	4	11	31
30.0-31.9	No.	10	17	1	12	25	65
> 31.9	No.	31	13	9	17	22	92
"Deficient"	%	4.5	8.9	6.7	10.8	12.1	9.2
"Low"	%	2.3	24.4	26.7	10.8	16.7	15.0
"Deficient + Low"	%	6.8	33.3	33.4	21.6	28.8	24.2
"High"	%	22.7	37.8	6.7	32.4	37.9	31.4
SERUM VITAMIN A (mcg/100 ml)							
< 10	No.	--	--	1	1	2	4
10-19	No.	9	10	9	15	31	74
20-49	No.	34	35	7	21	32	129
> 49	No.	--	--	--	--	1	1
"Deficient"	%	--	--	5.9	2.7	3.0	1.9
"Low"	%	20.9	22.2	52.9	40.5	47.0	35.6
"Deficient + Low"	%	20.9	22.2	58.8	43.2	50.0	37.5
SERUM CAROTENE (mcg/100 ml)							
< 20	No.	--	--	--	2	3	5
20-39	No.	2	1	--	9	29	41
40-99	No.	33	21	15	25	30	124
> 99	No.	8	23	2	1	4	38
"Deficient"	%	--	--	--	5.4	4.5	2.4
"Low"	%	4.6	2.2	--	24.3	43.9	19.7
"Deficient + Low"	%	4.6	2.2	--	29.7	48.4	22.1
SERUM VITAMIN C (mg/100 ml)							
< 0.10	No.	--	--	--	--	--	--
0.10-0.19	No.	1	--	--	1	6	8
0.20-0.39	No.	2	7	--	8	15	32
> 0.39	No.	42	39	17	46	53	197
"Deficient"	%	--	--	--	--	--	--
"Low"	%	2.2	--	--	1.8	8.1	3.4
"Deficient + Low"	%	2.2	--	--	1.8	8.1	3.4

(Continued on next page)

TABLE 43-A. (CONTINUED - page 3) (BIOCHEMICAL FINDINGS - CIVILIANS - BY GENERAL AREAS - DISTRIBUTION)

General Area		Songkhla	Chiengmai	Lopburi	Udorn 1/	Ubol	TOTAL 1/
URINE (per gm creatinine)							
THIAMINE (mcg)							
< 27	No.	5	23	3	4	14	49
27-65	No.	11	10	3	9	22	55
66-130	No.	10	10	4	6	10	40
> 130	No.	15	9	6	23	18	71
"Deficient"	%	12.2	44.2	18.8	9.5	21.9	22.8
"Low"	%	26.8	19.2	18.8	21.4	34.4	25.6
"Deficient + Low"	%	39.0	63.4	37.6	30.9	56.3	48.4
RIBOFLAVIN (mcg)							
< 27	No.	24	27	6	14	29	100
27-79	No.	14	22	7	20	25	88
80-270	No.	4	3	3	7	8	25
> 270	No.	--	1	--	--	--	1
"Deficient"	%	57.1	50.9	37.5	34.1	46.8	46.7
"Low"	%	33.3	41.5	43.8	48.8	40.3	41.1
"Deficient + Low"	%	90.4	92.4	81.3	82.9	87.1	87.8
NIACIN (mg)							
0.50-1.59	No.	--	3	--	1	5	9
1.60-4.30	No.	21	24	6	16	27	94
> 4.30	No.	25	28	10	22	30	115
"Low"	%	--	5.4	--	2.6	8.1	4.1
"High"	%	54.3	50.9	62.5	56.4	48.4	52.8

1/ Omitting Rachinutis High School, Udorn, from the Udorn and Total columns.
2/ Hematocrit values are somewhat low and MCHC values somewhat high compared with true values because of intermittent hemolysis.

TABLE 44'- A. BIOCHEMICAL FINDINGS[1/] AMONG THE THAI CIVILIANS BY MAJOR AGE GROUPS AND INDIVIDUAL LOCATIONS - MEAN VALUES

General Area	Songkhla		Chiengmai			Lop-buri	Udorn			Ubol			
Specific Village	Bang Dan (Buddhist)	Don Kee Leg (Islam)	Ban Fon	San Pong	Padad	Ta Kae	Rachiautis High School	Phon Ngam	Marg Yeh	Sri Kai	Ban Kao	Nong Manao	TOTAL
BLOOD	Means												
TOTAL SERUM PROTEIN (gms/100 ml)													
M + F < 15	7.2 (2)	7.4 (2)	7.6 (1)	8.3 (2)	7.1 (4)	7.6 (4)	7.1 (11)	7.5 (7)	7.3 (7)	7.1 (7)	7.7 (11)	7.4 (7)	7.4 (65)
M + F 15+, NPNL	7.7 (14)	7.3 (20)	7.1 (11)	7.6 (13)	7.4 (6)	7.2 (11)	7.2 (2)	7.4 (9)	7.3 (6)	7.3 (15)	7.7 (8)	7.5 (7)	7.4 (122)
F 15+, PL	7.5 (5)	7.1 (2)	7.3 (4)	-	7.3 (5)	7.3 (2)	-	6.8 (3)	7.4 (5)	8.2 (2)	7.8 (4)	8.0 (5)	7.5 (37)
Totals	7.6 (21)	7.3 (24)	7.2 (16)	7.5 (15)	7.3 (15)	7.3 (17)	7.2 (13)	7.4 (19)	7.3 (18)	7.3 (24)	7.7 (23)	7.6 (19)	7.4 (224)
SERUM ALBUMIN (gms/100 ml)													
M + F < 15	4.0 (2)	3.6 (2)	4.1 (1)	4.2 (2)	4.2 (4)	3.9 (4)	3.4 (11)	3.4 (7)	3.4 (7)	3.4 (7)	4.2 (11)	3.5 (7)	3.5 (65)
M + F 15+, NPNL	3.8 (14)	3.8 (20)	3.7 (11)	3.9 (13)	3.9 (6)	3.6 (10)	3.7 (2)	3.5 (9)	3.8 (6)	3.5 (15)	3.3 (8)	3.7 (7)	3.7 (121)
F 15+, PL	3.7 (5)	3.4 (2)	4.1 (4)	-	3.5 (5)	1.5 (2)	-	3.0 (3)	3.4 (5)	3.3 (2)	3.2 (4)	3.7 (5)	3.5 (37)
Totals	3.8 (21)	3.7 (24)	3.8 (16)	3.9 (15)	3.9 (15)	3.7 (16)	3.5 (13)	3.4 (19)	3.5 (18)	3.4 (24)	3.3 (23)	3.6 (19)	3.6 (223)
SERUM GLOBULIN (gms/100 ml)													
M + F < 15	3.2 (2)	3.8 (2)	3.5 (1)	3.1 (2)	3.0 (4)	3.7 (4)	3.7 (11)	4.1 (7)	3.9 (7)	3.7 (7)	4.4 (11)	3.8 (7)	3.8 (65)
M + F 15+, NPNL	3.9 (14)	3.5 (20)	3.4 (11)	3.6 (13)	3.4 (6)	3.5 (11)	3.5 (2)	3.6 (9)	3.5 (6)	3.8 (15)	4.4 (8)	3.9 (7)	3.7 (122)
F 15+, PL	3.8 (5)	3.6 (2)	3.2 (4)	-	3.8 (5)	3.5 (2)	-	3.9 (3)	4.0 (5)	4.8 (2)	4.6 (4)	4.3 (5)	3.9 (37)
Totals	3.8 (21)	3.5 (24)	3.4 (16)	3.6 (15)	3.4 (15)	3.6 (17)	3.6 (13)	3.8 (19)	3.8 (18)	3.8 (24)	4.4 (23)	4.0 (19)	3.8 (224)

(Continued on next page)

TABLE 44-A. (CONTINUED - page 2) (BIOCHEMICAL FINDINGS - CIVILIANS - BY LOCATIONS - MEAN

General Area	Songkhla		Chiengmai		Lop-buri	Udorn			Ubol			
Specific Village	Bang Dan (Buddhist)	Don Kee Leg (Islam)	Ban Fon	San Pong	Padad	Ta Kae	Rachinutis High School	Phon Ngam	Marg Yah	Sri Kai	Ban Kao	Nong Manao	TOTAL
BLOOD	Means												
ALBUMIN/GLOBULIN RATIO													
M + F < 15	1.25	0.90	1.20	1.45	1.50	1.10	0.94	0.84	0.86	0.91	0.76	0.97	0.9
	(2)	(2)	(1)	(2)	(4)	(4)	(11)	(7)	(7)	(7)	(11)	(7)	(65)
M + F 15+, NPNL	1.08	1.14	1.13	1.12	1.38	1.12	1.05	0.89	1.15	0.98	0.76	0.98	1.07
	(14)	(20)	(11)	(13)	(6)	(11)	(2)	(9)	(6)	(15)	(8)	(7)	(122)
F 15+, PL	0.98	1.00	1.57	-	1.12	1.15	-	0.76	0.88	0.70	0.75	0.88	0.98
	(5)	(2)	(4)	-	(5)	(2)	-	(3)	(5)	(2)	(4)	(5)	(37)
Totals	1.08	1.11	1.24	1.17	1.33	1.12	0.96	0.85	0.96	0.94	0.76	0.95	1.02
	(21)	(24)	(16)	(15)	(15)	(17)	(13)	(19)	(18)	(24)	(23)	(19)	(224)
HEMOGLOBIN (gms/100 ml)													
M + F < 15	12.6	12.9	11.6	11.6	10.6	10.9	12.0	12.3	11.2	11.0	10.7	10.0	11.3
	(2)	(2)	(1)	(2)	(4)	(4)	(11)	(7)	(7)	(7)	(11)	(7)	(65)
M + F 15+, NPNL	12.3	12.9	11.6	12.7	9.9	12.3	12.3	13.5	13.2	12.4	12.4	10.4	12.3
	(14)	(20)	(11)	(13)	(6)	(9)	(2)	(9)	(6)	(15)	(8)	(7)	(120)
F 15+, PL	11.6	10.0	11.6	-	11.5	10.4	-	7.6	10.1	9.5	9.0	9.6	10.2
	(5)	(2)	(4)	-	(5)	(2)	-	(3)	(5)	(2)	(4)	(5)	(37)
Totals	12.1	12.6	11.6	12.5	10.6	11.7	12.0	12.1	11.6	11.7	11.0	10.0	11.6
	(21)	(24)	(16)	(15)	(15)	(15)	(13)	(19)	(18)	(24)	(23)	(19)	(222)
HEMATOCRIT[2/] (%)													
M + F < 15	35.7	39.5	35.4	36.0	35.2	29.1	31.2	35.1	34.3	34.0	32.8	32.6	33.7
	(6)	(2)	(5)	(4)	(8)	(7)	(11)	(13)	(18)	(10)	(13)	(10)	(107)
M + F 15+, NPNL	37.7	37.2	35.4	40.3	32.4	30.1	24.5	41.4	40.6	38.7	38.9	30.7	36.9
	(14)	(20)	(11)	(13)	(5)	(9)	(2)	(9)	(7)	(15)	(8)	(7)	(120)
F 15+, PL	34.4	30.0	35.2	-	37.0	21.5	-	24.7	32.0	34.5	30.0	28.4	31.5
	(5)	(2)	(4)	-	(5)	(2)	-	(3)	(5)	(2)	(4)	(5)	(37)
Totals	36.6	36.8	35.4	39.3	34.5	28.8	30.2	36.1	35.4	36.7	34.3	31.0	34.8
	(25)	(24)	(20)	(17)	(18)	(18)	(13)	(25)	(30)	(27)	(25)	(22)	(264)
MCHC[2/] (%)													
M + F < 15	31.5	31.5	27.0	30.5	31.8	30.2	39.5	31.7	30.3	30.1	32.8	30.0	32.5
	(2)	(2)	(1)	(2)	(4)	(4)	(11)	(7)	(7)	(7)	(11)	(7)	(65)
M + F 15+, NPNL	31.3	33.1	31.5	30.1	31.4	40.1	48.5	31.3	31.0	30.7	30.1	32.8	32.4
	(13)	(20)	(11)	(13)	(5)	(9)	(2)	(9)	(6)	(15)	(8)	(7)	(118)
F 15+, PL	32.2	32.0	31.0	-	29.8	46.5	-	28.7	30.2	26.5	29.0	32.0	31.3
	(5)	(2)	(4)	-	(5)	(2)	-	(3)	(5)	(2)	(4)	(5)	(37)
Totals	31.6	32.9	31.1	30.1	30.9	38.3	40.9	31.6	30.5	30.2	31.2	31.6	32.2
	(20)	(24)	(16)	(15)	(14)	(15)	(13)	(19)	(18)	(24)	(23)	(19)	(220)

(Continued on next page)

TABLE 44-A. (CONTINUED - page 3) (BIOCHEMICAL FINDINGS - CIVILIANS - BY LOCATIONS - MEANS)

General Area	Songkhla		Chiengmai			Lop-buri	Udorn			Ubol			
Specific Village	Bang Dan (Buddhist)	Don Kee Leg (Islam)	Ban Fon	San Pong	Padad	Ta Kae	Rachinutis High School	Phon Ngam	Marg Yah	Sri Kai	Ban Kao	Nong Manao	TOTAL
BLOOD							Means						
SERUM VITAMIN A (mcg/100 ml)													
M + F < 15	22.0	16.5	16.5	18.0	25.7	18.0	20.3	19.5	18.6	13.3	17.5	21.3	18.9
	(2)	(2)	(1)	(2)	(4)	(4)	(11)	(7)	(7)	(7)	(11)	(7)	(65)
M + F 15+, NPNL	23.1	27.2	26.6	31.3	31.7	22.9	28.0	26.9	29.3	27.5	25.0	24.3	26.7
	(14)	(18)	(11)	(12)	(6)	(11)	(2)	(9)	(6)	(15)	(8)	(7)	(119)
F 15+, PL	23.0	22.0	20.0	-	29.5	17.0	-	17.2	17.5	17.5	23.5	22.3	21.6
	(5)	(2)	(4)	-	(5)	(2)	-	(3)	(5)	(2)	(4)	(5)	(37)
Totals	22.9	25.7	24.3	29.4	29.4	21.1	21.5	22.7	21.9	22.5	21.1	22.7	23.6
	(21)	(22)	(16)	(14)	(15)	(17)	(13)	(19)	(18)	(24)	(23)	(19)	(221)
SERUM CAROTENE (mcg/100 ml)													
M + F < 15	65	70	85	50	63	73	56	48	55	35	49	46	53
	(2)	(2)	(1)	(2)	(4)	(4)	(11)	(7)	(7)	(7)	(11)	(7)	(65)
M + F 15+, NPNL	71	68	112	97	140	73	90	41	57	44	46	54	72
	(14)	(18)	(11)	(12)	(6)	(11)	(2)	(9)	(6)	(15)	(8)	(7)	(119)
F 15+, PL	87	80	137	-	155	85	-	45	47	35	53	41	79
	(5)	(2)	(4)	-	(5)	(2)	-	(3)	(5)	(2)	(4)	(5)	(37)
Totals	74	69	116	90	124	74	61	44	53	41	49	48	68
	(21)	(22)	(16)	(14)	(15)	(17)	(13)	(19)	(18)	(24)	(23)	(19)	(221)
SERUM VITAMIN C (mg/100 ml)													
M + F < 15	1.00	0.54	1.34	1.10	1.14	1.12	1.08	0.87	0.68	0.92	0.66	0.72	0.85
	(2)	(2)	(1)	(2)	(4)	(4)	(11)	(13)	(18)	(10)	(13)	(10)	(90)
M + F 15+, NPNL	0.72	0.86	0.89	0.66	0.94	0.79	1.00	0.60	0.84	0.49	0.47	0.70	.0.73
	(14)	(20)	(11)	(13)	(6)	(11)	(2)	(9)	(7)	(15)	(8)	(7)	(123)
F 15+, PL	0.84	1.04	0.87	-	0.68	0.54	-	0.48	0.72	0.24	0.44	0.62	0.67
	(5)	(2)	(4)	-	(5)	(2)	-	(3)	(5)	(2)	(4)	(5)	(37)
Totals	0.77	0.85	0.91	0.72	0.91	0.84	1.07	0.72	0.73	0.63	0.56	0.70	0.76
	(21)	(24)	(16)	(15)	(15)	(17)	(13)	(25)	(30)	(27)	(25)	(22)	(250)
URINE					Medians (per gm creatinine)								
THIAMINE (mcg)													
M + F < 15	400	139	131	47	98	165	98	217	176	72	174	98	145
	(4)	(1)	(6)	(3)	(6)	(7)	(10)	(12)	(12)	(8)	(13)	(7)	(89)
M + F 15+, NPNL	74	93	18	13	26	72	166	72	47	52	37	42	50
	(13)	(19)	(11)	(12)	(6)	(8)	(1)	(8)	(6)	(13)	(7)	(7)	(111)
F 15+, PL	105	105	224	-	30	25	-	55	147	72	30	55	51
	(2)	(2)	(4)	-	(4)	(1)	-	(3)	(1)	(2)	(4)	(3)	(26)
Totals	90	98	72	14	46	98	103	156	136	57	72	55	75
	(19)	(22)	(21)	(15)	(16)	(16)	(11)	(23)	(19)	(23)	(24)	(17)	(226)

(Continued on next page)

TABLE 44-A. (CONTINUED - page 4) (BIOCHEMICAL FINDINGS - CIVILIANS - BY LOCATIONS - MEA

General Area	Songkhla		Chiengmai			Lop-buri	Udorn			Ubol			
Specific Village	Bang Dan (Buddhist)	Don Kae Leg (Islam)	Ban Fon	San Pong	Padad	Ta Kae	Rachinutis High School	Phon Ngam	Marg Yah	Sri Kai	Ban Kao	Nong Manao	TOTAL
URINE	Medians (per gm creatinine)												
RIBOFLAVIN (mcg)													
M + F < 15	51	77	60	38	38	65	47	65	41	26	59	22	47
	(4)	(2)	(6)	(3)	(8)	(7)	(9)	(12)	(11)	(8)	(13)	(7)	(90)
M + F 15+, NPNL	21	22	20	27	21	26	26	26	15	26	26	17	22
	(13)	(16)	(10)	(11)	(6)	(8)	(1)	(8)	(6)	(12)	(7)	(6)	(104)
F 15+, PL	17	14	18	-	22	39	-	38	82	39	38	38	25
	(5)	(2)	(4)	-	(5)	(1)	-	(3)	(1)	(2)	(4)	(3)	(30)
Totals	22	22	25	26	28	36	45	48	32	20	41	22	31
	(22)	(20)	(20)	(14)	(19)	(16)	(10)	(23)	(18)	(22)	(24)	(16)	(224)
N^1-METHYLNICOTINAMIDE (mg)													
M + F < 15	4.9	6.0	7.0	5.2	4.9	4.7	5.6	5.2	6.3	5.2	5.7	2.3	5.2
	(4)	(1)	(6)	(3)	(8)	(7)	(10)	(12)	(11)	(8)	(13)	(7)	(90)
M + F 15+, NPNL	4.2	4.5	3.6	3.9	5.2	5.2	7.8	2.8	3.4	4.2	4.0	3.7	4.0
	(15)	(19)	(11)	(12)	(6)	(8)	(1)	(7)	(6)	(13)	(7)	(7)	(112)
F 15+, PL	6.5	5.6	2.3	-	4.7	8.4	-	7.4	11.6	9.0	7.1	2.3	4.9
	(5)	(2)	(4)	-	(5)	(1)	-	(2)	(1)	(1)	(4)	(2)	(27)
Totals	4.5	4.6	4.0	4.1	4.9	5.1	5.8	4.4	5.1	4.7	5.3	2.5	4.6
	(24)	(22)	(21)	(15)	(19)	(16)	(11)	(21)	(18)	(22)	(24)	(16)	(229)

1/ Figures in parentheses are numbers of individuals studied.
2/ Hematocrit values are somewhat low and MCHC values somewhat high compared with true values because of intermittent hemolysis.

TABLE 45-A. BIOCHEMICAL FINDINGS[1] AMONG THE THAI CIVILIANS IN TERMS OF AGE AND SEX

BLOOD	Males[3] Age (years) 0-4	5-9	10-14	15-44	45+	TOTAL	Females, NPNL[3] Age (years) 0-4	5-9	10-14	15-44	45+	TOTAL
TOTAL SERUM PROTEIN												
No. of subjects	-	11	16	52	19	98	3	16	19	32	19	89
Mean (gms/100 ml)	-	7.1	7.2	7.3	7.2	7.2	7.9	7.5	7.4	7.5	7.7	7.6
% "Low"	-	-	-	-	-	-	-	-	-	-	-	-
SERUM ALBUMIN												
No. of subjects	-	11	16	52	18	97	3	16	19	32	19	89
Mean (gms/100 ml)	-	3.5	3.6	3.7	3.5	3.6	3.5	3.4	3.6	3.8	3.5	3.6
% "Low"	-	54.5	31.2	13.5	27.8	23.7	33.3	50.0	26.3	9.4	42.1	28.1
SERUM GLOBULIN												
No. of subjects	-	11	16	52	19	98	3	16	19	32	19	89
Mean (gms/100 ml)	-	3.6	3.6	3.5	3.7	3.5	4.5	4.1	3.8	3.6	4.2	3.9
% "High"	-	45.4	50.0	51.9	47.4	50.0	-	31.2	15.8	37.5	10.5	24.7
% "Very High"	-	45.4	43.8	42.3	42.1	42.8	100.0	68.8	78.9	50.0	78.9	67.4
ALBUMIN/GLOBULIN RATIO												
No. of subjects	-	11	16	52	19	98	3	16	19	32	19	89
Mean	-	1.02	1.02	1.10	1.02	1.06	0.80	0.87	0.99	1.15	0.88	1.00
HEMOGLOBIN												
No. of subjects	-	11	16	52	18	97	3	16	19	31	19	88
Mean (gms/100 ml)	-	10.7	11.6	13.7	12.4	12.8	12.9	10.8	11.4	11.4	9.8	11.0
% "Deficient"	-	54.5	50.0	13.5	38.9	28.9	-	81.2	63.2	54.8	94.7	68.2
% "Low"	-	45.4	43.8	42.3	33.3	41.2	100.0	12.5	31.6	45.2	5.3	29.5
HEMATOCRIT[2]												
No. of subjects	7	21	20	53	18	119	11	28	20	31	18	108
Mean (%)	32.1	34.0	35.8	40.4	37.3	37.5	33.4	34.4	30.8	34.9	30.0	33.0
% "Deficient"	71.4	33.3	30.0	11.3	33.3	25.2	45.4	53.6	55.0	41.9	61.1	50.9
% "Low"	28.6	61.9	55.0	30.2	33.3	40.3	54.5	39.3	35.0	38.7	38.9	39.8
MCHC[2]												
No. of subjects	-	11	16	52	18	97	3	16	19	30	18	86
Mean (%)	-	31.1	31.6	33.0	31.8	32.4	44.7	29.8	34.5	32.2	31.4	32.5
% "Deficient"	-	18.2	12.5	1.9	16.7	8.2	-	18.8	5.3	6.7	5.6	8.1
% "Low"	-	9.1	18.8	9.6	11.1	11.3	-	12.5	10.5	23.3	11.1	15.1
% "High"	-	45.4	37.5	57.7	55.6	52.6	66.7	18.8	47.4	46.7	33.3	39.5
SERUM VITAMIN A												
No. of subjects	-	11	16	51	19	97	3	16	19	30	19	87
Mean (mcg/100 ml)	-	17.9	20.1	29.5	25.1	25.8	16.2	17.5	20.2	23.8	25.4	21.9
% "Deficient"	-	9.1	-	-	-	1.0	-	12.5	10.5	3.3	-	5.7
% "Low"	-	72.7	68.8	15.7	21.0	32.0	66.7	50.0	42.1	26.7	21.0	34.5

(Continued on next page)

TABLE 45-A. (CONTINUED - page 2) (BIOCHEMICAL FINDINGS - CIVILIANS - BY AGE AND SEX)

BLOOD	Males[3/]-Age (years)						Females, NPNL[3/]-Age (years)					
	0-4	5-9	10-14	15-44	45+	TOTAL	0-4	5-9	10-14	15-44	45+	TOTA
SERUM CAROTENE												
No. of subjects	-	11	16	51	19	97	3	16	19	30	19	8
Mean (mcg/100 ml)	-	55	55	60	67	60	45	43	60	86	86	7
% "Deficient"	-	-	-	3.9	5.3	3.1	33.3	6.2	-	-	-	2.
% "Low"	-	36.4	18.8	21.6	15.8	21.6	33.3	43.8	21.0	3.3	15.8	18.
SERUM VITAMIN C												
No. of subjects	7	15	17	53	19	111	9	22	20	32	19	10
Mean (mg/100 ml)	0.46	0.86	0.94	0.70	0.68	0.74	0.58	0.82	1.03	0.85	0.63	0.8
% "Low"	14.3	-	-	1.9	5.3	2.7	22.2	-	5.0	-	-	2.
URINE												
THIAMINE												
No. of subjects	4	19	20	50	18	111	6	24	16	24	19	8
Median (mcg/gm C)	233	191	108	45	30	62	46	142	131	74	72	9
% "Deficient"	-	-	10.0	34.0	50.0	25.2	33.3	4.2	-	29.2	26.3	16.
% "Low"	-	21.0	20.0	34.0	27.8	27.0	33.3	16.7	12.5	16.7	21.0	18.
RIBOFLAVIN												
No. of subjects	4	19	19	47	17	106	6	23	19	22	18	8
Median (mcg/gm C)	39	40	53	21	19	31	26	48	56	25	17	3
% "Deficient"	50.0	31.6	15.8	59.6	58.8	46.2	50.0	21.7	26.3	54.5	61.1	40.
% "Low"	25.0	63.2	57.9	34.0	41.2	44.3	33.3	52.2	57.9	31.8	38.9	44.
N'-METHYLNICOTINAMIDE												
No. of subjects	4	18	20	51	18	111	6	24	18	24	19	9
Median (mg/gm C)	7.0	4.4	5.3	3.8	3.8	4.2	5.2	5.3	5.4	4.7	4.2	5.
% "Low"	-	-	-	5.9	-	2.7	-	8.3	-	8.3	-	4.
% "High"	75.0	50.0	80.0	41.2	27.8	48.6	83.3	62.5	72.2	58.3	47.4	61.

1/ When % "Low" only is cited, no cases occurred in the "Deficient" range.
2/ Hematocrit values are somewhat low and MCHC values somewhat high compared with true values because of intermittent hemolysis.
3/ Includes children from Rachinutis High School

TABLE 46-A. BIOCHEMICAL FINDINGS AMONG THE THAI MILITARY AND CIVILIANS - DISTRIBUTION OF VALUES IN DETAIL FOR ALL GROUPS COMBINED[1/ 2/]

BLOOD	Ranges	Civilians No. of Subjects	Civilians % of Total	Military No. of Subjects	Military % of Total
TOTAL SERUM PROTEIN	gms/ 100 ml				
"Deficient"	0.0-5.9	-	-	-	-
"Low"	6.0-6.4	2	0.9	6	2.3
"Acceptable"	6.5-6.9	33	15.6	46	18.0
"High"	7.0-7.4	90	42.7	107	41.8
	7.5-7.9	58	27.5	62	24.2
	8.0-8.4	19	9.0	20	7.8
	8.5-8.9	5	2.4	10	3.9
	9.0-11.7	4	1.9	5	2.0
Totals		211	100.0	256	100.0
SERUM ALBUMIN	gms/ 100 ml				
"Deficient"	0.0-2.4	-	-	-	-
"Low"	2.5-2.9	15	7.1	2	0.8
	3.0-3.4	46	21.9	5	2.0
"Acceptable"	3.5-3.9	112	53.3	90	35.3
	4.0-4.4	30	14.3	112	43.9
	4.5-4.9	5	2.4	29	11.4
"High"	5.0-5.4	1	0.5	14	5.5
	5.5-5.9	1	0.5	2	0.8
	6.0-6.2	-	-	1	0.4
Totals		210	100.0	255	100.1
SERUM GLOBULIN	gms/ 100 ml				
"Deficient"	0.0-0.9	-	-	-	-
"Low"	1.0-1.4	1	0.5	3	1.2
	1.5-1.9	2	0.9	4	1.6
"Acceptable"	2.0-2.4	2	0.9	18	7.1
	2.5-2.9	12	5.7	59	23.1
"High"	3.0-3.5	72	34.1	105	41.2
"Very High"	3.6-4.0	50	23.7	41	16.1
	4.1-4.5	48	22.7	19	7.4
	4.6-5.0	12	5.7	3	1.2
	5.1-7.6	12	5.7	3	1.2
Totals		211	99.9	255	100.1
ALBUMIN/GLOBULIN RATIO	A/G				
	0.5-0.9	91	43.1	23	9.0
	1.0-1.4	106	50.2	155	60.8
	1.5-1.9	10	4.7	59	23.1
	2.0-2.4	2	0.9	9	3.5
	2.5-2.9	-	-	5	2.0
	3.0-3.4	2	0.9	-	-
	3.5-3.9	-	-	3	1.2
	4.0-4.4	-	-	1	0.4
Totals		211	99.8	255	100.0
HEMOGLOBIN	gms/ 100 ml				
	3.0-3.9	1	0.5	-	-
	4.0-5.9	3	1.4	4	1.6
"Deficient"	6.0-7.9	16	7.7	7	2.8
	8.0-9.9	26	12.4	19	7.5
	10.0-11.9	64	30.6	34	13.5
"Low"	12.0-13.9	65	31.1	73	29.0
"Acceptable"	14.0-14.9	15	7.2	48	19.0
"High"	15.0-16.9	17	8.1	54	21.4
	17.0-19.9	2	1.0	13	5.2
Totals		209	100.0	252	100.0
HEMATOCRIT[3/]	%				
"Deficient"	12-19	3	1.2	5	2.0
	20-24	16	6.4	7	2.8
	25-29	18	7.2	12	4.8
	30-32	24	9.6	13	5.2
	33-35	40	15.9	17	6.7
"Low"	36-38	57	22.7	23	9.1
	39-41	40	15.9	33	13.1
"Acceptable"	42-45	40	15.9	75	29.8
	46-49	13	5.2	53	21.0
	50-60	-	-	14	5.6
Totals		251	100.0	252	100.1

(Continued on next page)

TABLE 46-A. (CONTINUED - page 2) (BIOCHEMICAL FINDINGS - MILITARY AND CIVILIANS - DISTRIBUTION OF VALUES IN DETAIL)

BLOOD	Ranges	Civilians No. of Subjects	Civilians % of Total	Military No. of Subjects	Military % of Total
MCHC[3/]	%				
"Deficient"	12.0-19.9	2	1.0	7	2.8
	20.0-23.9	2	1.0	5	2.0
	24.0-25.9	4	1.9	6	2.4
	26.0-27.9	11	5.3	9	3.6
"Low"	28.0-29.9	31	15.0	30	11.9
"Acceptable"	30.0-31.9	65	31.4	45	17.9
"High"	32.0-33.9	52	25.1	59	23.4
	34.0-35.9	24	11.6	39	15.5
	36.0-39.9	8	3.9	24	9.5
	40.0-67.0	8	3.9	28	11.1
Totals		207	100.1	252	100.1
SERUM VITAMIN A	mcg/ 100 ml				
"Deficient"	0-9	4	1.9	-	-
"Low"	10-19	74	35.6	32	12.6
"Acceptable"	20-29	87	41.8	83	32.7
	30-39	34	16.3	98	38.6
	40-49	8	3.8	34	13.4
"High"	50-59	1	0.5	7	2.8
Totals		208	99.9	254	100.1
SERUM CAROTENE	mcg/ 100 ml				
"Deficient"	0-9	1	0.5	-	-
	10-19	4	1.9	9	3.5
"Low"	20-29	13	6.2	22	8.7
	30-39	28	13.5	32	12.6
"Acceptable"	40-59	71	34.1	71	28.0
	60-79	28	13.5	60	23.6
	80-99	25	12.0	31	12.2
"High"	100-139	27	13.0	27	10.6
	140-179	6	2.9	1	0.4
	180-229	5	2.4	1	0.4
Totals		208	100.0	254	100.0

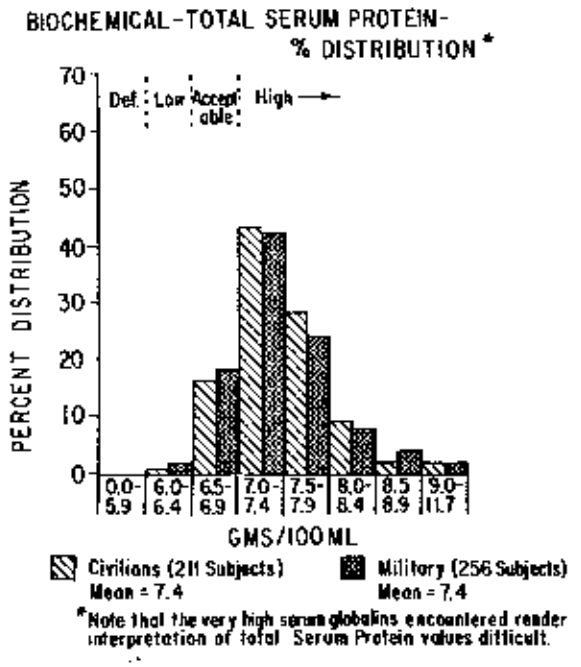
BLOOD	Ranges	Civilians No. of Subjects	Civilians % of Total	Military No. of Subjects	Military %
SERUM VITAMIN C	mg/100 ml				
"Deficient"	0.00-0.09	-	-	4	
"Low"	0.10-0.19	8	3.4	39	
"Acceptable"	0.20-0.29	15	6.3	43	
	0.30-0.39	17	7.2	40	
"High"	0.40-0.49	20	8.4	43	
	0.50-0.69	42	17.7	49	
	0.70-0.89	55	23.2	24	
	0.90-1.09	49	20.7	7	
	1.10-1.49	30	12.7	5	
	1.50-1.99	1	0.4	2	
Totals		237	100.0	256	1
URINE					
THIAMINE	mcg/gm C				
"Deficient"	0-26	49	22.8	18	
"Low"	27-65	55	25.6	22	
"Acceptable"	66-129	40	18.6	53	
"High"	130-199	30	14.0	32	
	200-299	16	7.4	41	
	300-399	8	3.7	22	
	400-499	7	3.3	20	
	500-599	4	1.9	6	
	600+	6	2.8	39	
Totals		215	100.1	253	

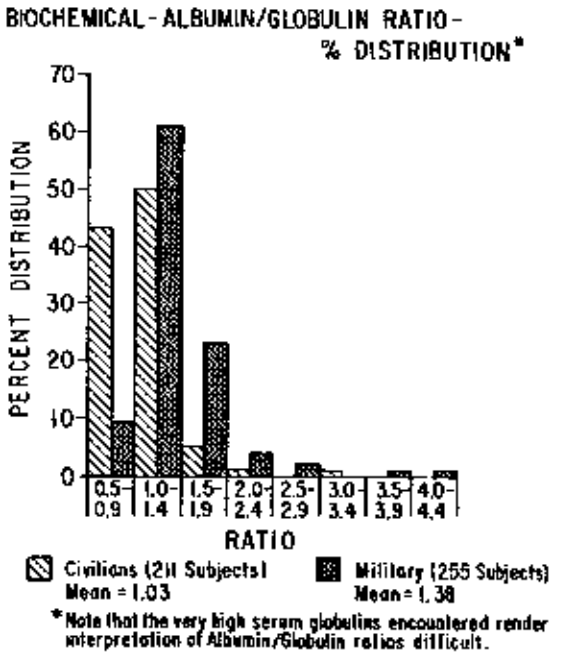
(Continued on next page

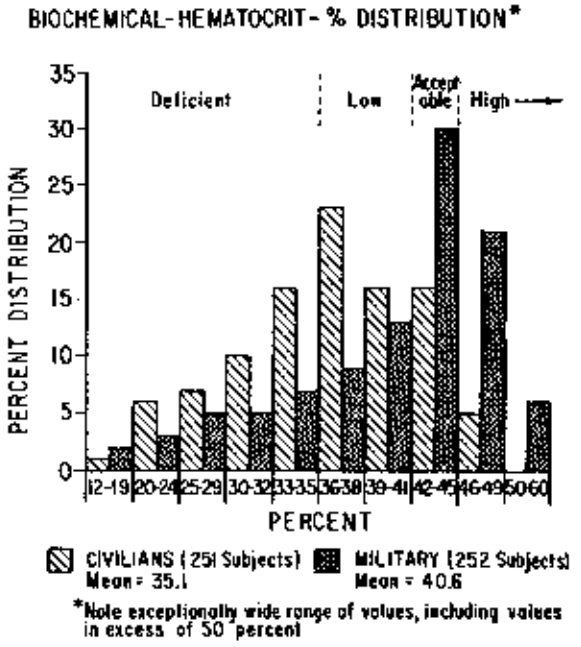
TABLE 46-A. (CONTINUED - page 3) (BIOCHEMICAL FINDINGS - MILITARY AND CIVILIANS - DISTRIBUTION OF VALUES IN DETAIL)

URINE	Ranges	Civilians		Military	
		No. of Subjects	% of Total	No. of Subjects	% of Total
RIBOFLAVIN	mcg/gm C				
"Deficient"	0-26	100	46.7	134	53.2
"Low"	27-49	51	23.8	80	31.7
	50-79	37	17.3	20	7.9
"Acceptable"	80-99	13	6.1	5	2.0
	100-149	9	4.2	5	2.0
	150-199	2	0.9	3	1.2
	200-269	1	0.5	1	0.4
"High"	270-399	-	-	-	-
	400-599	-	-	-	-
	600+	1	0.5	4	1.6
Totals		214	100.0	252	100.0
N'MN	mg/gm C				
"Deficient"	0.00-0.49	-	-	-	-
"Low"	0.50-1.59	9	4.1	3	1.2
"Acceptable"	1.60-2.99	44	20.2	56	22.2
	3.00-4.29	50	22.9	83	32.9
"High"	4.30-5.99	52	23.9	50	19.8
	6.00-7.99	27	12.4	32	12.7
	8.00-9.99	20	9.2	16	6.3
	10.00-14.99	13	6.0	11	4.4
	15.00-19.99	2	0.9	1	0.4
	20.00+	1	0.5	-	-
Totals		218	100.1	252	99.9

1/ The only group omitted from the civilian data is Rachinutis High School, Udorn; military data are for the combined services.
2/ See appropriate graphs in main report.
3/ Hematocrit values are somewhat low and MCHC values somewhat high compared with true values because of intermittent hemolysis.







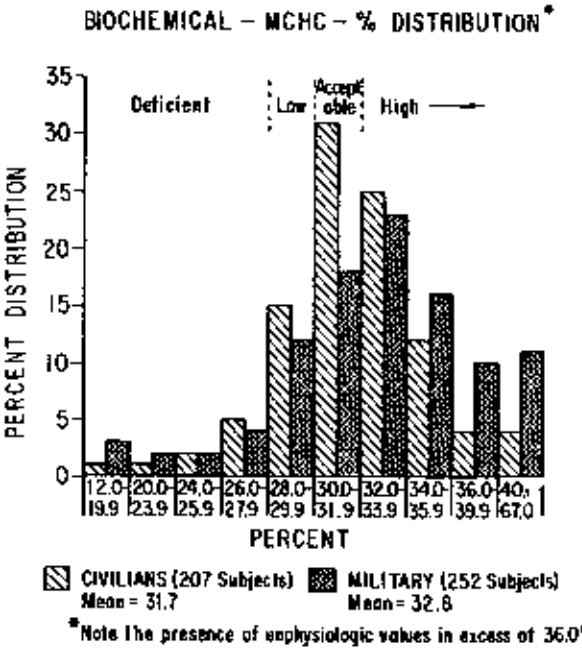


Figure 6-A. Distribution of Values for a Number of Biochemical Distributions NOT Presented in the Main Report.

TABLE 47-A. BIOCHEMICAL FINDINGS[1] AMONG THE THAI CIVILIANS IN TERMS OF MAJOR AGE AND SEX GROUPS, WITH COMPARISONS OF PREGNANT AND LACTATING WOMEN AND THE MILITARY

	Males			Females			
	Civilians[3]		COMBINED MILITARY SERVICES	NPNL[3]		Pregnant	Lactating
Age (years)--->	< 15	15+		< 15	15+	15+	15+
BLOOD							
TOTAL SERUM PROTEIN							
No. of subjects	27	71	256	38	51	9	28
Mean (gms/100 ml)	7.2	7.2	7.4	7.5	7.6	6.9	7.7
% "Low"	-	-	2.3	-	-	22.9	-
SERUM ALBUMIN							
No. of subjects	27	70	255	38	51	9	28
Mean (gms/100 ml)	3.6	3.7	4.1	3.5	3.7	3.1	3.7
% "Low"	40.7	17.1	2.7	36.8	21.6	88.9	32.1
SERUM GLOBULIN							
No. of subjects	27	71	255	38	51	9	28
Mean (gms/100 ml)	3.6	3.5	3.2	4.0	3.9	3.8	4.0
% "High"	48.1	50.7	41.2	21.0	27.4	33.3	10.7
% "Very High"	44.4	42.2	25.9	76.3	60.8	66.7	78.6
ALBUMIN/GLOBULIN RATIO							
No. of subjects	27	71	255	38	51	9	28
Mean	1.02	1.08	1.38	0.92	1.05	0.83	1.03
HEMOGLOBIN							
No. of subjects	27	70	252	38	50	9	28
Mean (gms/100 ml)	11.2	13.4	13.3	11.3	10.8	10.4	10.2
% "Deficient"	51.9	20.0	25.4	65.8	70.0	100.0	67.9
% "Low"	44.4	40.0	29.0	28.9	30.0	-	21.4
HEMATOCRIT[2]							
No. of subjects	48	71	252	59	49	9	28
Mean (%)	34.5	39.6	40.6	33.0	33.1	31.1	31.6
% "Deficient"	37.5	16.9	21.4	52.5	49.0	88.9	57.1
% "Low"	54.2	31.0	22.2	40.7	38.8	11.1	32.1
MCHC[2]							
No. of subjects	27	70	252	38	48	9	28
Mean (%)	31.4	32.7	32.8	33.3	31.9	32.0	31.0
% "Deficient"	14.8	5.7	10.7	10.5	6.2	-	17.9
% "Low"	14.8	10.0	11.9	10.5	18.8	-	25.0
% "High"	40.7	57.1	59.5	36.8	41.7	66.7	42.9
SERUM VITAMIN A							
No. of subjects	27	70	254	38	49	9	28
Mean (mcg/100 ml)	19.2	28.3	31.3	18.8	24.4	19.6	22.2
% "Deficient"	3.7	-	-	10.5	2.0	11.1	-
% "Low"	70.4	17.1	12.6	47.4	24.5	55.6	39.3

(Continued on next page)

62y788 O - 62 - 13

TABLE 47-A. (CONTINUED - page 2) (BIOCHEMICAL FINDINGS - MAJOR AGE AND SEX GROUPS - COMPARISONS WITH PREGNANT AND LACTATING WOMEN AND THE MILITARY)

	Males			Females			
	Civilians[3]		COMBINED MILITARY SERVICES	NPNL[3]		Pregnant	Lactating
Age (years) --->	< 15	15+		< 15	15+	15+	15+
BLOOD							
SERUM CAROTENE							
No. of subjects	27	70	254	38	49	9	28
Mean (mcg/100 ml)	55	62	62	51	86	96	74
% "Deficient"	-	4.3	3.5	5.3	-	-	-
% "Low"	25.9	20.0	21.2	31.6	8.2	11.1	21.4
SERUM VITAMIN C							
No. of subjects	39	72	256	51	51	9	28
Mean (mg/100 ml)	0.83	0.70	0.44	0.86	0.77	0.79	0.63
% "Deficient"	-	-	1.6	-	-	-	-
% "Low"	2.6	2.8	15.2	5.9	-	-	7.1
URINE							
THIAMINE							
No. of subjects	43	68	253	46	43	5	21
Median (mcg/gm C)	161	41	204	131	73	142	48
% "Deficient"	4.6	38.2	7.1	6.5	27.9	20.0	23.8
% "Low"	18.6	32.4	8.7	17.4	18.6	20.0	47.6
RIBOFLAVIN							
No. of subjects	42	64	252	48	40	8	22
Median (mcg/gm C)	46	21	24	48	22	20	30
% "Deficient"	26.2	59.4	53.2	27.1	57.5	75.0	50.0
% "Low"	57.1	35.9	39.7	52.1	35.0	12.5	36.4
N'METHYLNICOTINAMIDE							
No. of subjects	42	69	252	48	43	7	20
Median (mg/gm C)	5.2	3.8	4.0	5.3	4.5	8.5	4.0
% "Low"	-	4.3	1.2	4.2	4.6	-	10.0
% "High"	66.7	37.7	43.6	68.7	53.5	85.7	45.0

1/ When % "Low" only is cited, no cases occurred in the "Deficient" range.
2/ Hematocrit values are somewhat low and MCHC values somewhat high compared with true values because of intermittent hemolysis.
3/ Includes children from Rachinutis High School.

TABLE 48-A. BIOCHEMICAL FINDINGS AMONG THE THAI MILITARY AND CIVILIANS - SUBJECTS WITH ZERO BLOOD LEVELS AND URINARY EXCRETIONS 1/

	Civilians			Military		
BLOOD	Total No. of Subjects	No. of Subjects "Deficient"	No. of Subjects with 0 Value	Total No. of Subjects	No. of Subjects "Deficient"	No. of Subjects with 0 Value
Serum Vitamin A (mcg/100 ml)	208	4	--	254	--	--
Serum Carotene (mcg/100 ml)	208	5	--	254	9	--
Serum Vitamin C (mg/100 ml)	237	--	--	256	4	--
URINE						
Thiamine (mcg/gm C)	215	49	9	253	18	1
Riboflavin (mcg/gm C)	214	100	21	252	134	37

1/ The only group omitted from the civilian data is Rachinutis High School, Udorn; military data are for the combined services.

TABLE 49-A. RELATIONSHIP BETWEEN SOME BIOCHEMICAL VALUES AND SEVERAL CLINICAL LESIONS

	Angular Lesions		Bilateral Ankle Jerks		Filiform Papillary Atrophy (all grades combined)	
MILITARY (COMBINED SERVICES)	Present	Absent	Loss Exists	Normal	Present	Absent
Riboflavin Excretion						
No. of subjects	7	245			9	243
Median (mcg/gm C)	18	24			38	23
% Distribution: < 27 mcg/gm C	57.1	53.1			22.2	54.3
27-79 "	42.8	39.6			66.7	38.7
80-269 "	--	5.7			11.1	5.3
270+ "	--	1.6			--	1.6
Thiamine Excretion						
No. of subjects			3	250	9	244
Median (mcg/gm C)			668	194	188	204
% Distribution: < 27 mcg/gm C			--	7.2	--	7.4
27-65 "			--	8.8	--	9.0
66-129 "			--	21.2	22.2	20.9
130+ "			100.0	62.8	77.8	62.7
Hemoglobin						
No. of subjects					9	243
Mean (gms/100 ml)					13.4	13.2
% Distribution: < 12.0 gms/100 ml					44.4	24.7
12.0-13.9 "					11.1	29.6
14.0-14.9 "					11.1	19.3
15.0+ "					33.3	26.3
CIVILIANS 1/						
Riboflavin Excretion						
No. of subjects	21	193			9	205
Median (mcg/gm C)	32	29			14	30
% Distribution: < 27 mcg/gm C	42.8	47.2			66.7	45.8
27-79 "	42.8	40.9			11.1	42.4
80-269 "	9.5	11.9			11.1	11.7
270+ "	4.8	--			11.1	--
Thiamine Excretion						
No. of subjects+			2	213	10	205
Median (mcg/gm C)			11	73	131	68
% Distribution: < 27 mcg/gm C			50.0	22.5	10.0	23.4
27-65 "			50.0	25.4	20.0	25.8
66-129 "			--	18.8	20.0	18.5
130+ "			--	33.3	50.0	32.2
Hemoglobin						
No. of subjects					10	199
Mean (gms/100 ml)					10.8	11.7
% Distribution: < 12.0 gms/100 ml					70.0	51.8
12.0-13.9 "					30.0	31.2
14.0-14.9 "					--	7.5
15.0+ "					--	9.5

1/ Omitting Rachinutis High School, Udorn.

J. IODINE NUTRITION APPENDIX

The purpose of this study was to evaluate the current status of iodine nutrition in elected segments of military and civilian populations. It has been recognized since the nitial goiter studies of Marine and Kimball (85) that the most sensitive group in any opulation sample is the adolescent female. Hence, it was decided to restrict the civilan study to this group. Moreover, an attempt was made to evaluate only those individuals ho had no goiter or at most grade I enlargement. In each area visited, after approval by he Governor of the Province, contacts were made with the principals of selected schools n urban and rural areas. A visit was made to schools in the morning and afternoon; the hyroid glands of the students in all rooms were palpated as they passed by a single xaminer. A method of recording similar to that described by Munoz and Anderson (86) was tilized. The WHO system of classifications was followed (41). At approximately 10 A.M. r 2 P.M., a group of girls, on an average 15, was picked at random. They were asked to rink a dose of approximately five microcuries of I^{131}, dispensed by an automatic pipette nto a plastic cup and diluted by water. The cup was rinsed with water and the rinsings ere swallowed. The next morning or afternoon a second visit was made to the school. Aparatus was set up so as to be ready to begin counting at approximately 9 A.M. or 1 P.M. ence, the values for the uptake represent 24 hours plus or minus one hour. At this secnd visit casual urine specimens were obtained in paper cups; these were transferred to mber bottles containing toluol. Samples of military groups were processed in a similar ashion.

A Nuclear Chicago portable decade scaler (No. 2800) was used in all studies. This nstrument contains a storage battery which can be recharged whenever necessary. It weighs 0 pounds and hence is readily portable. A transistorized scintillation detector (Nuclear hicago, Model DS5-2) with a one-inch sodium iodide crystal and a flat field collimated ose piece was used. This was mounted on a wooden block attached to the base of a laboraory jack (Cenco-Lerner, 19,089). A plastic tube was made to fit over the end of the colimator of such a length that its end was exactly 25 cm from the face of the sodium iodide rystal. This end was placed against the neck so as to cover the thyroid region. The ubject was seated in a straight-backed chair to which was clamped a dental type head-rest. he head was positioned so that the neck surface was parallel to the plane of the plastic ube's opening.

Radioactive iodine (I^{131}) was obtained from the Radio-chemical Center, Amersham, ngland, through the cooperation of Dr. Romsai Suwanik. Each week appropriate dilutions ere made so that the dose to be administered was contained in 1 cc of water. The amount as gauged so that the rate of decay would furnish a dose of five microcuries at mid-week. ne cc of the dose was diluted to 20 cc in a volumetric flask. This standard was counted t 25 cm from the surface of the crystal, i.e., on a plane with the end of the plastic ube. This standard had been calibrated with a plastic neck phantom (ORINS, Oak Ridge) so s to obtain the correction factor for scatter and absorption. This factor, 0.84, was ultiplied by the count obtained over the neck. Two counting intervals of two minutes ach were made with the neck unshielded; two more were made with a one-half inch lead hield between the neck and plastic tube for background levels.

The creatinine content of the urine samples was determined by the alkaline picrate ethod. Iodine determinations were performed by the Boston Medical Laboratory, Inc., oston, Massachusetts, utilizing a modified Zak method (87,88).

TABLE 50-A. SCHOOL CENSUS OF THAILAND, 1960[1/2/]

Number of Students at Different Levels of Education

Kindergarten	22,395
Pre-primary	16,662
Primary	3,569,595
Lower Secondary	365,954
Upper Secondary	213,254
Pre-University	26,155
Teacher Training	18,848
Short Time Course	3,749
Lower Vocational	2,613
Upper Vocational	23,267
Higher Vocational	28,790
Technical	4,887
Others	58,949
Total	4,355,118

Number of Children in Schools In Terms of Sex and Age

Age	Male	Female	Total
8 years	317,241	301,369	618,610
9 years	24,786	22,341	47,127
10 years	8,476	7,547	16,023
11 years	3,659	3,417	7,076
12 years	2,202	1,780	3,982
13 years	1,093	872	1,965
14 years	608	558	1,166
15 years	162	98	260
Total	358,227	337,982	696,209

1/ Each year 500,000 are old enough to enter school but 100,000 will never enter, and only 50,000 will complete four years. (Thailand - Years of Progress, Bangkok World, Special Supplement, Oct. 20, 1960.)

2/ Data obtained from "Educational Statistics," a publication of the Ministry of Education, Bangkok, 1960.

K. DIETARY APPENDIX

. Military Dietary Survey

The dietary team consisted of two nutritionists from the United States, two hailand Royal Army Quartermaster officers and two Thai Quartermaster (QM) enlisted en. One of the officers also served as an interpreter-translator.

Seven major areas were studied and they included six separate Army units at angkok, Songkhla, Chiengmai, Udorn, and two units at Ubol (a camp and a field unit n maneuvers), one Navy unit at Sattaheep, and an Air Force group at Lopburi. These nits covered most of Thailand, in the south, north, northeast, northwest, and central reas.

a. Food intake procedures

Food consumption was measured at the military installations by both the inventory ethod and the chemical method using food composites.

The reliability and accuracy of the chemical method depends upon (a) accurately eighing all the prepared food served and all the discarded food left on the trays, b) obtaining an accurate head count during each meal, (c) preparing the representative ood composites, and (d) finally, performing careful chemical analyses on the food omposites. These composites were analyzed for protein, fat, crude fiber, moisture, nd ash, carbohydrate being calculated by difference, plus riboflavin, niacin, and itamin C. Undermilled rice samples were collected from each unit studied and analyzed hemically for thiamine, riboflavin, niacin, and iron.

The inventory method for measuring food consumption is based on the weights of he food as purchased, minus the trimming losses converted back to its raw equivalent, nd is then computed for protein, fat, carbohydrate, and the various minerals and itamins. In this study we have utilized data from the Thailand Food Tables, the Far astern Table of Food Composition (89), the Food and Agriculture Organization Tables of ood Composition (90), and the United States Department of Agriculture Handbook No. 8 (91).

In each unit studied an attempt was made to gather information on the monetary alue of the daily ration in each location, how it was spent and whether the food was urchased through a contractor or purchased daily by the messing personnel. Informa- ion was also gathered on food preparation, messing practices, the acceptability of ood items, the source of the water, fish sauce, rice and salt supply, and the daily ice consumption of each unit. Additional information was also gathered on whether the hai military dietary recommendations were being followed and to check on the issue of ruits, multi-vitamins, etc.

b. Master menu

A daily master menu is issued by the Army one month in advance and, as a result, ood can be procured in large quantities in advance. The local merchants may bid for hese items on a monthly basis and then distribute the foods daily to each mess. Food s issued on the basis of unit strength (head count). If less men eat, the daily mone- ary allowance is paid back to the commander's fund which is used for special unit func- ions.

The master menu is prepared by the QM section and changes can be made only by he Ration Committee section, depending on the availability of foods in a known location.

According to specifications in the master menu, the daily rice ration is 1,000 gms/man, but it can be purchased and milled with 70 to 75 percent of the bran removed. This specification also says that no more than 25 percent of broken rice should be included in the sample. Since undermilled rice is much cheaper, it is always procured for enlisted men in training and as a result was available in all the messes studied. Canned beef, which is highly acceptable, is issued once a month to all the Army units and is paid for at a rate of 0.10 baht/man/day (one baht = $0.05 U.S.). The Air Force serves the canned beef only when the shelf life has expired. Eggs are occasionally served at the military installations.

The basic monetary ration allowance is five baht/day, but one baht is given back to each soldier for "pocket money" daily. The monetary allowance (Table 51-A) was practically the same for all the military units, but the allocations for each item changed (rice, etc.) depending on the local food costs.

TABLE 51-A. BASIC MONETARY RATION ALLOWANCE--THAI MILITARY PRIVATES (BAHT/DAY[1/])

	Bangkok (Army)	Songkhla (Army)	Chiengmai (Army)	Lopburi (Air Force)	Udorn (Army)	Ubol (Army)	Sattaheep (Navy)
Rice	1.40	1.40	1.40	1.30	1.55	1.20	1.30
Other Food	2.40	2.30	2.40	1.50	2.25	2.60	2.60
Canned Food	0.10	0.10	0.10	0.00	0.10	0.10	0.00
Fuel	0.10	0.10	0.10	0.10	0.10	0.10	0.10
For Soldier	1.00	1.10	1.00	2.10	1.00	1.00	1.00
Total	5.00	5.00	5.00	5.00	5.00	5.00	5.00

1/ During field bivouac, the privates are allowed seven baht/day (one for pocket money) but the NCO's are allowed ten baht which is all spent on food.

Rice was the only nonperishable item that was stored so it was supplied on a daily, weekly, or monthly basis, depending primarily on the amount of storage space that was available to each unit. Fresh foods were delivered daily to each unit and no food (except rice) was left over for the next day. Fruits are very expensive so they are not authorized in the daily menu. As a result no fruits, with the exception of limes (used as seasoning), were ever served at the messes. Two of the units (at Ubol and Chiengmai) served desserts such as rice cakes with bananas once a month and in one unit green papaya was served as a vegetable in soup.

c. Mess areas and practices

The messing areas were all open with no screens, being built on a cement base, with cement floors and having either galvanized iron or tile roofs. Most of the units had electricity which could be used only during the evening hours. (None of the units have enough power for the large blendor for preparing food composites so the small one had to be used.) One unit at Chiengmai was newly painted but it did not have any protection against flies and other insects. At Sattaheep the mess hall roof had not been repaired since the hurricane two years previously. During our stay it rained continuously and as a result the eating area was always wet.

Most of the mess halls could feed up to 500 men at a meal, having long wooden tables and settees that seated 30 to 45 men. One unit had oil cloths for their tables. In practically all of the areas, the food was divided equally and served by one man from each unit for groups of four to six men. In this way every man was assured of an equal share (meat and vegetables) whether he arrived early or late. The sharing of food was the same in all the units. The men marched to the mess hall and back to the barracks and they sat at attention and were not allowed to eat, talk, or leave the table except on command. Each man received only one helping of the meat, fish, and vegetable dishes. Rice was always cooked in abundance so there was always enough for second or third helpings, but was issued only by the servers. The trays were left on the tables after eating, making it quite simple to collect the plate waste. This also made the cleaning by the servers easy. In most of the units each man had a bowl for his rice and helped himself to an equal portion of the fish and meat dishes. The food was prepared some time in advance so it was not unusual to let the food sit on the tables for one to one and one-half hours before it was consumed. During this time the food became cold but was protected from the many flies with large cone-shaped bamboo hats and baskets. The servers and cooks were not allowed to eat until the troops had finished and had left the mess hall so it was not unusual for these men to save a considerable quantity of food for themselves. The unit at Lopburi was the only unit eating cafeteria style and in this instance metal trays were used.

The men used spoons for eating in most units but at Sattaheep each man was issued both spoons and forks. In areas where glutinous rice is served (Udorn and Chiengmai) the men ate with their fingers. The rice was molded into a ball which was eaten directly or "dunked" into a meat dish or soup. These units served finger bowls to prevent the fingers from becoming sticky. The Army normally served the troops three meals a day consisting of a fairly heavy breakfast and evening dinner (usually two items and rice) and a light lunch (rice and one other item). In the Navy the men were served only two meals a day on week ends (breakfast and dinner) but at the Air Force mess the men were served only two meals each day (breakfast and dinner), dinner usually beginning at 3 P.M. The men were paid cash (2.1 baht/day more) to eat their third meal outside but they got around this by eating two very large meals at the mess, thus saving a portion of the money for themselves. The Air Force also issued 1,000 gms of rice a day for the two meals alone and it was no wonder that the food intakes were 3,563 and 3,204 Calories/man for these two meals.

In the Thailand military services all the cooks, servers, and kitchen help are military personnel. The NCO's, who are administrative personnel, are graduates from the Food Service Schools in Bangkok which they have attended for three months. In addition the QM offers a three-month course for officers in Food Service and at the end of this time the officer is placed in charge of a military mess.

d. Cooking areas

All of the cooking areas were fairly large but were open having no screens. The floors were built of cement and the roofs were either galvanized iron or tiled. The cooking area was divided into two sections: one for rice alone and the other for the remaining foods. As in most countries in the Far East, the cooking was done in large iron pots, set in a cement base, which were fired with wood, either from the inside or the outside of the mess. When they were fired from the inside (such as at the Air Force Base at Lopburi), it was practically impossible to work in the kitchens, due to the dense smoke. Even though the kitchen at Lopburi had eight large iron pots for cooking they were able to feed only half of the men at a time, since rice had to be

cooked in two portions. This unit also had a shortage of trays, which had to be washed during the meals. This was one of the very unusual kitchens since it boasted of a few electrical kitchen utensils including food grinders and mixers. The Navy at Sattaheep had the cleanest and most modern kitchen of all the units studied. All the cooking was done in steam pressure cookers, the steam being provided by a large steam boiler (fired with wood) that was built adjacent to the kitchen. In all, this kitchen had eight pressure cookers, three for steaming rice and the remaining five for other foods, and two deep fat fryers. In addition, they had an electric meat slicer, and two large potato peelers. They also had a very large refrigerator that had not been in operation for at least three months, since no one was available to perform the electrical repairs. The Army unit in Bangkok was the only one that had a refrigerator that was in operation.

In practically all of the units the trimming of meats and vegetables was done outdoors with large cleavers on a cement slab, built for easy drainage, which made cleaning fairly easy.

e. Food preparation

Very few of the food items were consumed in a raw state with an occasional exception being cucumbers, Chinese cabbage, green onions, and eggplants. The foods were always cooked for long periods of time. In general the food preparation procedures were quite poor. Many of the men complained to us that the food preparation had been quite poor prior to our arrival, but that it had now improved. At Songkhla a tremendous quantity of food was issued daily during our stay (as a result of our presence) which was reflected in the food intakes, food wastes and leftovers. At Chiengmai the food had also improved since our arrival and at Udorn the food preparation was the poorest. In this kitchen one dish was prepared at each meal, in addition to rice, being cooked together in one large mixture. Many men missed meals at these units so the intakes, even though they seemed high, were not a reflection of all the men but only of the ones who ate.

Only undermilled rice was served at the mess halls, but it was not too highly acceptable. During our stay one unit bought and issued a 30-day supply of polished rice, which was a very unusual situation. In Thailand two types of rice are consumed by the population: regular rice in the south and glutinous or "stieky" rice in the northern areas. The glutinous rice is prepared by soaking the rice in water for four to eight hours. At the end of this time the fluid is drained, the rice being transferred to a large circular bucket that fits over one of the iron pots. The lid is covered and the rice is steamed for two to three hours. There is no waste in this procedure. The troops in the north preferred this type of rice.

The undermilled rice was prepared by adding it to boiling water and allowing most of the excess water to boil off, with constant stirring. The iron pots were not covered at this stage as is done in Taiwan and other Far Eastern countries. In the Thai procedure the rice was served quite dry and there was always from three to six percent burnt rice at the bottom of the iron pots which was wasted.

The regular polished rice was steamed. The rice was soaked in water for two to three hours, then transferred to small aluminum pans containing water and placed under steam pressure for 40 minutes (40 pounds/square inch). The rice was then consolidated in large baskets and served. There was no waste in this procedure.

The normal feeding pattern in the Thailand military consisted of at least three items (including rice) for breakfast and dinner and two items for lunch. These other food items usually included a soup and were prepared with either meat or fish. The soup mixture usually contained a large quantity of vegetables, such as cabbage, green beans,

gourds, green onions, and coconut milk, plus a small quantity of pork or fish and many condiments. These ingredients were added to a quantity of coconut milk and water and cooked for one to two hours. The sauteed meat or fish was also prepared by cooking the meat in vegetable oil and then adding large quantities of vegetables and condiments. This item was also steamed at times for one to two hours before serving. Quite frequently deep fat fried fish was served for breakfast. An item that was served frequently was nam prik. This latter food item is usually a mixture of hot chili, sugar, limes, garlic, tamarind, hot red or yellow curry or shrimp paste and tomatoes, all ground to a fine mixture. In addition, they frequently used freshly ground cooked fish, or fermented fish. This food item was always served with a vegetable mixture. At each meal nam pla (fish sauce) was served. This item is made up of a fish sauce, used as a seasoning, that contains very hot chili peppers that have been ground to very fine particles. The foods were usually dipped into this hot sauce before eating. It should be noted that all of the vegetables, meats, and fish were washed in cold water before cooking.

Coconut milk was prepared by soaking shredded coconut in a fairly large quantity of water (10 to 20 gallons) for a short period of time. The residue was squeezed until all milk was removed from the pulp. The mixture was then screened and the residue discarded. The diluted coconut milk was then added to one of the food mixtures and allowed to simmer for two to three hours. This milk was usually served at each meal.

Dairy products were not available in any of the military units with the exception of duck eggs, which were served on some occasions. Fruits were never served due to the high cost. Multivitamin tablets were not served to any of the military including the Air Force pilots.

Very few of the units had running water, so most of the time the water for washing and cleaning purposes had to be carried into the cooking areas. Tea was never served during meals, but rain water and well water for drinking purposes were available on the tables in large quantities during meals.

The feeding of men in groups of four to six created quite a washing and cleaning problem after each meal. The extra mess personnel usually rinsed the utensils in cool soapless water from wells or the local streams. After rinsing, the utensils and serving bowls were sun-dried prior to use for the next meal. Only in one unit (the Air Force at Lopburi) was there an attempt made to sterilize the serving trays and kitchen utensils in boiling water, but the main purpose of sterilization was defeated since the men usually dried the trays with dirty cloths.

f. Food production

None of the military units studied encouraged food production or gardening of any sort but the Air Force had one agricultural group that controlled the raising of livestock (pigs, cattle, ducks, chickens, etc.). The edible waste from each mess hall was fed to the livestock but each unit still had to purchase the livestock at somewhat reduced rates.

g. Food outside the mess

An attempt was made to interview the military personnel on the food they ate between meals, outside the mess. Due to the fairly low salary scale of privates in the Thai Army, very few of the men could afford to buy any extra food.

h. Collection of rain water

Each unit had an extremely large covered cement tank which was about eight to ten feet deep (four to six feet underground), 20 feet wide and approximately 100 feet long

for the collection and storage of rain water during the rainy seasons. At one end of the tank was a hand pump for getting the water. This tank was covered to prevent the evaporation of the rain water. Every unit that we visited had either metal or tiled roofs connected with a system of drains for collection of the rain water but at least half of the units required minor repairs of the pipes and drainage system, which were not in usable condition. As a result the rain water was lost and either well or stream water was used for drinking purposes with no other means of water purification.

i. Sanitation

Generally speaking the sanitation in the military messes was comparable with the other countries in the Far East. One would not expect to keep out flies and insects without screens or windows. In addition to these insects, most mess halls had many dogs as pets who ate the scraps dropped on the floor during and after meals. Inspections were conducted daily or weekly by the assigned food service officers.

j. Edible waste

The edible waste was usually sold on the local market for "pig feed," the profit reverting to the "special funds" used for the units at the discretion of the commanding officers. In the Air Force the money went into the "welfare fund," used for the same purpose. In Ubol some of the money was used to purchase kitchen utensils. In Chiengmai hogs were purchased and raised with the edible waste from the messes.

k. The use of condiments

The Thailand population enjoy and consume a large quantity of hot spices and condiments in their daily diets. These items include fish sauce, hot chili, either fresh or dried, black pepper, hot chili paste, salt, garlic, green onions, vinegar, fermented fish, basil, mint, lemon grass, lime leaves, tamarind, turmeric, ginger, and soy sauce. No Thailand meal is complete without the fish sauce and hot chili.

l. Over-preparation of foods

There was a tendency to prepare more food than was served to the troops, especially in the Navy and Air Force units, and the Army unit at Songkhla (Table 52-A). The Army units at Chiengmai, Udorn, and Ubol had only an over-preparation of rice. From 10.7 percent (Udorn) to 25 percent (Ubol) of the total rice cooked was automatically set aside (before the meals) and never served to the troops. This may have been due either to the large quantity of raw rice being issued (1,000 gm/man/day) or to the unacceptability of undermilled rice. Most of this leftover food and edible waste food was sold commercially as edible waste, but some was used as animal feed by dependent families.

m. Field operations

Field operations in the Thai Army were considerably complicated by the fact that there was quite a shortage of the combat ration. This was due to the very small quantity procured, resulting from the prohibitive expense of the ration at 15 baht a day, due in turn to the expensive canning process. It was used solely as an emergency ration. As a result, maneuvers were carried out fairly close to a town or village, since fresh foods had to be procured daily. In one of the units we visited the food was purchased at a village 20 miles away from camp so the cooks and the messing personnel had to make a daily 40-mile trip over very bad roads. The chemical composition of the combat ration is presented in Table 53-A.

TABLE 52-A. OVER-PREPARATION OF FOODS (LEFTOVERS)--THAI MILITARY UNITS

	ARMY					AIR FORCE	NAVY
General Area	Bangkok	Songkhla	Chiengmai	Udorn	Ubol	Lopburi	Sattaheep
Food Items	Percent of Total Cooked						
Rice	11.6	19.6	17.8	10.7	25.6	12.9	11.9
Fried rice w/beef		23.6					
Fried Fish		9.2				11.5	20.6
Mung bean noodles							33.0
Fish stew w/chili paste	13.7		0 N L Y	0 N L Y	0 N L Y		
Beef curry		12.4				21.2	
Beef and bamboo shoots		12.2					
Pork curry and eggplant						9.3	
Bamboo shoots w/pork			R I C E	R I C E	R I C E	15.2	
Chinese cabbage w/beef							19.6
String beans w/pork							12.6
Soup, cucumbers w/pork	7.7						
Soup, mung bean noodle		2.1					18.7
Swamp cabbage w/pork							24.9
Beef w/eggplant							26.2
Beef w/mint, etc.							26.6
Nam prik		13.4				11.7	38.3
Chili w/vinegar							15.9
Eggplant, raw						22.9	

TABLE 53-A. NUTRIENT COMPOSITION OF THE THAI COMBAT RATION 1/ 2/

	Per 100 gm Ration	Per Total Ration
Total Calories	--	1,900
Protein, gm	5.94	70.8
Fat, gm	4.19	51.8
Carbohydrate, gm	23.32	288
Moisture gm	64.25	795
Ash, gm	1.71	21.2
Fiber, gm	0.59	7.1
Calcium, mg	27.9	345
Iron, mg	3.28	40.3
Thiamine, mg	.013	0.16
Riboflavin, mg	.058	0.69
Niacin, mg	1.29	16.0
b-Carotene, mg	.029	0.36
Ascorbic Acid	2.0	25

1/ By composite analysis.
2/ Total weight of individual ration = 1,218 gms.

n. Results

The daily nutrient intakes calculated from standard food tables and from the food composites of the various military units are presented in Tables 54-A, 55-A and 56-A. As in most studies conducted by the ICNND there was fairly good agreement between both methods except for calcium, iron, and the B vitamins. The results from the chemical analyses of the food composites will be used in the discussion.

The data in Tables 57-A and 58-A represent the plate waste (edible) and the preparation losses (inedible) for each unit studied in Thailand.

Table 59-A shows the daily consumption of the major food items at each unit surveyed while Table 60-A represents the average of the food items consumed at all of the combined units. The major food sources of each individual nutrient are presented in Table 61-A.

Table 62-A represents the basic daily ration allowance provided for all the various military groups, the major items being rice, 1,000 gms/man/day; meat, fish, or poultry 150 gms/day; and fresh vegetables 500 gms/day.

The distribution of food or rations for a unit in combat or on maneuvers is presented in Table 63-A.

Table 64-A shows the mineral composition of the water and salt samples collected at the various areas in Thailand. It includes data on fluorine, calcium, and the salt content.

The chemical composition of the various foods collected in Thailand are all presented in Tables 65-A and 79-A. They include the analyses of protein, fat, moisture, ash, calcium, iron, thiamine, niacin, and pyridoxine.

The results of bomb calorimetry on the food composites are presented in Table 66-A. Approximations of the proportions of nutrients contributed by rice alone in the Army are presented in Table 67-A.

Comparisons of the daily nutrient intakes, vitamin intakes, and mineral intakes of other countries in the Far East are all presented in Table 68-A.

o. Summary

The mean caloric intake of 2,947 Calories/day was quite adequate, being equivalent to 53.2 Calories/kg of body weight. This is in the same range of the military personnel studied in South Vietnam in 1959 (34) and Taiwan in 1960 (56). The lowest intakes were recorded at Ubol where the values were 45.7 Calories/kg body weight.

The thiamine intake was fairly high, averaging 0.64 mg/1,000 Calories consumed for all the units. This is the highest value that we have recorded in countries in the Far East (a low of 0.24 in Vietnam) and was due primarily to the serving of undermilled rice at the military messes. The lowest thiamine intake was at Udorn (0.25 mg/1,000 Calories) which is in the "low" ICNND range but all the other values were above 0.42 mg which is in the "acceptable" range.

The mean riboflavin intake was 0.31 mg/1,000 Calories (0.91 mg/day) which is in the "low" ICNND range. "Deficient" intakes of riboflavin were found at Udorn (0.10 mg) and Sattaheep (0.18 mg/1,000 Calories) and "low" intakes of 0.29 mg/1,000 Calories were recorded at the Bangkok unit. The mean of 0.31 mg/1,000 Calories was slightly higher than

the values found in Taiwan in 1954 (0.24 mg), Korea in 1957 (0.26 mg) and the Philippines in 1958 (0.28 mg/1,000 Calories). The intake of 0.80 mg/1,000 Calories at Taiwan in 1960 was due primarily to the enrichment of rice.

The protein intakes averaged 84 gms/day or 1.52 gms/kg of body weight. This was in the "high" ICNND interpretive range. All of the values for each unit were in the "acceptable" to "high" range. These intakes were slightly lower than the values for Taiwan (94 gms), Korea (127 gms), S. Vietnam (100 gms), and the Philippines (105 gms).

The mean vitamin A intakes of <1,795 I.U./day were in the "deficient" range. All of the units studied were in the "deficient" ICNND range. Only in Korea in 1957 were lower vitamin A intakes recorded (1,218 I.U./day).

Vitamin C values were in the "low" to "acceptable" range, averaging 30 mg/day. Intakes in the "low" range were found at Chiengmai (28 mg), Udorn (25 mg), Ubol (21 mg), Lopburi (29 mg), and Sattaheep (18 mg/day). In the 1960 Taiwan study values of 17 mg/day were observed, but all other vitamin C intakes in countries in the Far East were above 43 mg/day.

As one would expect, the niacin intakes were high, averaging 33.5 mg/day. This is higher than any values reported in countries in the Far East, which ranged from 18 to 26 mg/day.

Our mean calcium intake of 675 mg/day was in the "acceptable" range and was slightly lower than intakes recorded in Taiwan, Korea, Vietnam, and the Philippines. At the camp in Ubol the observed intake of 152 mg/day was in the "deficient" range and the value of 351 mg at Sattaheep was in the "low" range.

As in other studies in the Far East, the mean iron intake of 63.0 mg/day was in the "high" range. This, as in other studies in the Far East, was due primarily to the iron from the cooking pots.

The mean salt intake of 18.1 gms/day was also high but this is very common in Far Eastern countries where the local populations like their foods highly seasoned. Only in Korea were higher salt intakes observed (mean of 20.1 gms/day). At Ubol the daily intake averaged 7.5 gms, at Chiengmai 11 gms, and at Sattaheep 14 gms/day.

TABLE 54-A. DAILY NUTRIENT INTAKE PER INDIVIDUAL PER DAY AMONG THE THAI MILITARY CALCULATED FROM STANDARD TABLES[1/] - INDIVIDUAL DAILY VALUES

Nutrients	ARMY							
	Bangkok		Songkhla			Chiengmai		
Day -->	1	2	1	2	3	1	2	3
No. of Men Eating in Mess/Day	256	239	262	320	330	167	183	177
Total Calories	2,859	2,687	3,669	3,474	3,088	3,812	3,039	3,617
Total Protein (gm)	67.6	73.7	98.8	84.0	75.2	92.5	67.2	73.9
% Calories	9.4	11.0	10.8	9.7	9.7	9.7	8.8	8.2
Animal Protein (gm)	19.9	24.7	25.9	28.1	22.4	36.6	26.1	18.8
% Calories	29.4	33.5	26.2	33.4	29.8	39.6	38.8	25.5
Total Fat (gm)	35.5	37.6	75.8	39.4	37.6	73.8	73.2	82.6
Fat, % Calories	11.2	12.6	18.6	10.2	11.0	17.4	21.7	20.6
Total CHO (gm)	590	505	655	644	596	665	505	623
CHO, % Calories	82.5	75.2	71.4	74.2	77.2	69.8	66.5	68.9
Calcium (mg)	616	203	201	395	594	731	317	547
Phosphorus (mg)	1,511	1,204	1,473	1,473	1,357	1,213	1,028	1,246
Iron (mg)	21.0	10.5	14.6	10.8	15.0	22.4	14.9	30.3
Vitamin A (I.U.)	839	2,089	10,314	1,243	7,479	3,483	4,560	9,241
Vitamin C (mg)	20	30	18	21	38	62	47	73
Riboflavin (mg)	0.71	0.49	1.25	0.70	0.60	0.78	1.12	0.94
Riboflavin (mg/1000 Cal)	0.25	0.18	0.34	0.20	0.19	0.20	0.37	0.26
Thiamine (mg)	1.09	0.93	2.48	2.43	2.03	2.64	2.56	3.90
Thiamine (mg/1000 Cal)	0.38	0.35	0.68	0.70	0.66	0.69	0.84	1.08
Niacin (mg)	13.3	17.7	35.9	33.5	29.4	45.2	33.0	28.4
Niacin (mg/1000 Cal)	4.7	6.6	9.8	9.6	9.5	11.9	10.9	7.9

1/ These values corrected for undermilled rice and cooking losses.

(Continued on next page)

TABLE 54-A. (CONTINUED - page 2) DAILY NUTRIENT INTAKE PER INDIVIDUAL PER DAY AMONG THE THAI MILITARY CALCULATED FROM STANDARD TABLES[1/] - INDIVIDUAL DAILY VALUES

Nutrients	ARMY						AIR FORCE		NAVY	
	Udorn			Ubol			Lopburi		Sattaheep	
				Camp	Field[2/]					
Day -->	1	2	3	1	1	2	1	2	1	2
No. of Men Eating in Mess/Day	364	388	361	156	23	23	428	410	179	182
Total Calories	3,837	3,562	3,802	3,344	4,847	4,920	3,563	3,204	3,072	2,853
Total Protein (gm)	96.3	89.8	93.2	81.8	138.7	113.4	72.2	74.0	75.0	69.0
Protein, % Calories	10.0	10.1	9.8	9.8	11.4	9.2	8.1	9.2	9.8	9.7
Animal Protein (gm)	33.5	32.1	29.1	32.6	61.6	41.2	9.1	18.7	19.0	26.8
Animal Protein, % Calories	34.8	35.7	31.2	40.0	44.4	38.3	12.6	25.3	27.5	35.7
Total Fat (gm)	40.8	40.3	37.3	55.0	67.7	110.1	29.4	19.6	47.3	28.5
Fat, % Calories	9.6	10.2	8.8	14.8	12.6	20.1	7.4	5.5	13.9	9.0
Total CHO (gm)	811	689	764	602	875	841	729	658	564	560
CHO, % Calories	84.5	77.4	80.4	72.0	72.2	68.4	81.8	82.1	73.4	78.5
Calcium (mg)	259	319	245	205	345	529	222	230	139	205
Phosphorus (mg)	1,213	1,156	1,212	1,358	2,199	1,878	1,422	1,365	1,282	1,139
Iron (mg)	22.3	16.9	16.1	16.5	22.6	32.7	13.4	13.3	15.5	17.1
Vitamin A (I.U.)	993	2,248	196	4,791	1,835	8,874	1,328	4,193	4,422	2,141
Vitamin C (mg)	6	48	19	80	34	174	10	10	6	32
Riboflavin (mg)	0.72	0.83	0.73	0.69	0.84	1.09	0.66	0.51	0.62	0.45
Riboflavin (mg/1000 Cal)	0.19	0.23	0.19	0.21	0.17	0.22	0.19	0.16	0.20	0.16
Thiamine (mg)	1.40	2.22	1.70	1.57	2.00	1.24	2.99	2.45	1.24	1.07
Thiamine (mg/1000 Cal)	0.36	0.62	0.45	0.47	0.41	0.25	0.84	0.76	0.40	0.38
Niacin (mg)	32.4	31.5	32.7	19.9	35.6	29.0	36.6	35.8	16.1	13.9
Niacin (mg/1000 Cal)	8.4	8.8	8.6	6.0	7.3	5.9	10.2	11.2	5.2	4.9

1/ These values corrected for undermilled rice and cooking losses.
2/ Day 1 in the field unit was an NCO group, day 2 an EM group.

429788 O - 62 - 14

TABLE 55-A. MEAN NUTRIENT INTAKE PER INDIVIDUAL PER DAY AMONG THE THAI MILITARY CALCULATED FROM STANDARD TABLES1/

Nutrients	ARMY							AIR FORCE	NAVY
	Bangkok	Songkhla	Chiengmai	Udorn	Ubol Camp	Ubol Field	Mean All Army	Lopburi	Sattaheep
No. of Men Studied	495	912	527	1,113	156	(46)	3,249	838	361
Total Calories	2,773	3,410	3,489	3,734	3,344	4,884	3,606	3,619	2,963
Total Protein (gm)	70.7	86.0	77.9	43.1	81.8	126.0	89.3	79.1	72.0
Protein, % Calories	10.2	10.1	8.9	10.0	9.8	10.3	9.9	8.7	9.7
Animal Protein (gm)	22.3	25.5	27.2	31.6	32.6	51.4	31.8	13.9	22.9
Animal Protein, % Calories	3.2	3.0	3.5	3.4	4.0	4.1	3.5	4.7	3.2
Total Fat (gm)	36.6	50.9	76.5	39.5	55.0	88.9	57.9	28.2	37.9
Fat, % Calories	11.9	13.4	19.7	9.5	14.8	16.4	14.3	5.5	11.5
Total Carbohydrate (gm)	548	632	598	755	602	858	666	737	562
Carbohydrate, % Calories	77.9	76.5	71.4	80.5	75.4	73.3	75.8	81.5	78.8
Calcium (mg)	410	397	532	274	205	437	376	226	172
Phosphorus (mg)	1,358	1,434	1,162	1,194	1,358	2,038	1,422	1,393	1,211
Iron (mg)	15.8	13.5	22.5	18.4	16.5	27.7	19.1	13.4	16.3
Vitamin A (I.U.)	1,464	6,345	5,761	1,145	4,791	5,355	4,144	2,760	3,282
Vitamin C (mg)	25	26	61	24	80	104	53	10	19
Riboflavin (mg)	0.56	0.85	0.95	0.76	0.69	0.96	0.80	0.59	0.53
Riboflavin (mg/1000 Cal)	0.20	0.25	0.27	0.20	0.21	0.20	0.22	0.16	0.18
Thiamine (mg)	1.01	2.31	3.03	1.77	1.57	1.62	1.89	2.72	1.16
Thiamine (mg/1000 Cal)	0.36	0.68	0.87	0.47	0.47	0.33	0.53	0.75	0.39
Niacin (mg)	15.5	32.9	35.5	32.2	19.9	32.3	28.1	36.2	15.0
Niacin (mg/1000 Cal)	5.6	9.6	10.2	8.6	6.0	6.6	7.8	10.0	5.1

1/ These values corrected for undermilled rice and cooking losses.

TABLE 56-A. NUTRIENT INTAKE PER INDIVIDUAL PER DAY AMONG THE THAI MILITARY BY FOOD COMPOSITE ANALYSES

Nutrients	ARMY							AIR FORCE	NAVY	Mean All Units
	Bangkok	Songkhla	Chiengmai	Udorn	Ubol Camp	Ubol Field 1/	Mean All Army	Lopburi	Sattaheep	
No. of Men Studied	495	912	527	1,113	156	(46)	3,249	838	361	4,402
Total Calories	2,930	2,609	2,869	3,784	2,431	3,362	2,998	2,977	2,608	2,947
Total Protein (gm)	58.6	70.9	87.1	109.1	67.0	149.6	90.4	67.9	64.6	84.4
Protein, % Calories	8.0	10.9	12.1	11.5	11.4	17.8	12.0	9.1	9.9	11.4
Protein (gms/kg) 2/	1.06	1.28	1.57	1.97	1.21	2.70	1.63	1.23	1.17	1.52
Total Fat (gm)	57.3	22.4	46.7	16.4	28.1	58.2	38.2	24.9	27.7	35.2
Fat, % Calories	17.6	7.7	16.6	3.9	10.8	15.6	12.0	7.5	9.6	11.1
Total Carbohydrates (gm)	545	531	525	800	455	560	569	620	525	570
Carbohydrates, % Calories	74.4	81.4	73.2	84.6	77.7	66.6	76.3	83.3	80.5	77.7
Ash (gm)	38.8	38.7	22.6	40.3	45.5	58.0	40.7	39.8	51.0	41.9
Crude Fiber (gm)	14.7	16.3	16.3	9.8	13.0	13.9	14.0	18.2	3.0	13.2
Calcium (mg)	586	1,392	636	600	152	1,226	765	455	351	675
Iron (mg)	59.0	53.5	56.3	87.0	60.3	70.0	64.3	48.1	70.2	63.0
Vitamin A (I.U.) (Includes carotene)	<1,456	<1,715	<1,692	<1,509	<1,908	<2,482	<1,802	<2,005	<1,540	<1,795
Thiamine (mg)	1.43	3.87	1.39	0.95	1.63	1.40	1.78	2.38	1.18	1.78
Thiamine (mg/1000 Cal)	0.49	1.48	0.48	0.25	0.70	0.42	0.64	0.80	0.45	0.64
Riboflavin (mg)	0.84	1.29	1.07	0.36	0.96	1.13	0.94	1.04	0.48	0.90
Riboflavin (mg/1000 Cal)	0.29	0.49	0.37	0.10	0.41	0.34	0.33	0.35	0.18	0.31
Niacin (mg)	31.4	41.4	35.4	19.6	38.5	29.4	32.6	49.8	22.9	33.5
Niacin (mg/1000 Cal)	10.7	15.7	12.3	5.2	16.4	8.7	11.5	16.7	8.9	11.8
Vitamin C (mg)	37	32	28	25	21	48	32	29	18	30
Fluoride (mcg)	195	250	119	276	126	298	211	186	244	212
Iodine (mcg)	130	139	69	124	-	-	116	89	-	112
Salt (gm)	23.0	21.7	10.8	18.2	7.5	21.3	17.1	27.5	14.4	18.1

1/ Omitted as a separate group from figures in main report, but included in totals in figures.
2/ Utilizing the mean weight of 55.4 kg for 4,324 military personnel.

TABLE 57-A. PLATE WASTE AMONG THAI MILITARY GROUPS--PERCENT DISCARDED PER UNIT PER DAY

FOOD	Bangkok	Songkhla	Chiengmai	Lopburi	Udorn	Ubol Camp	Ubol Field	Sattabeep
Green Beans	58.4	13.3	27.7	--	--	--	--	32.3
Cucumbers	32.2	59.7	30.1	--	--	--	--	--
Green Onions	44.5	28.5	26.6	--	24.5	30.0	46.3	40.3
Chinese Celery	47.0	--	--	--	--	--	--	--
Mung Bean Sprouts	11.5	--	17.0	--	--	--	--	--
Bamboo Shoots	8.1	28.0	27.6	45.8	58.6	--	--	--
Coconut Shredded	35.0	46.2	9.8	23.3	26.0	--	61.5	42.8
Cabbage, Chinese	--	18.5	53.4	--	27.6	--	22.5	31.7
Cabbage, Swamp	--	14.8	11.5	26.8	--	--	--	42.7
Onions, Common	--	64.5	32.5	--	19.0	--	--	40.3
Tomatoes, Green	--	--	--	43.0	--	--	--	--
Wax Gourd	--	--	47.8	--	32.5	--	--	--
Ka Leaves	--	--	43.2	--	--	--	--	--
"Poo" Beans	--	--	--	28.2	--	--	--	--
Egg Plant	--	--	25.7	42.4	27.7	--	58.8	39.1
Sweet Potato	--	--	--	--	--	34.0	--	--
Squash	--	--	31.2	--	--	--	--	--
Basil	58.3	--	--	--	20.0	--	--	--
Lime Leaves	42.8	46.3	--	--	28.0	20.0	--	42.7
Pepper, Black	--	20.6	22.1	--	--	--	--	--
Pepper, Chili	51.0	38.5	6.0	40.3	27.2	--	--	57.6
Garlic	39.4	34.5	41.0	45.6	--	--	45.0	26.8
Gachai	58.3	--	15.6	--	--	--	--	--
Kha	52.5	85.0	38.0	--	15.5	20.0	--	--
Tamarind	52.0	12.8	3.2	38.0	--	--	--	42.7
Turmeric	--	85.0	--	--	--	--	--	--
Mushrooms, Dry	--	20.6	13.0	--	--	--	--	40.0
Mint	--	--	--	24.3	--	34.0	--	24.5
Ginger	--	--	28.0	--	--	--	--	--
Lemon Grass	--	85.0	31.8	--	34.4	35.4	72.4	--
Mung Bean, Dry	9.0	--	--	--	--	--	--	14.9
Rice	30.4	31.1	30.6	16.1	17.6	20.6	36.1	23.8
Noodles, Mung Bean	--	20.7	13.3	--	--	--	--	26.6
Pineapple	40.0	--	--	--	--	--	--	--
Limes	--	27.4	--	92.7	19.7	--	57.6	--
Papaya, Green	--	--	--	--	--	--	71.6	--
Sugar, Palm	33.3	34.8	30.2	34.3	29.7	--	--	35.3
Soy Sauce	44.3	--	--	--	--	--	--	22.8
Fish Sauce	--	34.7	42.2	28.8	38.1	27.2	33.2	40.6
Red Chili Paste	23.9	39.8	29.0	43.2	39.2	34.0	64.1	37.7
Salt	--	35.2	39.8	--	19.0	--	--	--
Chicken	40.0	--	--	--	--	--	--	--
Eggs	--	21.1	29.6	--	--	--	--	--
Pork	29.6	--	8.4	18.8	--	--	35.6	39.0
Pork Skin	--	--	11.0	--	--	--	--	--
Water Buffalo	--	26.7	--	31.0	12.0	14.7	58.9	31.3
Water Tripe	--	86.2	--	--	15.5	--	--	--
Shrimp	9.0	12.7	13.0	--	--	--	--	--
Fish, Fresh	35.2	38.2	--	11.5	18.1	--	68.7	50.0
Fish, Fermented	--	25.1	--	--	27.0	--	72.6	--
Edible Oils	50.6	27.0	41.9	18.7	30.2	--	45.1	30.4

TABLE 56-A. PERCENT PREPARATION WASTES (INEDIBLE) AT VARIOUS THAI MILITARY UNITS

	ARMY					AIR FORCE	NAVY
General Area	Bangkok	Songkhla	Chiengmai	Udorn	Ubol	Lopburi	Sattaheep
FOOD ITEMS							
Green Onions	40.0		40.0	11.3	14.7		
Celery, Chinese	89.0						
Cabbage, Common			30.6				
String Beans	3.8		13.0				
Cucumbers	8.9	6.2	21.6		26.6		
Sweet Potatoes		29.3			38.7		
Coconut, Shredded		41.9		46.7		49.5	77.5
Onions, Common		80.0	20.0	16.7			
Peppers, Fresh		13.8	6.0				
Swamp Cabbage		38.0					20.0
Chinese Cabbage		24.8	25.2	13.8	13.5		
Wax Gourd			39.6	38.7			
Squash			38.9				
Eggplant			1.3	20.5			14.9
Fish, Fresh	45.3	34.3		23.6		4.5	36.4
Chicken	39.8		5.0	38.1	25.8		
Shrimp		22.7					
Eggs, Shelled			12.5	10.1			
Water Buffalo							25.3
Rice, Burnt	4.6	3.6			6.4	2.8	
Khu	22.2						
Pineapple	22.7						
Limes				70.0			
Tacrite	23.5						
Garlic		43.5	50.0				
Tamarind		68.3				50.0	70.0
Chili Peppers		21.1		8.3			27.3
Kare	22.2		60.8				
Lemon Grass			25.0	32.7	16.7		
Lime Leaves	33.3						
Mint							46.4

TABLE 59-A. MAJOR FOOD ITEMS CONSUMED DAILY AMONG THE THAI MILITARY BY LOCATION

Food Items	ARMY					AIR FORCE	NAVY	Mean All Units
	Bangkok	Songkhla	Chiengmai	Udorn	Ubol	Lopburi	Sattaheep	
	Gms/Man/Day							
Rice	582	890	711	907	922	840	674	775
Cereals, other	35.0	6.0	5.0	0.0	24.5	0.0	36.7	15.3
Beef (Water buffalo)	31.7	44.6	66.2	71.2	126.5	15.4	43.1	57.0
Pork	7.6	0.0	90.0	0.0	35.2	14.1	26.6	24.8
Chicken	22.6	0.0	7.9	8.2	33.3	0.0	0.0	10.3
Fish	54.6	73.6	8.5	54.6	28.0	29.6	16.0	37.8
Fish Sauce	31.5	12.4	4.0	17.7	28.7	29.3	41.0	25.3
Red Curry Paste	37.0	9.6	11.6	5.0	9.0	20.8	12.8	15.1
Soybean Paste	0.0	2.0	8.3	0.0	0.0	0.0	0.0	1.5
Oil, edible	4.7	26.4	10.6	3.7	7.6	2.3	5.7	8.7
Eggs	0.0	2.0	0.9	18.1	0.0	0.0	32.3	7.6
Vegetables	218	229	354	109	259	211	110	213
Fruits	46.0	10.0	0.0	3.0	3.3	3.3	0.0	9.4
Condiments[1/]	7.8	18.6	20.1	21.4	14.3	7.8	30.0	17.1
Sugar	6.9	15.1	1.6	1.5	3.2	9.8	11.0	7.0
Salt	0.0	5.5	2.5	0.4	0.0	0.0	0.0	1.1

1/ Condiments include garlic, tamarind, hot chili, basil, mint, black pepper, green onions, lime leaves, lemon grass, etc.

TABLE 60-A. MAJOR FOOD ITEMS CONSUMED DAILY AMONG THE THAI MILITARY - MEANS FOR ALL UNITS COMBINED

Food Items	Gms/day	Food Items	Gms/day
Rice	775.0	Vegetables	
Rice Noodles	4.1	Egg Plant	30.0
Mung Bean Noodles	10.1	Tomatoes, Green	3.7
Mung Beans, Dried	3.0	Kare Leaf	4.0
Tapioca Flour	0.5	Onions, Common	1.5
Beef (Water Buffalo)	57.0	Onions, Green	7.7
Pork	24.8	Celery, Chinese	0.8
Chicken	10.3	Mung Bean Sprouts	8.8
Fish	37.8	Bamboo Shoots	16.0
Fish Sauce	25.3	Coconut, Shredded	12.0
Red Chili Paste	15.1	String Beans	14.5
Soy Bean Paste	1.5	Cucumbers	29.0
Oil, Edible	8.7	Sweetpotatoes	9.0
Eggs	7.6	Chinese Cabbage	37.0
Sugar	7.0	Swamp Cabbage	8.7
Condiments[1/]		Common Cabbage	8.7
Salt	1.1	Wax Gourd	10.0
Mint	1.3	Yellow Squash	6.3
Basil	0.1	"Poo" Beans	5.8
Garlic	1.7	Pickled Cabbage	0.2
Caa Tuber	0.6	Fruits	
Tacrite	0.1	Pineapple	5.3
Lime Leaves	0.5	Limes	3.4
Tamarind	1.2	Papaya, Green	1.8
Kachai	0.1		
Mushrooms, Dried	0.3		
Lemon Grass	0.7		
Turmeric	0.1		
Ginger	0.2		
Vinegar	1.4		

1/ Each unit used at least 10 different condiment-type foods daily.

TABLE 61-A. MAJOR FOOD SOURCES OF INDIVIDUAL NUTRIENTS[1/2/3/] AMONG THE THAI MILITARY - PERCENT MEANS FOR ALL UNITS COMBINED

Food Items	Calories	Protein	CHO	Fat	Calcium	Iron	Vitamin A	Thiamine	Riboflavin	Niacin	Vitamin C	Phosphorus
	Percent of Total											
Rice	81.6	63.5	94.9	15.3	37.3	48.8	0.0	68.5	41.9	66.3	0.0	67.8
Noodles (Rice and mung bean)	1.0	1.2	1.7	0.2	0.3	0.6	0.0	0.7	0.0	0.7	0.0	1.9
Beef (Water Buffalo)	4.5	12.3	0.0	25.0	1.8	8.3	0.7	3.4	12.2	7.9	0.0	8.0
Pork	3.3	3.7	0.0	22.3	0.6	2.2	0.0	9.6	5.4	1.7	0.0	3.7
Chicken	0.9	2.2	0.0	5.0	0.3	1.4	2.5	0.7	2.7	2.6	0.0	1.9
Fish	1.3	9.6	0.0	0.4	8.4	1.7	0.0	1.4	5.4	8.3	0.0	7.1
Fish Sauce	0.4	3.1	0.1	0.0	2.7	3.9	0.0	0.0	2.6	3.6	0.0	0.8
Red Chili Paste	0.6	1.4	0.5	1.4	0.8	7.2	1.3	2.1	2.7	1.0	0.0	0.0
Oil, Edible	2.2	0.0	0.0	17.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eggs	0.3	1.2	0.0	1.8	1.2	1.1	2.6	0.7	2.7	0.0	0.0	0.0
Sugar	0.8	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Egg Plant	0.2	0.0	0.3	0.2	2.1	1.1	1.1	2.7	2.7	0.7	1.9	0.8
Tomatoes, Green	0.0	0.0	0.0	0.0	0.0	0.6	0.3	0.0	0.0	0.0	0.0	0.0
Onions, Green	0.1	0.2	0.1	0.0	0.6	0.0	0.0	0.0	0.0	0.0	5.8	0.0
Mung Bean Sprouts	0.2	0.0	0.2	0.2	0.0	0.0	0.1	0.7	4.1	0.3	5.8	1.0
Bamboo Shoots	0.1	0.0	0.0	1.4	0.9	0.6	0.0	4.1	1.4	0.3	0.0	0.7
Coconut, Shredded	1.1	0.5	0.2	7.4	0.6	1.1	0.0	0.0	0.0	0.0	0.0	0.9
String Beans	0.2	0.5	0.2	0.2	0.3	1.1	3.8	0.7	2.7	4.0	0.0	2.9
Cucumbers	0.1	0.2	0.1	0.0	0.9	0.6	0.0	0.7	1.4	0.0	3.9	0.7
Sweet Potatoes	0.3	0.2	0.4	0.2	0.9	0.6	21.2	0.7	0.0	0.3	3.9	0.5
Cabbage	0.3	0.0	0.4	0.4	27.2	19.4	61.1	2.7	10.8	2.0	73.1	1.9
Yellow Squash	0.1	0.0	0.1	0.0	0.3	0.0	4.3	0.0	0.0	0.0	0.0	0.3
Wax Gourd	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.7	1.4	0.0	1.9	0.1
Hyacinth Beans	0.1	0.0	0.1	0.0	0.9	0.6	0.7	0.0	0.0	0.0	1.9	0.2
Pineapple	0.1	0.0	0.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.9	0.0
Condiments, etc. (Remainder)	-	-	-	-	-	-	-	-	-	-	-	-

1/ as calculated from standard food tables
2/ See Table 60-A for gms of each food item consumed.
3/ Note that Table 67-A presents data on nutrient contribution by rice for Army only.

TABLE 62-A. BASIC DAILY RATION ALLOWANCE FOR ALL THAI MILITARY UNITS

Rice (unmilled) Regular or Glutinous	1,000 gms
Meat, (Pork, Fish or Poultry)	150 gms
Vegetables, Fresh	500 gms

Other items can vary depending on the daily Master Menu.

A 10-day average of these items is as follows:

Fish Sauce	82.0 gm/man/day
Lard	17.0 "
Salt	1.0 "
Shrimp Paste	2.5 "
Sugar, Palm	11.6 "
Vinegar	10.0 "
Coconut, Shredded	59.0 "
Tamarind, Pulp	7.6 "

TABLE 63-A. DISTRIBUTION OF RATIONS FOR AN ARMY FIELD UNIT AT UBOL, THAILAND[1/]

DAY I

Breakfast

1 Salted Egg
300 gms of Undermilled Rice

Lunch

Salted Beef, 1 Piece
Hot Chili
Dried Onions
400 gm Undermilled Rice

Dinner

1/10 of a Whole Chicken
300 gm Undermilled Rice[2/]

DAY II

Breakfast

1/10 of a Whole Chicken
Fermented Fish
300 gm Undermilled Rice

Lunch

Fermented Fish
Salted Egg
Salted Beef
400 gm Undermilled Rice

Dinner

Salted Egg
Canned Beef
Condiments
300 gm Undermilled Rice

1/ In the field, NCO's received 10 baht/day for food, no pocket money.
In the field, EM's received 7 baht/day, 1 for pocket money.

NCO's received polished rice } Cooks must prepare for both
EM's received undermilled rice } groups who usually eat together.

2/ The waste was approximately 300 gm of cooked rice/man/day.

TABLE 64-A. MINERAL COMPOSITION OF WATER AND SALT SAMPLES (MILITARY SOURCES)

WATER SAMPLES	Fluoride mcg/100 ml	Calcium mg/100 ml	Salt (NaCl) mg/100 gm
Bangkok	0	1.1	0.6
Songkhla	7	1.4	20.3
Chiengmai	20	1.4	0.0
Lopburi	24	2.4	0.0
Udorn	16	0.8	0.0
Ubol	10	1.6	1.0
Sattaheep	20	2.4	11.2
SALT SAMPLES	mcg/100 gms	mg/100 gms	
Songkhla	97	109.0	
Udorn	159	155.0	
Ubol	156	67.0	

TABLE 65-A. CHEMICAL ANALYSES OF INDIVIDUAL FOODS - OBTAINED FROM THAI MILITARY UNITS

Sample No.	Food Item	Calories	Water	Protein	Fat	Ash	CHO[1/]
				gms/100 gms			
41	Rice, Bangkok	360	13.33	3.80	3.60	1.16	78.11
41A	Rice, Bangkok, Army	355	12.39	5.78	1.85	1.26	78.72
42	Rice, Songkhla	356	14.60	5.32	3.55	0.93	75.60
43	Rice, Chiengmai	359	14.60	5.62	4.44	1.24	74.10
44	Rice, Lopburi	361	12.62	6.62	3.50	1.40	75.86
45	Rice, Udorn	359	14.02	6.36	3.37	0.47	75.78
46	Rice, Udorn	366	13.92	5.81	4.89	0.75	74.63
47	Rice, Ubol	357	13.31	6.12	3.24	1.54	75.79
48	Rice, Sattaheep	354	13.82	6.30	2.44	0.72	76.72
	Chinese Flower	352	13.50	7.28	3.79	3.28	72.15
	Mung Bean	QNS	12.22	17.49	QNS	0.91	QNS
	Kachin	140	70.21	6.46	4.94	1.05	17.34
	Swamp Cabbage	43	82.68	3.36	0.24	6.76	6.96
	Soy Bean, Fermented	QNS	42.19	QNS	QNS	22.46	QNS
	Sago Root	153	67.48	1.26	5.30	0.98	24.98
	Conchai Leaves	37	84.22	1.99	0.38	6.92	6.49
	Fish, Fermented	QNS	48.17	QNS	QNS	22.94	QNS
	Lemon Grass	QNS	73.72	QNS	QNS	12.40	QNS
	Lime Leaves	125	59.13	4.29	1.47	11.53	23.58
	Green Papaya	QNS	82.37	QNS	QNS	12.07	QNS
	Caa Tuber	QNS	76.52	QNS	QNS	12.25	QNS
	Poo Bean	QNS	79.94	QNS	QNS	12.01	QNS
	Egg Plant, Long	QNS	87.88	QNS	QNS	7.50	QNS
	Shredded Coconut	177	60.39	5.70	10.81	8.92	14.18
	Bamboo Shoots, Fermented	QNS	84.56	QNS	QNS	9.04	QNS
	Red Chili Paste	121	56.00	4.30	2.43	16.70	20.57
	Tamarind	174	50.24	0.72	1.74	8.50	38.80
	Green Chili Paste	100	56.13	2.86	1.53	20.72	18.76
	Shrimp Paste	123	35.50	9.82	1.23	35.38	18.07
	Kachai	46	77.03	0.69	0.51	11.98	9.79
	Kamin	58	75.52	0.45	1.20	11.53	11.30
	Fish Sauce, Sattaheep	QNS	71.64	QNS	QNS	25.75	QNS
	Sauce, Songkhla	10	72.14	0.66	0.03	25.51	1.66
	Fish Sauce, Ubol	14	71.39	0.13	0.12	25.37	2.99
	Fish Sauce, Bangkok	QNS	68.90	QNS	QNS	24.60	QNS
	Fish Sauce, Chiengmai	14	71.74	0.49	0.06	24.73	2.98
	Fish Sauce, Lopburi	13	72.08	0.88	0.04	24.80	2.20
	Nampla, Udorn	30	72.29	1.23	2.80	25.30	0.0
	Mushroom (hoonoo)	351	16.04	7.59	5.19	2.72	68.46
	Pork Skin	QNS	12.13	QNS	QNS	QNS	QNS

1/ By difference

(Continued on next page)

TABLE 65-A. (CONTINUED - page 2) CHEMICAL ANALYSES OF INDIVIDUAL FOODS - OBTAINED FROM THAI MILITARY UNITS

Sample No.	Food Item	Iron mg/100 gms	Thiamine mcg/100 gms	Niacin mg/100 gms	Pyridoxine mcg/100 gms
41	Rice, Bangkok	0.31	438	4.60	330
41A	Rice, Bangkok, Army	0.32	505	3.49	638
42	Rice, Songkhla	0.46	590	5.45	550
43	Rice, Chiengmai	0.31	343	6.26	494
44	Rice, Lopburi	0.34	628	3.22	490
45	Rice, Udorn	1.43	91.7	1.40	153
46	Rice, Udorn	0.33	162	5.29	263
47	Rice, Ubol	0.65	308	4.35	453
48	Rice, Sattaheep	0.36	158	2.02	350
	Chinese Flower	3.22	< 36	2.80	120
	Mung Bean	4.05	150	2.20	370
	Kachin	0.57	235	2.68	342
	Swamp Cabbage	0.88	123	3.04	236
	Soy Bean, Fermented	26.55	123	1.63	242
	Sagu Root	0.28	QNS	4.30	180
	Conchai Leaves	0.12	64.8	1.78	113
	Fish, Fermented	1.74	28	1.52	< 10
	Lemon Grass	3.48	22	< 0.41	24.1
	Lime Leaves	0.27	87.1	2.86	1,140
	Green Papaya	0.75	QNS	0.77	14.3
	Caa Tuber	0.75	32	< 0.40	53.2
	Poo Bean	0.48	234	0.92	67.3
	Egg Plant, Long	11.86	30.8	0.82	34.4
	Shredded Coconut	0.06	< 19	1.22	49.8
	Bamboo Shoots, Fermented	0.50	13.1	< 0.28	38.4
	Red Chili Paste	0.33	64.3	1.64	778
	Tamarind	0.69	215	2.27	206
	Green Chili Paste	2.90	63.4	3.29	520
	Shrimp Paste	1.71	< 36	3.45	26.4
	Kachai	0.99	36.3	0.94	81.4
	Kamin	2.22	27.6	< 0.44	47.4
	Fish Sauce, Sattaheep	0.13	< 5.8	< 0.26	5.1
	Sauce, Songkhla	0.25	< 5.1	< 0.22	4.0
	Fish Sauce, Ubol	0.34	< 8.0	< 0.25	3.4
	Fish Sauce, Bangkok	0.08	< 6.8	0.97	20.0
	Fish Sauce, Chiengmai	0.29	< 4.1	0.50	< 1.7
	Fish Sauce, Lopburi	0.31	< 5.3	0.45	< 3.3
	Nample, Udorn	0.33	< 4.2	0.55	10.5
	Mushroom (hoonoo)	7.53	QNS	1.73	58.4
	Pork Skin	1.42	< 96	1.18	< 4.9

TABLE 66-A. BOMB CALORIMETRY COMPARISONS FOR TOTAL CALORIES WITHIN THE THAI MILITARY

	Dry Weight of Food Composite (gms)	Total Calories/Man/Day		
		By Bomb Calorimetry		Using 4-9-4[1/]
		Calories/gm (dry weight)	Total Calories	Total Calories
Bangkok	713	4.33	3,087	2,930
Songkhla	687	4.26	2,889	2,609
Chiengmai	695	4.52	3,141	2,869
Udorn	976	4.09	3,992	3,784
Ubol	610	5.03	3,068	2,431
Lopburi	716	4.27	3,057	2,977
Sattaheep	671	3.87	2,596	2,608
Mean			3,119	2,887
Difference				232
Combat Ration	423	3.79	1,603	1,900

1/ Protein and carbohydrate: 4 Calories/gm; fat: 9 Calories/gm.

TABLE 67-A. QUANTITIES AND PROPORTIONS OF NUTRIENTS CONTRIBUTED BY RICE ALONE WITHIN THE THAI ARMY[1/]

	Quantity	Percent of Total
Calories	2,700	74.9
Protein	51.4 gms	57.6
Fat	6.1 gms	10.5
Iron	6.1 mg	31.9
Calcium	45.0 mg	12.0
Vitamin A	0.0 I.U.	0.0
Thiamine	0.83 mg	43.9
Riboflavin	0.22 mg	27.5
Niacin	11.5 mg	40.9
Vitamin C	0.0 mg	0.0

1/ As calculated from standard food tables.

TABLE 68-A. MEAN INDIVIDUAL NUTRIENT INTAKES PER MAN PER DAY - COMPARISON OF THE THAI MILITARY WITH RESULTS OF ICNND STUDIES IN MILITARY GROUPS OF OTHER FAR EASTERN COUNTRIES[1/]

INDIVIDUAL NUTRIENTS	Republic of China (Taiwan)		Republic of Korea	Republic of Vietnam	Republic of Philippines	Kingdom of Thailand
	1954	1960	1957	1959	1958	1960
Total Calories	3,610	2,857	3,814	3,123	2,638	2,947
Protein (gm)	95	93	127	100	105	84
Protein, % Calories	10.5	13.7	13.3	12.8	15.9	11.4
Fat (gm)	77	38	43	45	30	35
Fat, % Calories	19.2	11.8	10.2	12.9	10.2	11.1
Carbohydrate (gm)	630	539	730	580	488	570
Carbohydrate, % Calories	70.3	75.2	76.5	74.3	73.9	77.7
Calcium (mg)	697	957	780	850	1,054	675
Iron (mg)	23.9	50.6	34.0	32.0	26.0	63.0
Iodine (mg)	-	-	-	1.25	-	0.11
Salt (gm)	15.6	12.9	20.1	13.7	-	18.1
Vitamin A (I.U.)	6,155	2,835	1,218	3,101	2,496	< 1,795
Thiamine (mg)	1.43			0.75	1.01	1.78
Thiamine (mg/1000 Cal)	0.40	0.38	0.55	0.24	0.39	0.64
Riboflavin (mg)	0.86			1.13	0.75	0.90
Riboflavin (mg/1000 Cal)	0.24	0.80	0.26	0.38	0.28	0.31
Niacin (mg)	18.0	25.5	21.1	17.8	19.0	33.5
Vitamin C (mg)	68	17	55	47	43	30
Rice Intake (gm)	620			525	129	775

1/ As determined by chemical analyses of food composites.

TABLE 69-A. SUGGESTED GUIDE TO INTERPRETATION OF NUTRIENT INTAKE DATA (based primarily on the young adult male)1/

	"Deficient"	"Low"	"Acceptable"	"High"
Protein (gms/person/kg)	< 0.50	0.50-0.99	1.00-1.49	1.50+
Calcium (mg/person/day)	< 300	300-399	400-799	800+
Iron (mg/person/day)	< 6.0	6.0-8.9	9.0-11.9	12.0+
Vitamin A (I.U./person/day)	< 2,000	2,000-3,499	3,500-4,999	5,000+
Vitamin C (mg/person/day)	< 10.0	10.0-29.9	30.0-49.9	50.0+
Thiamine (mg/1,000 calories)	< 0.20	0.20-0.29	0.30-0.49	0.50+
Riboflavin (mg/person/day)	< 0.70	0.70-1.19	1.20-1.59	1.60+
Niacin (mg/person/day)	< 5.0	5.0-9.9	10.0-14.9	15.0+

1/ Standards of the ICNND Manual

2. Civilian Dietary Survey

A dietary survey of the civilian population was conducted by the civilian dietary team. Information was obtained on the amounts of food consumed by families and the average intake of nutrients. Composite food samples were collected for chemical analysis to provide additional information on average nutrient intakes. The civilian dietary team consisted of one nutritionist from the United States, five dietitians from Thailand, and a FAO nutritionist assigned to Thailand.

Food intakes were determined on families located in nine villages representing five major areas in Thailand. The villages of Bang Dan and Don Kee Leg were located in southern Thailand, Ban Fon and San Pong were located in northwest Thailand, Ta Kae in central Thailand, Phon Ngam and Marg Yah in northeast Thailand, and Sri Kai and Ban Kao in eastern Thailand. A total of 93 families was observed in the nine villages, representing approximately 20 percent of the civilians examined clinically in each area. The population sample included 513 persons to determine the average food intakes. In addition, 24 infants less than one year of age were a part of the total population sample of 537 people.

a. Methods used

Food intakes were determined by detailed family dietary surveys. Each dietitian was assigned one or two families each day. She weighed and recorded all food prepared for the family and all leftover food or food not consumed by the family. Each family was surveyed one or two days, depending on the availability of time in each location. During each family dietary survey, the dietitian also completed the standard ICNND questionnaire for recording information about each family concerning age, sex, lactating or pregnant women, foods purchased, infant feeding, menu patterns, and foods consumed in other seasons.

The average daily intake for each food item within a village was determined by tabulating the foods consumed by each family, obtaining the total amount of each food item consumed, and dividing by the number of person days, i.e., each person over one year of age was considered as a "person," regardless of sex or age with no further correction factors introduced. The nutrient intake was calculated using standard tables of food composition from the average daily food intakes for each village.

In addition to the recipe method for determining food intakes and the nutritional evaluations of the diet, a food composite sample was prepared to represent the average food intake for each village. Foods were purchased in the local markets, weighed out in proportion to the average amount consumed of each item, and blended with water for thorough mixing. After thorough mixing of the food composite, two portions, each representing 10 percent of the average daily intake of food per person, were weighed out and one was preserved with oxalic acid and the other with alcoholic potassium hydroxide, and placed in shipping containers. These samples were shipped to the United States for chemical analysis. In addition to the food composite samples, individual samples were taken of rice, salt, and water for each village. The rice and water samples were usually obtained from the families observed. Salt samples were obtained from the local market.

Within each village families were selected for dietary surveys at random with the assistance of the local public health officer and the village headman. Households which did not contain a typical family composition were excluded, such as widows, widowers, single individuals, or less than three in a household. Households which included two related families were treated as one household or one family.

In tabulating the daily nutrient intake, adjustments were made for estimated losses of thiamine, riboflavin, and niacin during food preparation and cooking. Considering the types of foods consumed, methods of preparation, and the average cooking losses as reported in the INNND manual, the factors used for correcting for cooking losses were 40 percent loss for thiamine, 10 percent loss for riboflavin, and 20 percent loss for niacin. Since the food composites for each village were made up with raw foods, the values obtained for chemical analysis were also corrected for normal cooking losses. For these samples, the adjustment for cooking losses were 25 percent loss for thiamine, 10 percent loss for riboflavin, and 20 percent loss for niacin. The thiamine factor was reduced to 25 percent loss because the food samples became hot during mixing with the blendor. It was assumed that the heat caused some thiamine destruction. Another factor which influenced the choice of these somewhat low loss factors was that glutinous rice, so commonly used, was not cooked in excess water and hence no nutrients were lost by discarding cooking water.

b. Food preparation

Rice was prepared by washing it two or three times with water, usually discarding the wash water, and then boiling it over a fire for about 30 minutes. Unfortunately, the excess water remaining after boiling was often also discarded. Glutinous rice was prepared by soaking it in water, usually overnight, before cooking; it was cooked with a minimum amount of water or steamed until soft. Rice was cooked only once or twice per day. In cooking, nonglutinous rice absorbed much more water than did glutinous rice. The cooked weight of regular rice was 2.5 to 3.0 times the dry, raw weight. However, for glutinous rice, the cooked weight was about 1.5 times the dry, raw weight. This difference in moisture content of cooked rice may explain why many people believe that glutinous rice provides more food value for heavy work.

Some of the following food dishes were frequently encountered, but it must be kept in mind that in most instances they made up a small proportion of the total food intake and some were geographically limited in use.

Fish curry was prepared by pounding onion, garlic, dried chilies, turmeric, and salt together, mixing with water, and cooking with fresh tamarind by boiling for about eight minutes. Then the seed and fibrous part of the tamarind were removed, salt fish added, and cooked for another ten minutes. Fresh fish curry was prepared by pounding shrimp paste, turmeric, and dried chilies together. These items were then mixed with coconut milk, placed in the cooking pot, tamarind added, and boiled for about ten minutes. Then the seed and fibrous part of the tamarind were removed, fresh fish added, and the curry boiled for about 15 minutes. In some cases, limes were used in place of tamarind and sea salt was frequently used. Fish was prepared on some occasions by pounding dried chili peppers, garlic, and salt together, and spreading this mixture on both sides of the fish. The fish was then smoked over a fire until cooked.

Beef curry was prepared by pounding dried chilies, onion, garlic, shrimp paste, and salt together. The beef was boiled in coconut milk until tender, and then the pounded ingredients, sliced bamboo shoot, and sliced green peppers were added and the mixture cooked for about 15 minutes.

Dried fish sour soup was prepared by pounding shrimp paste, dried chili, turmeric, salt, garlic, and onion together and boiling with water. Dried fish, sliced eggplant, and the extract of young tamarind pulp were added and cooked until done. Total cooking time was about one hour.

Chicken curry was prepared by pounding dried chilies, fresh chili, onion, garlic, salt, and shrimp paste together. These ingredients were mixed with some coconut milk in an iron pan and heated with the chicken, then more coconut milk was added and the mixture boiled for about 20 minutes.

629788 O - 62 - 15

Bamboo-shoots-with-coconut-milk soup was prepared by cooking the sliced bamboo shoots in coconut milk, adding ripe tamarind, and boiling for about 15 minutes.

Kee-Leg-leaves soup was prepared by pounding salt, lemon grass, peppers, turmeric, onion, garlic, and shrimp paste together, mixing with coconut milk, and boiling for a few minutes; then the leaves of the Kee Leg tree were added and cooked until tender.

Frog curry was prepared by smoking the frog over the fire, pounding salt, shrimp paste, fermented fish, fermented soybean, fresh pepper, turmeric, and lemon grass together and boiling with water. The frog was chopped and cooked with the other ingredients for about ten minutes.

Pumpkin soup was prepared by peeling and slicing the pumpkin, pounding green pepper, fermented fish, fermented soybeans, and salt together, and boiling all ingredients until the pumpkin was tender.

Pork soup with Chinese cabbage was prepared by boiling fermented soybean, fermented fish, fresh soybean paste, diced pork, and sliced cabbage for about ten minutes.

Sesban-cassia-flowers-and-leaves sour soup (Sesbania grandiflora) was prepared by cooking fish and removing the bone, pounding the meat with lemon grass, dried chilies, garlic, "Kra Chai," and onion, and boiling these ingredients. Then fermented fish, sesban cassia flowers and leaves, and the extract of tamarind pulp were added and cooked further. Cooking time was about 30 minutes.

Fermented soybean was prepared by cooking the seed for two to three hours, and fermented for two to three days. The fermented seed was pounded into a paste, wrapped in banana leaves, steamed for one hour, and dried in the sun. This product would keep in a satisfactory condition for about five to ten days.

c. Results

The average daily intake of nutrients for the family dietary surveys of each village as determined by calculations using tables of food composition and chemical analyses of composite food samples is shown in Tables 70-A and 71-A. Only small differences existed between the average nutrient intakes as determined by the two methods. The average caloric intake was 1,770 calories per person per day based on chemical analyses of composite food samples. This intake is slightly below the calculated caloric requirement of the sampled population. The average protein intake was 47.2 gms per day, which is slightly above the estimated protein allowance for this population. Thirty-one percent of the protein came from animal products and total protein provided 10.8 percent of the calories consumed.

According to our observations and records, breast feeding of infants is <u>not</u> being discontinued in favor of sweet condensed milk. The use of condensed milk was observed in a number of places to supplement breast feeding and to feed the one- or two-year-old child when the breast milk had to be reserved for a new infant. One case was observed where two young children (not twins) of one woman were both being breast fed. A lot of the sweetened condensed milk sold in Thailand is used with coffee for the adults. It would be better to import evaporated milk in place of sweetened condensed milk, since evaporated milk would provide more milk protein for the money. However, it has to be recognized that sweetened condensed milk will keep much longer without refrigeration after the can has been opened.

The average calcium intake was 266 mg per person per day, a distinctly marginal intake. Some lime paste was consumed with betel nut leaves which was not recorded during the dietary survey. The average intake of iron of 23 mg was quite satisfactory.

TABLE 70-A. NUTRIENT INTAKE PER INDIVIDUAL PER DAY AMONG THE THAI CIVILIANS CALCULATED FROM STANDARD FOOD TABLES

VILLAGE	No. of families	No. of Persons	Calories	Total Protein		Animal Protein		CHO (gms)	Fat (gms)	Calcium (mg)
				Total Protein (gms)	% of Total Calories	Animal Protein (gms)	% of Total Protein			
Bang Dan	11	53	1,592	56.9	14.3	28.9	50.8	280	25	144
Don Kee Leg	12	54	1,975	53.9	10.9	18.6	34.5	324	54	156
Average (Songkhla)			1,784	55.4	12.4	23.8	43.0	302	40	150
Ban Fon	9	43	1,797	44.3	9.9	7.8	17.6	379	19	330
San Pong	10	53	1,600	41.9	10.5	12.6	30.1	326	11	372
Average (Chiengmai)			1,699	43.1	10.1	10.2	23.7	353	15	351
Ta Kae (Lopburi)	11	60	1,519	46.6	12.3	18.5	39.7	274	22	272
Phon Ngam	10	61	1,875	48.3	10.3	12.9	26.7	396	6	331
Marg Yah	10	66	2,083	49.0	9.4	10.5	21.4	435	12	308
Average (Udorn)			1,979	48.7	9.8	11.7	24.0	416	9	320
Sri Kai	10	62	1,849	42.7	9.2	7.5	17.6	395	6	259
Ban Kao	10	61	2,107	57.9	11.0	19.5	33.7	426	8	326
Average (Ubol)			1,978	50.3	10.2	13.5	26.8	411	7	293
All Groups Combined	93	513	1,821	49.1	10.8	15.2	31.0	359	18	278

	Phosphorus (mg)	Iron (mg)	Vitamin A (I.U.)	Thiamine (mg)[1]	Thiamine (mg/1000 Cal)[1]	Riboflavin (mg)[1]	Riboflavin (mg/1000 Cal)[1]	Niacin (mg)[1]	Vitamin C (mg)
Bang Dan	704	8	277	.36		.46		11	4
Don Kee Leg	726	12	1,114	.46		.53		12	38
Average (Songkhla)	715	10	696	.41	.23	.50	.28	11.5	21
Ban Fon	593	6	5,194	.76		.56		12	88
San Pong	631	10	3,126	.49		.33		11	49
Average (Chiengmai)	612	8	4,160	.63	.37	.45	.26	11.5	69
Ta Kae (Lopburi)	580	5	2,760	.37	.24	.42	.28	10	32
Phon Ngam	645	9	813	.47		.29		15	43
Marg Yah	661	10	1,038	.53		.36		14	14
Average (Udorn)	653	10	926	.50	.25	.33	.17	14.5	29
Sri Kai	583	11	574	.40		.26		12	9
Ban Kao	802	22	1,135	.49		.41		14	25
Average (Ubol)	692	17	855	.45	.23	.34	.17	13	17
All Groups Combined	658	10	1,781	.48	.26	.40	.22	15	34

1/ Corrected for cooking losses.

TABLE 71-A. NUTRIENT INTAKE PER INDIVIDUAL PER DAY AMONG THE THAI CIVILIANS - BY FOOD COMPOSITE ANALYSES

VILLAGE	No. of families	No. of Persons	Calories	Total Protein (gms)	Protein (gms/kg) 2/	CHO (gms)	Fat (gms)	Calcium (mg)
Bang Dan	11	53	1,527	53.0	1.67	277	23	100
Don Kee Leg	12	54	2,018	54.5	1.71	320	58	103
Average (Songkhla)			1,772	53.8	1.69	299	40.5	102
Ban Fon	9	43	1,733	53.5	1.68	354	12	568
San Pong	10	53	1,586	38.6	1.21	332	12	174
Average (Chiengmai)			1,660	46.5	1.46	343	12	371
Ta Kae (Lopburi)	11	60	1,474	39.0	1.23	298	14	143
Phon Ngam	10	61	1,760	40.5	1.27	380	9	363
Marg Yah	10	66	1,914	50.0	1.57	411	8	320
Average (Udorn)			1,837	45.0	1.42	396	8.5	342
Sri Kai	10	62	1,793	39.0	1.23	385	11	113
Ban Kao	10	61	2,130	56.3	1.77	457	9	508
Average (Ubol)			1,962	47.7	1.50	421	10	311
All Groups Combined	93	513	1,770	47.2	1.48	357	17.3	266

	Iron (mg)	Vitamin A (I.U.)	Thiamine (mg) 1/	Thiamine (mg/1000 Cal)	Riboflavin (mg) 1/	Riboflavin (mg/1000 Cal)	Niacin (mg) 1/	Vitamin C (mg)	Salt (gms)
Bang Dan	29	<2,500	.30		.36		7.89	12.0	7.85
Don Kee Leg	19	<2,500	.36		.45		9.22	33.8	8.25
Average (Songkhla)	24	<2,500	.33	.19	.41	.23	8.56	22.9	8.05
Ban Fon	40	<4,773	.68		1.12		10.66	30.6	10.40
San Pong	14	<3,849	.36		.40		6.66	37.3	4.08
Average (Chiengmai)	27	<4,311	.52	.31	.76	.46	8.66	34.0	7.24
Ta Kae (Lopburi)	19	<2,542	.36	.24	.52	.35	8.22	28.8	5.80
Phon Ngam	34	<3,000	.30		.45		9.42	22.8	6.70
Marg Yah	18	<2,500	.49		.38		11.54	23.8	12.68
Average (Udorn)	26	<2,750	.40	.22	.42	.23	10.48	23.3	9.69
Sri Kai	22	<2,500	.47		.36		11.34	17.0	9.00
Ban Kao	15	<2,500	.43		.43		13.28	28.8	17.03
Average (Ubol)	18.5	<2,500	.45	.23	.40	.20	12.31	22.9	13.02
All Groups Combined	23.3	<2,963	.42	.24	.50	.28	9.80	26.1	9.09

1/ Corrected for cooking losses.
2/ Utilizing the mean weight of 31.8 kg for 2,083 civilians of all ages and both sexes, excluding only pregnant and lactating women.

The average intake of vitamin A, using standard tables of food composition, was 1,781 International Units and based on analysis of composite food samples, it was less than 2,963. The concentration of vitamin A in the diluted food samples was too low to permit a more precise reading.

The average thiamine intake was 0.42 mg per day. Variations in thiamine intakes among villages were small, indicating a relatively consistent picture of low thiamine intake.

The intake of riboflavin was 0.50 mg per person per day, which is an unusually low intake; the values of riboflavin intake among villages were variable but consistently low.

The average daily intake of niacin based on chemical analysis was 9.8 mg per person per day. The average value determined from tables of food composition was about 50 percent higher.

The average vitamin C intake was 26.1 mg per person per day.

Table 76-A shows the average daily consumption of individual foods for the entire survey, and Table 77-A shows the contributions of each major food class to the total intake of each of the individual nutrients. In the villages surveyed, approximately three fourths of the rice consumed was glutinous rice. Six of the villages surveyed were located in areas where glutinous rice is commonly produced and consumed (the villages in the Chiengmai, Udorn, and Ubol areas); on the average 440 gms of dry rice were consumed per person per day by the families surveyed. The average daily intake of meat and fish was 63.8 gms with fish or fish products representing more than half of this food intake. Many kinds of vegetables were consumed in the various villages observed. The average intake of vegetables was 81.9 gms per person per day. The intake of fruits as measured by the dietary survey was very low. Fruits are generally expensive. The intake probably varies with the season of the year to some degree. Also, it was difficult to obtain a record of all fruit consumed; fruit is frequently used as a snack item, especially by the children.. The average salt intake (as salt itself) as measured during the survey was 2.4 gms per day. The salt intake from all sources based on the analysis of composite food samples indicated that the average was 9.09 gms.

Rice was the principal food in the diet. It provided 70 percent by weight of the food consumed and 87 percent of the calories. Rice, meat, fish, and vegetables represented 93 percent of the total food consumed and 95 percent of the calories consumed.

The chemical analyses of the rice samples collected during the survey indicated a consistent level of Calories per 100 gms of rice. The protein level varied among the samples. The average protein value for rice was lower than usually reported for rice. The nutrients contained in "new crop" glutinous rice were similar in amount to "old crop" rice which had been stored for about a year. When several samples of rice were analysed for their individual amino acid contents (see Table 81-A) it was interesting to note that glutinous rice had relatively more lysine and threonine--the amino acids usually considered to be limiting in rice--than were present in a sample of "ordinary" non-glutinous rice.

d. Summary

The civilian dietary survey team recorded food intakes on 93 families located in nine villages, representing 513 persons, not including infants. The villages were located in southern, northwestern, central, northeast, and eastern Thailand.

The average intake of calories, calcium, thiamine, riboflavin, and possibly vitamin A, appeared too low for optimal nutritional status. These individual nutrients are discussed in greater detail in the main report.

TABLE 72-A. ESTIMATED CALORIE REQUIREMENT PER CAPUT FOR THE THAI CIVILIAN POPULATION SAMPLE BY AGE GROUPS (Adults: Males, 51 kg; Females, 43.6 kg; age, 39 years)

Age Groups (Years)	Distribution No. of Subjects	Distribution Percent	Calories Required Per Caput	Proportionate Share of Calories
Infants	24	4.47	1,000	45
1 - 3	47	8.75	1,170	102
4 - 6	49	9.12	1,530	140
7 - 9	47	8.75	1,890	165
10 - 12	50	9.31	2,205	205
13 - 15				
Boys	16	2.98	2,790	83
Girls	19	3.54	2,340	83
16+				
Males	133	24.77	2,293	568
Females	152 1/	28.71	1,670	480
Total	537	100.00	1,871	1,871

1/ Includes 42 lactating or pregnant women. Calories needed for lactation included in requirement for infants.

TABLE 73-A. ESTIMATED CALORIE REQUIREMENTS PER CAPUT FOR THAI CIVILIAN FAMILIES IN EACH LOCATION BASED ON REQUIREMENTS OF EACH AGE GROUP

Age Groups (Years)	Songkhla %	Songkhla Cal 1/	Chiengmai %	Chiengmai Cal 1/	Lopburi %	Lopburi Cal 1/	Udorn %	Udorn Cal 1/	Ubol %	Ubol Cal 1/
Infants	2.7	27	4.0	40	3.2	32	7.3	73	3.9	39
1 - 3	8.2	96	8.0	94	6.5	76	11.7	137	7.8	91
4 - 6	8.2	126	18.0	275	4.8	73	6.6	101	7.8	119
7 - 9	8.2	155	7.0	132	12.9	244	10.2	193	7.0	132
10 - 12	9.1	201	10.0	221	6.5	143	10.2	225	9.4	207
13 - 15										
Boys	3.6	100	2.0	56	0.0	---	3.6	100	3.9	109
Girls	3.6	84	0.0	---	4.8	112	4.4	103	4.7	110
16+										
Males	25.5	585	24.0	550	22.6	518	23.4	537	27.4	628
Females	30.9	515	27.0	448	38.7	642	22.6	379	28.1	472
Total	100		100		100		100		100	
Calories per caput		1,889		1,816		1,840		1,848		1,907

1/ Proportionate share of calories per caput based on requirement as shown in Table 68-A.

TABLE 74-A. ESTIMATED PROTEIN REQUIREMENTS FOR THE THAI CIVILIAN POPULATION SAMPLE, BY AGE GROUPS (Adults: Males, 51 kg; Females, 43.6 kg; age, 39 years)

Age Group (Years)	Distribution		Protein Required		Proportionate Share of Protein per Caput
	No. of Subjects	Percent	Per kg 3/	Per Caput	
			Gms	Gms	
Infants	24	4.47	3.0	18	.80
1 - 3	47	8.75	2.5	25	2.19
4 - 6	49	9.12	2.0	28	2.55
7 - 9	47	8.75	1.5	27	2.36
10 - 12	50	9.31	1.5	39	3.63
13 - 15	35	6.52	1.5	50	3.26
16+					
Males	133	24.77	1.0	51	12.63
Females	152 1/	28.71	1.0 2/	51	14.64
Total	537	100.00		42.06	42.06

1/ Includes 42 lactating or pregnant women.
2/ Plus allowances for lactation and pregnancy.
3/ Note: Requirement per kg adapted from FAO Nutritional Studies No. 16 to provide approximately twice the minimum allowance of the reference protein.

TABLE 75-A. AVERAGE AMOUNTS OF SPECIFIC FOODS CONSUMED PER CAPUT FOR THAI CIVILIAN FAMILIES OF EACH VILLAGE

Village	Rice	Meat Fish	Eggs	Vegetables	Fruits	Fats	Salt	Misc.
				Gms				
Bang Dan	338	100	13	27	0	5.1	2.3	45
Don Kee Leg	369	69	9	92	1.4	2.4	3.6	122
Ban Fon	453	36	2	162	15.5	-	5.3	9
San Pong	445	63	2	108	10.0	1.7	1.9	9
Ta Kae	327	71	12	81	0.6	3.5	0.2	34
Phon Ngam	478	57	--	93	11.5	-	1.4	3
Marg Yah	536	50	--	66	-	-	1.9	1
Sri Kai	487	37	--	20	16.3	-	2.0	3
Ban Kao	529	96	--	92	-	-	2.9	4
Average	440	64	4	82	6	1.4	2.4	25

TABLE 76-A. AVERAGE DAILY CONSUMPTION OF INDIVIDUAL FOODS PER CAPUT FOR THAI CIVILIANS

Food	Gms
Rice:	
Regular, milled	85.7
Regular, home-pounded	33.1
Glutinous, milled	143.4
Glutinous, home-pounded	178.0
Total	440.2
Meat and Fish:	
Fish, fresh	23.7
Fish, fermented	10.5
Fish, dried	5.0
Shrimp	2.2
Chicken	6.9
Frog	4.9
Beef	8.3
Pork	1.0
Field Rat (ehen)	1.3
Total	63.8
Eggs:	
Duck	3.4
Hen	.8
Total	4.2
Vegetables:	
Chinese cabbage	14.4
Cucumbers	4.8
Bamboo shoots	7.1
Chili peppers	4.3
Eggplant	2.7
Gourds	2.7
Plantain flowers	2.2
(Vegetables continued)	
Sesban Cassia, leaves, flowers	2.2
String beans	8.0
Papaya, green	2.8
Pumpkin leaves	4.5
Onion and Garlic	1.6
Sweet potato	6.2
Cassava	2.8
Miscellaneous	15.6
Total	81.9
Fruits:	
Banana	2.2
Papaya, ripe	2.5
Others, (Pomelo, orange, lime, tangerine)	1.4
Total	6.1
Fats and Oils:	
Coconut oil	0.6
Lard	0.8
Total	1.4
Salt	2.4
Sugar	0.2
Miscellaneous:	
Coconut products	18.4
Tamarind pulp	2.0
Chillies	1.1
Chestnut	0.8
Fish sauce	0.8
Lemon grass	0.5
Soybean products	0.9
Vinegar	0.4
Others 1/	0.5
Total	25.4

1/ Turmeric, lime leaves, lime peel, galanga, etc.

TABLE 77-A. MAJOR FOOD SOURCES OF INDIVIDUAL NUTRIENTS[1/2/3/] AMONG THE THAI CIVILIANS - PERCENT MEANS FOR ALL GROUPS COMBINED

	Percent Contribution to Total Diet					
	Rice	Meat	Eggs	Vegetables	Fruits	Miscellaneous
Total Diet (by weight)	70	10	0.6	13	1	4
Calories	87	5.8	0.4	1.9	0.3	3.9
Protein	65	29	1.2	2.8	-	2.0
Calcium	24	57	1.0	14.0	-	3.9
Phosphorus	62	28	1.1	5.0	-	3.0
Iron	58	21	1.4	12.2	-	6.4
Vitamin A	-	5	4.4	84.0	2.0	4.7
Thiamine	82	5	1.0	10.0	-	3.0
Riboflavin	55	20	3.5	17.3	-	3.5
Niacin	69	22	-	8.2	-	1.0
Vitamin C	3	-	-	83.5	12.2	1.6

1/ as calculated from standard food tables
2/ see Table 75-A for gms of each individual food item consumed
3/ -: percent less than 1.0

TABLE 78-A. SUMMARY OF CHEMICAL ANALYSES OF RICE SAMPLES

Nutrients	Kind of Rice					
	Rice Milled	Rice Home-Pounded	Glutinous Milled	Glutinous Home-Pounded	Glutinous New Crop	Glutinous Old Crop
No. of analyses	4	1	11	2	4	6
	In 100 Gms of Rice					
Calories	367	369	359	361	359	361
Protein (gm)	4.23	6.23	4.66	5.59	4.20	4.85
Carbohydrate (gm)	76.6	74.7	75.7	75.4	76.3	75.6
Fat (gm)	4.8	5.0	4.2	4.0	4.1	4.3
Calcium (mg)	11.5[1/]	8.2	11.4	-	13.1	9.7
Iron (mg)	.23	.25	.15	.06	.13	.15
Ash (gm)	.52	.84	.54	.45	.47	.57
Thiamine (mcg)	71	118	98	91	97	102
Niacin (mg)	2.11	3.94	2.42	2.47	2.27	2.38
Pyridoxine (mcg)	80.7	91.5	83.1	61.3	79.8	81.7

1/ This is the average value for three samples only of milled rice.

TABLE 19-A. CHEMICAL ANALYSES OF INDIVIDUAL FOODS OBTAINED FROM THAI CIVILIAN GROUPS

Sample Number	Food Item[2]	Calories	Water	Protein	Fat	Ash	CHO[1]
				gms/100 gms			
H-1	Paddy Rice	351	13.26	5.20	5.28	5.69	70.57
H-2	Hulled Rice	368	13.96	4.98	5.60	1.03	74.43
H-3	White Rice	371	14.38	5.93	5.95	0.33	73.41
H-4	Rice Polishings	306	14.50	5.80	3.70	13.71	62.29
H-5	Rice Bran	371	14.87	6.60	10.34	5.31	62.88
H-6	Parboiled, Milled Rice	378	11.59	4.20	5.69	0.96	77.56
H-7	Parboiled, Paddy Rice	345	11.15	5.06	3.58	7.16	73.05
H-10	Rice, Pounded	369	13.20	6.23	5.01	0.84	74.72
H-11	Rice Milled	367	12.76	4.22	4.10	0.50	78.42
H-16	Glut. Rice	356	14.56	3.25	3.44	0.62	78.13
H-18	Koon Stalk, Ban Fou	Bottle arrived broken					
H-19	Koon Stalk, Ban Pon	13	95.92	0.46	0.29	1.22	2.11
H-20	Glut. Rice	359	14.78	5.71	4.18	0.67	74.66
H-21	Rice, Milled	356	15.60	4.06	4.17	0.73	75.44
H-29	Rice, Composite (10 families)	372	12.70	2.72	4.88	0.50	79.20
H-31	Glut. Rice, Milled	358	15.40	2.59	4.20	0.45	77.36
H-32	Glut. Rice, Family Composite	366	14.70	3.65	5.45	0.48	75.72
H-37	Glut. Rice, New	363	14.46	2.92	4.65	0.56	77.41
H-38	Glut. Rice, Old	359	15.08	4.94	4.50	0.72	74.76
H-43	Glut. Rice, Composite	355	15.88	4.90	4.19	0.55	74.48
H-46	Glut. Rice, Milled	--	--	5.71	4.45	0.46	--
H-47	Glut. Rice; New Crop	358	15.26	5.86	4.13	0.44	74.31
H-48	Glut. Rice, Old Pounded	365	14.38	5.74	4.81	0.45	74.62
H-49	Glut. Rice, New Pounded	356	14.75	5.44	3.26	0.44	76.11
H-57	Glut. Rice, Composite	356	14.64	5.99	3.25	0.50	75.62
H-60	Pak Mued	76	62.92	2.16	0.23	18.24	16.45
H-67	Pak Tob Leaves	Bottle arrived broken					
H-68	Glut. Rice, Old	--	--	5.79	3.55	0.47	--
H-69	Glut. Rice, Old	355	14.68	5.98	3.16	0.40	75.78
H-70	Glut. Rice, New	348	16.61	5.87	3.31	0.46	73.75
H-71	Glut. Rice	358	14.90	5.94	3.81	0.43	74.92
H-87	Pak Mued Leaves	26	92.53	1.14	1.04	2.26	3.03
	Tea	315	18.35	20.28	1.77	5.13	54.47

1/ By difference.
2/ "Glut.": abbreviation for "glutinous"

(continued on next page)

TABLE 79-A.. (CONTINUED - page 2) (CHEMICAL ANALYSES OF INDIVIDUAL FOODS OBTAINED FROM THAI CIVILIAN GROUPS)

Sample Number	Food Item 1/	Iron mg/100 gm	Thiamine mcg/100 gm	Niacin mg/100 gm	Pyridoxine mcg/100 gm
H-1	Paddy Rice	0.54	52.0	2.76	93.5
H-2	Hulled Rice	0.55	108	2.78	114
H-3	White Rice	0.31	36.0	1.45	57.4
H-4	Rice Polishings	8.32	7.99	6.67	277
H-5	Rice Bran	0.11	24.0	26.2	448
H-6	Parboiled Milled Rice	0.18	118	2.93	136
H-7	Paddy Rice, Parboiled	0.62	75.9	2.32	84.8
H-10	Rice, Pounded	0.25	118	3.94	91.5
H-11	Rice, Milled	0.18	60.0	1.98	144
H-16	Glut. Rice	0.17	110	2.67	95.2
H-18	Koon Stalk, Ban Pon	Bottle arrived broken			
H-19	Koon Stalk, Ban Pon	0.13	< 5.7	< 0.94	< 21
H-20	Glut. Rice	0.24	104	1.98	76.1
H-21	Rice, Milled	0.20	92.0	2.39	54.6
H-29	Rice, Composite (10 families)	0.21	96.0	2.62	66.7
H-31	Glut. Rice, Milled	0.29	112	2.59	108
H-32	Glut. Rice, Family Composite	0.18	134	1.88	93.2
H-37	Glut. Rice, New	0.05	100	1.84	89.8
H-38	Glut, Rice, Old	0.17	83.5	1.70	111
H-43	Glut. Rice, Composite	0.18	70.7	2.88	84.5
H-46	Glut. Rice, Milled	0.04	90.8	2.41	76.9
H-47	Glut. Rice, New Crop	0.14	80.2	2.84	65.1
H-48	Glut. Rice, Old, Pounded	0.06	88.1	3.13	66.2
H-49	Glut. Rice, New, Pounded	0.05	93.8	1.80	56.4
H-57	Glut. Rice, Composite	0.17	98.0	2.99	66.0
H-60	Pak Mued	0.12	QNS	1.15	38.6
H-67	Pak Tob Leaves	Bottle arrived broken			
H-68	Glut. Rice, Old	0.05	91.4	2.89	48.7
H-69	Glut. Rice, Old	0.17	54.9	2.33	57.1
H-70	Glut. Rice, New	0.20	82.5	2.82	81.1
H-71	Glut. Rice	0.21	77.3	2.64	72.4
H-87	Pak Mued Leaves	0.10	51.8	0.20	39.8
	Tea	1.96	71.2	3.36	133

1/ "Glut.": abbreviation for "glutinous"

TABLE 80-A. ESSENTIAL AMINO ACID COMPOSITION OF SELECTED PROTEINS COMPARED WITH FAO REFERENCE PROTEIN[1/]

	FAO Pattern	Rice	Soy Flour	White Wheat Flour	Fish	Egg
	Mg amino acid per gm nitrogen					
Isoleucine	270	322	333	262	317	428
Leucine	306	535	484	442	474	565
Lysine	270	236	395	126	549	396
Phenylalanine	180	307	309	322	231	368
Tyrosine	180	269	201	174	159	274
Threonine	180	241	247	174	283	310
Tryptophan	90	65	86	69	62	106
Valine	270	415	328	262	327	460
Sulfur-containing - total	270	222	197	192	262	342
Methionine	144	142	86	78	178	196
Protein score	100	72	73	47	-	100
Biological value (rat)[2/]	-	-	75	52	-	87

1/ Source: Protein Requirements. FAO Nutritional Studies No. 16, FAO, Rome 1957.
2/ Percentage of absorbed nitrogen retained in body.

TABLE 81-A. AMINO ACID (A.A.) COMPOSITION OF TWO THAI RICE SAMPLES AND A THAI FISH SAUCE SAMPLE

AMINO ACIDS	Fish Sauce[1]			Rice Samples[2]	
	% nitrogen per A.A.	total A.A.	free A.A.	"regular" total A.A.	glutinous total A.A.
		gms A.A./16 gms nitrogen			
Lysine	0.235	7.56	7.21	3.68	4.38
Histidine	0.057[3]	2.84	2.36	2.06	2.90
Arginine	0.012[3]	0.38	0.31	8.92	10.36
Aspartic acid	0.090	5.03	3.80	10.15	11.43
Threonine	0.043	2.33	2.17	3.77	4.48
Serine	0.044	2.05	1.88	5.53	6.78
Glutamic acid[4]	0.137	8.47	4.11	20.78	22.57
Proline	0.000	0.00	0.00	4.28	3.80
Glycine	0.092	2.92	1.18	5.49	5.86
Alanine	0.104	3.92	3.04	7.08	7.81
Cystine (1/2)	0.000	0.00	0.00	2.15	0.35
Valine	0.053	2.60	2.00	5.80	3.33
Methionine	0.046	0.04	1.13	2.68	2.52
Isoleucine	0.030	1.64	1.34	4.21	4.18
Leucine	0.028	1.60	1.78	9.85	10.79
Tyrosine	0.002	0.16	0.13	4.06	4.05
Phenylalanine	0.021	1.48	1.17	6.24	8.43
Cystathionine	-	-	-	0.31	0.00
Ammonia	0.204	-	-	-	-
Total % nitrogen/A.A.	1.198				
Total nitrogen (Kjeldahl) (%)		2.075		0.712	0.641
Non-protein nitrogen (%)		0.218			
Alpha amino nitrogen (%)		1.721			
% recovery of alpha amino nitrogen		79.6			

1/ "first quality" sample
2/ "regular" rice sample is sample H-21 and glutinous rice sample is sample H-32 of Table 49-A
3/ values corrected for non-amino nitrogen
4/ A significant ninhydrin reactive peak appeared on the chromatogram immediately following glutamic acid. The balance of the alpha amino nitrogen (0.351%) may be accounted for in the unidentifiable ninhydrin reactants.

TABLE 82-A. MINERAL COMPOSITION OF THAI CIVILIAN FOOD COMPOSITES, SALT SAMPLES AND WATER SAMPLES

FOOD COMPOSITES	Composite Number	Fluorine (mcg/person/day)	Iodine (mcg/person/day)
Songkhla Area			
Bang Dan	H-90	975	-
Don Kee Leg	H-88	725	-
Chiengmai Area			
Ban Fon	H-17	1,720	119
San Pong	H-24	904	78
Lopburi Area			
Ta Kae	H-92	1,100	63
Udorn Area			
Phon Ngam	H-35	850	68
Marg Yah	H-41	625	60
Ubol Area			
Sri Kai	H-51	575	58
Ban Kao	H-58	3,925	-
Average		1,267	74

SALT SAMPLES	Salt Source	Calcium (mg/100 gms)	Fluorine (mcg/100 gms)
Bang Dan	Sea	257	106
Don Kee Leg	Sea	187	187
Ban Fon	Sea	338	153
San Pong	Sea	96	181
Ta Kae	Sea	176	166
Phon Ngam	Brine well	399	128
Marg Yah	Brine well	475	288
Sri Kai	Brine well	111	178
Ban Kao	Surface soil	743	47
Ban Kao	Brine well	655	134

WATER SAMPLES	Water Source	(mg/100 ml)	(mcg/100 ml)	Salt (mg/100 gms)
Ban Fon	Well	3.2	27	1.8
Ta Kae	Well	6.0	34	4.6
Ta Kae	Rain	1.0	0	0.2
Phon Ngam	Well	2.5	12	7.3
Phon Ngam	Well	2.6	30	5.0
Marg Yah	Well	0.8	6	2.3
Marg Yah	Well	1.1	8	1.4
Sri Kai	Well	1.7	10	12.6
Ban Kao	Well	0.2	14	0.0

TABLE 83-A. PARASITOLOGICAL FINDINGS AMONG THE THAI MILITARY BY GENERAL AREAS

General Area	ARMY					AIR FORCE	NAVY	COMBINED SERVICES
	Bangkok	Songkhla	Chiengmai	Udorn	Ubol	Lopburi	Sattaheep	
No. of stools examined	30	31	14	33	27	37	30	202
FECAL ORGANISMS	Percent Infested							
Intestinal Protozoa								
Entamoeba histolytica (amoebiasis)	-	9.7	21.4	12.1	7.4	10.8	16.7	10.4
Endolimax nana	20.0	29.0	28.6	21.2	29.6	24.3	50.0	28.7
Entamoeba coli	30.0	38.7	28.6	36.4	55.6	43.2	40.0	39.6
Iodamoeba butschlii	3.3	-	-	-	-	-	-	0.5
Intestinal Flagellates								
Giardia intestinalis (giardiasis)	-	-	-	-	3.7	2.7	3.3	1.5
Embadomonas intestinalis	-	-	-	-	-	-	3.3	0.5
Helminths (worms)								
Ascaris lumbricoides (roundworm)	10.0	29.0	28.6	36.4	40.7	32.4	26.7	29.2
Strongyloides stercoralis (roundworm)	-	-	-	-	-	-	3.3	0.5
Trichostrongylus colubriformis (roundworm)	3.3	3.2	7.1	-	-	-	-	1.5
Ancylostoma duodenale (hookworm)	16.7	35.5	14.3	12.1	14.8	16.2	10.0	17.3
Taenia saginata & T. solium (tapeworms)	-	-	-	3.0	-	-	-	0.5
Hymenolepsis nana (dwarf tapeworm)	-	-	-	-	3.7	-	-	0.5
Trichuris trichiura (whipworm)	-	-	-	-	3.7	-	-	0.5
Opisthorchis viverrini (liver fluke)	-	-	-	9.1	3.7	2.7	-	2.5
Fasciolopsis buski (intestinal fluke)	-	-	-	-	-	-	3.3	0.5
Salmonella								
Salmonella typhi (typhoid fever)	-	-	14.3	-	-	-	-	1.0
Salmonella meleagridia	-	-	-	-	-	2.7	-	0.5
Salmonella virchow	-	-	-	-	-	5.4	-	1.0
Salmonella weltevreden	-	-	-	-	-	2.7	-	0.5
Salmonella stanley	-	-	-	3.0	-	-	-	0.5
Salmonella anatum	-	-	-	-	-	-	3.3	0.5
No parasites or salmonella	30.0	6.4	14.3	6.1	3.7	10.8	-	9.9
Persons with 1 parasite or salmonella								49.5
Persons with 2 parasites or salmonella								32.7
Persons with 3 parasites or salmonella								7.4
Persons with 4 parasites or salmonella								0.5
Persons with 5+ parasites or salmonella								-

TABLE 84-A. PARASITOLOGICAL FINDINGS AMONG THE THAI CIVILIANS BY GENERAL AREAS

General Area	Songkhla	Chiengmai	Lopburi	Udorn	Ubol	Total
No. of stools examined	17	29	11	32	27	116
FECAL ORGANISMS			Percent Infested			
Intestinal Protozoa						
Entamoeba histolytica (amoebiasis)	5.9	13.8	18.2	12.5	11.1	12.1
Endolimax nana	35.3	24.1	36.4	31.2	22.2	28.4
Entamoeba coli	23.5	24.1	36.4	50.0	37.0	35.3
Helminths (worms)						
Ascaris lumbricoides (roundworm)	17.6	44.8	36.4	28.1	25.9	31.0
Strongyloides stercoralis (roundworm)	-	-	-	3.1	-	0.9
Trichostrongylus colubriformis (roundworm)	11.8	-	-	-	-	1.7
Ancylostoma duodenale (hookworm)	41.2	13.8	9.1	25.0	22.2	22.4
Taenia Saginata & T. solium (tapeworms)	-	-	-	3.1	-	0.9
Hymenolepsis nana (dwarf tapeworm)	-	6.9	9.1	6.2	-	4.3
Trichuris trichiura (whipworm)	-	-	-	3.1	3.7	1.7
Opisthorchis viverrini (liver fluke)	-	-	-	12.5	14.8	6.9
Salmonella						
Salmonella derby	5.9	-	18.2	-	-	2.6
Salmonella newport	-	-	-	3.1	-	0.9
Salmonella panama	-	-	-	-	11.1	2.6
No parasites or salmonella	11.8	10.3	9.1	-	3.7	6.0

Persons with 1 parasite or salmonella	45.7
Persons with 2 parasites or salmonella	37.1
Persons with 3 parasites or salmonella	10.3
Persons with 4 parasites or salmonella	-
Persons with 5+ parasites or salmonella	0.9

TABLE 85-A. PARASITOLOGICAL FINDINGS AMONG THE THAI MILITARY AND CIVILIANS-RELATIONSHIP OF HEMOGLOBIN VALUES TO INTESTINAL INFESTATION

FECAL ORGANISM	Number of Subjects		Hemoglobin (gms/100ml)	
	Military	Civilians	Military	Civilians
Ancylostoma duodenale (hookworm)	33	23	12.9	11.8
Ascaris lumbricoides (roundworm)	57	26	12.5	11.4
Entamoeba coli (intestinal protozoa)	78	35	13.0	12.8
Endolimax nana (intestinal protozoa)	57	24	12.9	12.2
Any type of parasite or salmonella	177	90	13.0	11.9
No parasites or salmonella	17	6	13.7	12.1
HEMOGLOBIN DISTRIBUTION (gms/100 ml)			**Percent Distribution**	
Any type of parasite or salmonella				
<12.0	51	43	28.8	47.8
12.0-13.9	52	27	29.4	30.0
14.0-14.9	30	9	16.9	10.0
15.0+	44	11	24.8	12.2
No parasites or salmonella				
<12.0	3	4	17.6	66.7
12.0-13.9	5	-	29.4	-
14.0-14.9	4	1	23.5	16.7
15.0+	5	1	29.4	16.7

629784 O - 62 - 16

TABLE 86-A. PARASITOLOGICAL FINDINGS AMONG THE THAI MILITARY AND CIVILIANS-COMPARISON WITH THE 1951-1955 SURVEY OF THE THAI DIVISION OF COMMUNICABLE DISEASE CONTROL[1/]

Regions[2/]	No. Examined	Specific Parasite: Ascaris lumbricoides	Hookworm	Trichuris trichiura	Strongyloides	Taenia	Opisthorchis viverrini	Fasciolopsis buski
		Percent Infested						
CENTRAL - Regions I and II								
1951-1955 Survey	21,478	26.4	11.2	3.3	-	0.2	0.3	1.3
ICNND (Bangkok, Lopburi, Sattaheep)	108	25.0	13.9	-	0.9	-	0.9	0.9
NORTHWEST - Region V								
1951-1955 Survey	8,389	26.4	18.1	5.2	0.9	1.2	10.3	0.1
ICNND (Chiengmai)	43	39.5	14.0	-	-	-	-	-
SOUTH - Region IX								
1951-1955 Survey	41,337	70.5	34.4	48.3	-	-	-	-
ICNND (Songkhla)	48	25.0	37.5	-	-	-	-	-
NORTH - Regions III and IV								
1951-1955 Survey	192,499	7.5	19.5	2.4	1.2	3.4	29.8	-
ICNND (Udorn, Ubol)	119	32.8	18.5	2.5	0.8	1.7	10.1	-
TOTALS								
1951-1955 Survey	263,703	19.6	21.1	9.7	0.9	2.5	22.1	0.1
ICNND Military Groups	202	29.2	17.3	0.5	0.5	0.5	2.5	0.5
ICNND Civilian Groups	116	31.0	22.4	1.7	0.9	0.9	6.9	-
ICNND Combined Groups	318	29.9	19.2	0.9	0.6	0.6	4.1	0.3

1/ Data taken from "Public Health in Thailand," a publication of the Ministry of Public Health, Bangkok, 1960.

2/ ICNND data for separate regions are for combined military and civilian groups.

M. FOOD RESOURCES APPENDIX

Tapioca Manufacture

Some observations should be made on the manufacture of tapioca in Thailand. In 1959, the tapioca exports totaled almost 150,000 tons. This traditional food product is manufactured in many small plants and the product finds ready market. The sanitary conditions at these smaller plants seem quite unsuitable for the manufacture of a food product and the problems of disposal of the soaking water and other refuse present special problems which usually cannot be adequately met by the small manufacturer. This frequently results in a bad odor in their neighborhood to which objections have been raised by residents as well as officials. The improvement of the arrangements and facilities of such small manufacturing enterprises is economically a difficult matter.

In view of this situation, the establishment of a modern tapioca factory near Skiracha was a most significant development. The S. R. Tapioca Company factory, which was visited by team members, is a completely modern factory with a continuous manufacturing process and a high degree of automation, impressive arrangements, and efficiency. Instead of requiring days, this factory produces dry (12 percent moisture) tapioca flour in a matter of hours, using spray dryers for the final step in the processing. The output of this plant amounts to about 500 tons of tapioca per month. The plant is run 24 hours a day and essentially the year-around. Most, if not all, of the product is shipped to the United States. The laboratories and the control procedures based on modern instrumentation were excellent.

This plant, standing in the center of a district noted for the odor from the small tapioca plants, is a fine demonstration of what can be accomplished in the agricultural industries with the application of good techniques, proper management, and scientific control methods. It also demonstrates (together with some other Thai manufacturing facilities such as the nearby chipboard factory) that capital, including foreign capital, is available for modern manufacturing schemes when they are based on raw materials regularly available in suitable quantities coupled with an assured market for the product. The S. R. Tapioca Company factory should be used as a demonstration to other food manufacturers in Thailand to emphasize the benefits of applying modern manufacturing methods, control, and management techniques.

The Royal Thai Army Quartermaster Subsistence Division

The Army quartermaster food laboratory and processing facilities in Bangkok were visited by several team members and brief observations follow. The Division is doing a commendable job in the development and production of processed army rations under very difficult conditions. Three types of preserved field rations are produced. These consist mostly of canned and dehydrated items including fried rice and meat, rice with meat in tomato sauce, and rice with shrimp paste. Pineapple rings are packed in flat small cans.

Considering the importance of field rations in modern warfare (92), there is question concerning both the magnitude of the development effort and the small production facilities. The processing plant consists mostly of old and worn-out machinery obviously maintained at great sacrifice of time and expense. The laboratory facilities seem also restricted and inadequate. Both are in sharp contrast to the fine facilities for research, development and manufacture at the Preserved Food Organization already discussed. Indeed, one may wonder why the vital activity of ration development is carried on in two separate organizations. The limited time of the survey did not allow an opportunity to obtain more information on this subject but the team would feel

remiss in not offering some comments on this subject. Obviously, improvements in the coordination in ration development and manufacturing efforts would benefit substantially not only the Armed Forces of Thailand but also the development of local food processing industries. The importance of training and fully utilizing adequately trained good technology and chemistry personnel - both in and out of uniform - cannot be overemphasized.

The Military Feeding of Regular (Non-glutinous) and Glutinous (Sticky) Rice

In the northern parts of Thailand, glutinous rice is more popular than the non-glutinous variety. Glutinous rice apparently is different from the non-glutinous rice in one gene only, but has very different properties. Contrary to the implication, glutinous rice is different from regular rice in its starch fractions and not in its nitrogenous constituents. In the cooking of glutinous rice, the rice is soaked in water for 4-6 hours followed by draining off the liquid and steaming for 2-3 hours. The glutinous rice is eaten by rolling the glutinous mass into small balls which then are dunked into whatever "with-rice" dish is served with it.

The survey found that in the North glutinous rice was used in military feeding whereas in other districts only the undermilled regular rice was issued. This practice seems undesirable since the soldiers, mostly from the local areas surrounding their military facilities, are familiar only with the one type of rice served. Since even the manner of eating is different for the two kinds of rice, it would seem desirable to feed a limited quantity of regular rice in the North and vice-versa. In any military emergency it is most unlikely that the military manpower demands in any part of the country could be restricted to soldiers coming from nearby districts. Thus it is inevitable that regular rice would have to be fed to soldiers accustomed to glutinous rice and glutinous rice only may be available to troops from the central and southern parts of Thailand. Serving the other kind of rice more frequently in all districts would allow the soldier to become familiar with both kinds. Experience has shown that in troop feeding, acceptance of new foods is more limited in an emergency than under normal conditions. Thus it might be well to anticipate such difficulties if they can be avoided by such very limited and simple training programs.

The Salt Industry

At the time of the survey, the basic daily salt ration allowance for Thai military personnel was1 gm/man/day. The mean daily salt issue observed was almost identical, namely, 1.1 gms/man/day. However, this mean value is misleading, since salt issue varied greatly from no salt issued on the days of the survey in Bangkok, Ubol, Lopburi, and Sattaheep, to5.5 gms/man issued at Songkla. Furthermore, the salt ration is only a small part of the total salt intake since several issue items such as fish sauce and red curry paste contain much salt. This point is well illustrated by the analytical results on composite military food samples which gave a mean salt intake value of18.1 gms/man/day. Here again, the range was considerable, namely, 7.5-27.5gms.

The production and distribution of salt is not a government monopoly in Thailand and therefore it is difficult to obtain reliable statistical figures. An exception to this is information on the quantity of salt exported which ranged from 223,000 to 265,000 tons annually since 1956, current estimates for 1959 and 1960 being around 250,000 (International Bank, 1959; Government Trade Bureau, Bangkok, 1960; Cooperative Salt Marketing Society, 1960). All exports are sea salt. The 1958 World Bank survey (17) mentions extensive salt deposits on the Korat Plateau (the Northern and Northeastern Regions of Figure 1), which "may be of commercial value at some future date." We also observed some salt wells near Udorn which were used seasonally, but the production (of a very crude salt) must have been small. The fact remains that we failed to obtain any statistical figures on the domestic use

of salt other than sea salt since apparently most non-sea salt is consumed in or near the locality where produced.

The nearest approximation of domestic salt usage was obtained from the shipping records of the Cooperative Salt Marketing Society in Bangkok. We were told that about 95 percent of the salt used in Thailand is produced by solar evaporation from the sea. The following figures represent shipments of salt produced commercially and by cooperatives during 1958:

TABLE 87-A. SHIPMENT DISTRIBUTION OF SALT THROUGH BANGKOK, 1958

To the north - Regions I, V and VI	15,171 tons
To the northeast - Regions III and IV	14,445 tons
To the east - Region II	819 tons
To the south - Regions VII, VIII and IX	527 tons
Total	30,962 tons

It is clear that salt shipments to the South might be so low on account of the local salt production. This might be the case, perhaps to a lesser extent, with shipments to the East but this is a surmise.

Apparently practically all of this salt is shipped by rail, and all salt shipments by rail originate in Bangkok where there are said to be about 20 salt warehouses used for storage. We were told that research by the Department of Science solved the problem of "soft" salt which presumably results from too rapid evaporation and that the improved methods of production are now being introduced. Further, it might be assumed that with the continued increase in the standard of living there will be an increased demand for the sea salt of better quality.

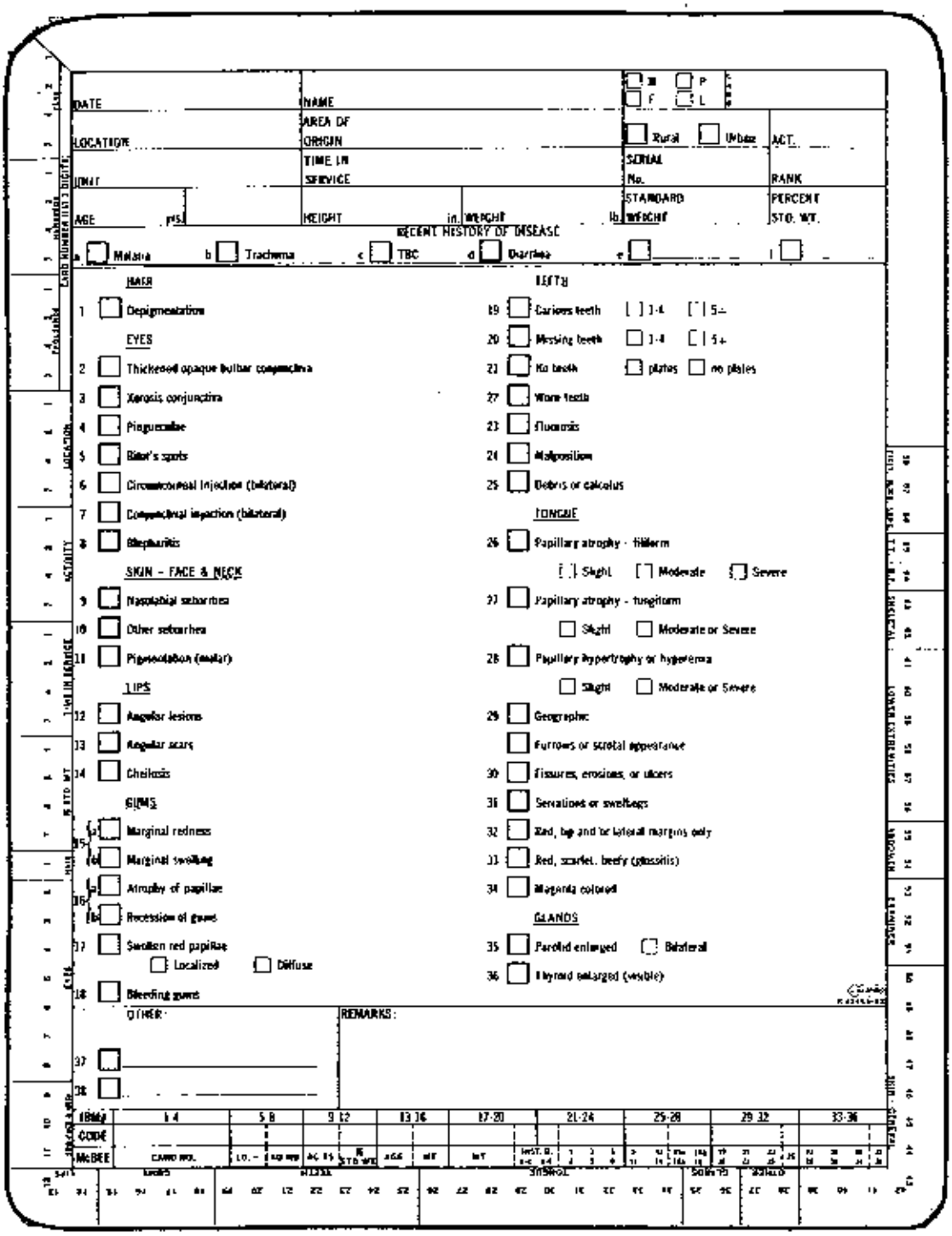


Figure 7-A. The ICNND Detailed Clinical Card - Front

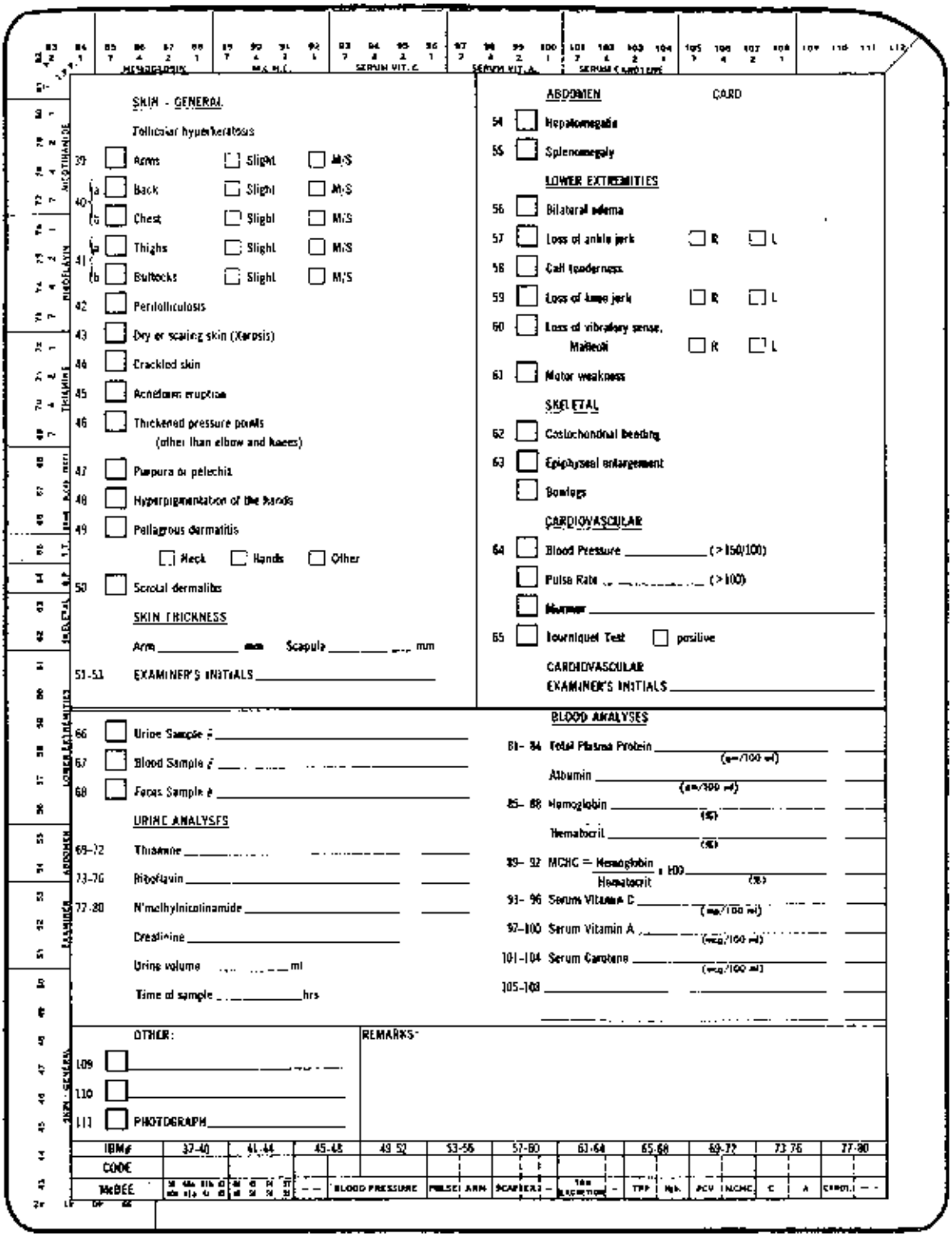


Figure 8-A. The ICNND Detailed Clinical Card - Back

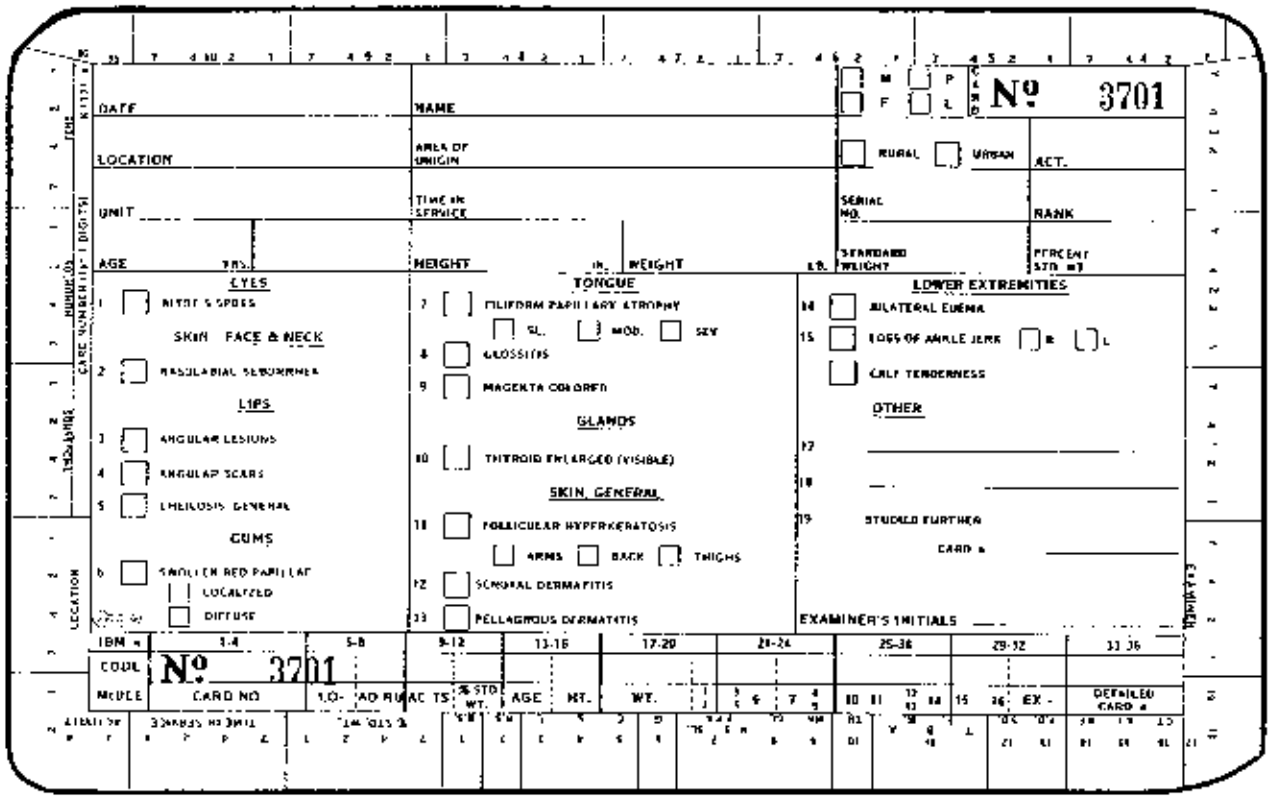


Figure 9—A. The ICNND Abbreviated Clinical Card

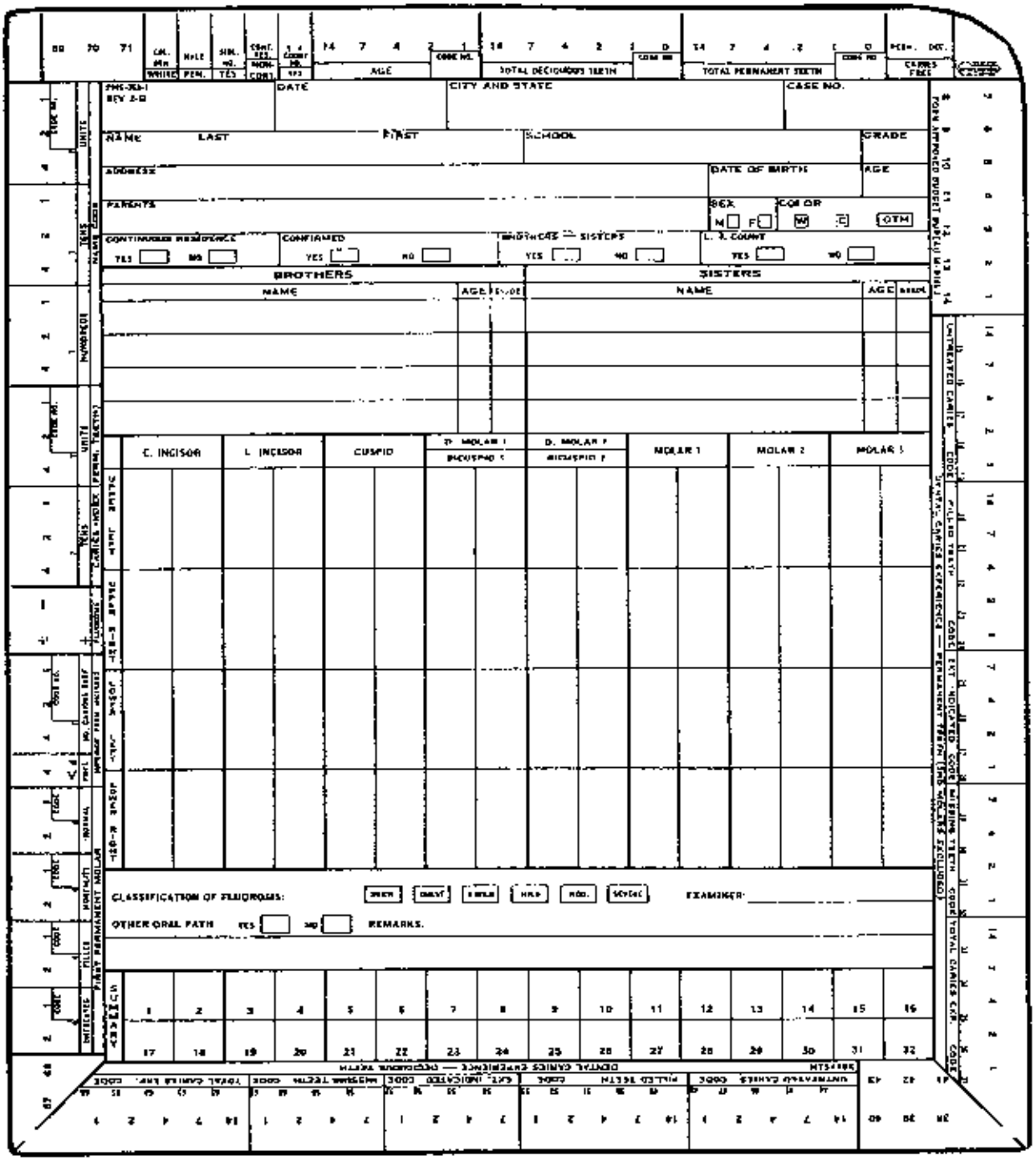
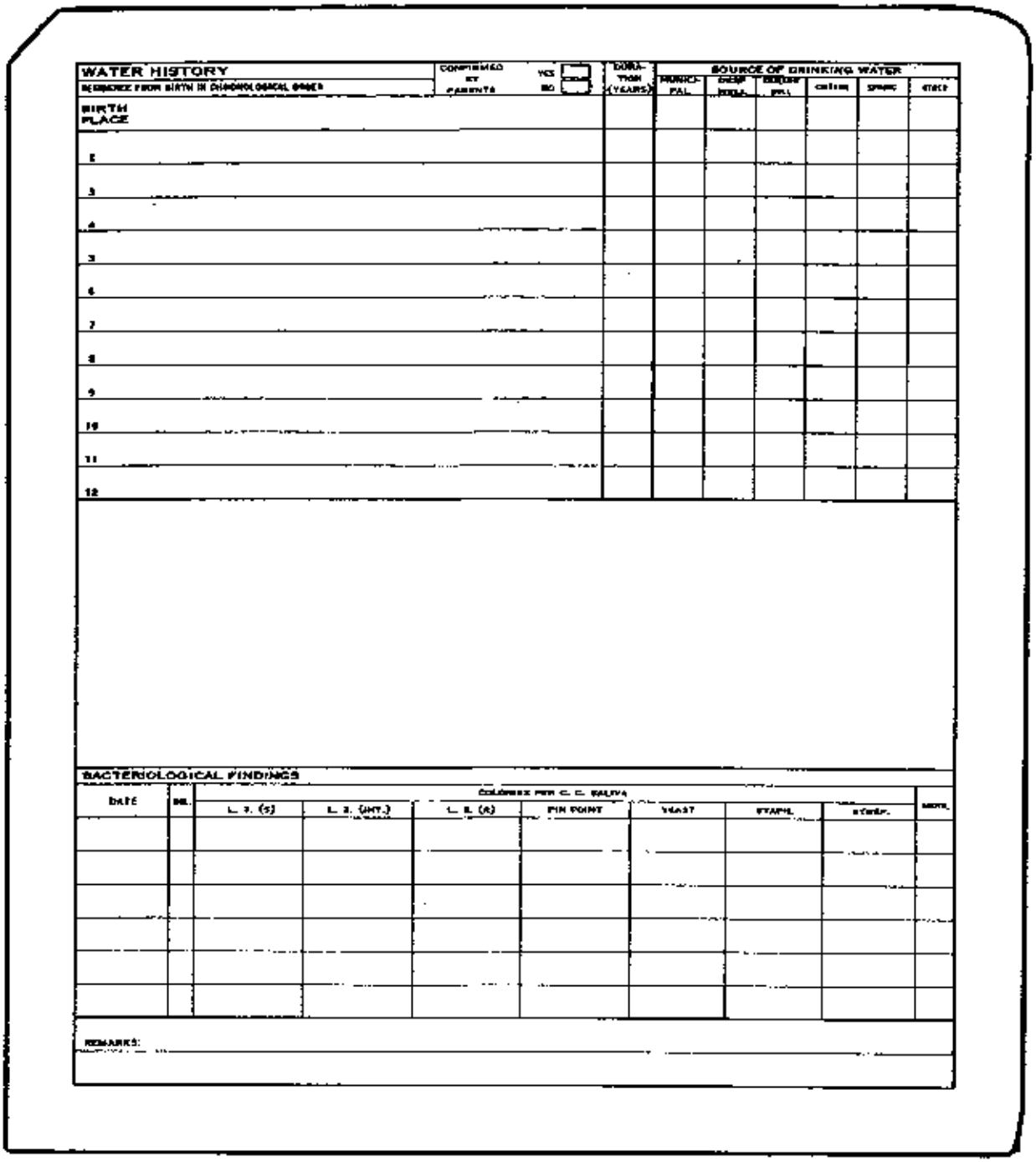


Figure 10-A. The National Institute of Dental Research Dental Card - Front



WATER HISTORY

RESIDENCE FROM BIRTH IN CHRONOLOGICAL ORDER

CONFIRMED BY PARENTS: YES / NO

	DURATION (YEARS)	SOURCE OF DRINKING WATER: MUNICIPAL	DEEP WELL	SHALLOW WELL	CISTERN	SPRING	OTHER
BIRTH PLACE							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

BACTERIOLOGICAL FINDINGS

DATE	INIT.	COLONIES PER C. C. SALIVA: L. F. (S)	L. F. (INT.)	L. F. (R)	PIN POINT	YEAST	STAPH.	STREP.	MOTIL.

REMARKS:

Figure II-A. The National Institute of Dental Research Dental Card — Back

TABLE 88-A. (The following are the contents of Form #1, ordinarily making up a two-page form.)

FORM #1 ICNND

SURVEY OF FOOD AND NUTRITION SERVICES IN THE ARMED FORCES

a. General - Describe and answer the following:
   (1) Food procurement system
   (2) Finances of food procurement
   (3) Ration distribution and issue system
   (4) Food storage system
   (5) Are troops employed in food production, especially on a local basis? Extent?
   (6) Are troops employed in food processing, locally?
   (7) Food service supervision:
      (a) Schools for cooks and bakers? Manuals or training aids?
      (b) Mess hall - kitchen, preparation, serving:
      (c) Rations - extent to which scales are met:
      (d) Ration supplements and frequency:
      (e) Monetary allowance for ration? How used?
      (f) Welfare funds? Red Cross, etc.:

b. Hospital and Medical
   (1) Dietetic service in military hospitals, describe the following:
      (a) Type
      (b) Adequacy of service:
      (c) Training of personnel:
   (2) Is a manual used in feeding of sick and wounded?
   (3) Status of nutrition training of medical staffs:
   (4) Summarize reports and collect copies when available, (include source).
      (a) Heights, weights and other anthropometric data:
      (b) Surveys of nutrition
      (c) Casualties and disabilities from malnutrition:
      (d) Special reports on nutrition problems:

c. Status of Civilian Nutrition (Include source and data):
   (1) Are dependents of soldiers consuming army ration?
   (2) Is food from civilian sources coming into troops' hands?

d. Locally Determined Nutritional Requirements or Standards
   List report and summary data available on the following:
   (1) Trainees:
   (2) Combat:
   (3) Bivouac or detention camps:
   (4) Civilian

e. Sanitation (check and describe the following:)
   (1) Cleansing of utensils and messing facilities
   (2) Water supply - source, treatment, etc.
   (3) Disposal of wastage
   (4) Inspection of mess

TABLE 89-A. FOOD INVENTORY RECORD (ICNND FORM #2)

Unit Surveyed _____ Dates _____ Average Men Per Day Fed _____

Food Item	Unit of Issue	Unit Wt. Lbs. or Kg.	Initial Inventory Units	Units Issued During Period	Total Issue Units	Final Inventory Units	Total Units Used	Average per man per day "as issued" Lbs. or Kg.	Avg. Edible waste per man per day	Average "as consumed" per man per day

TABLE 90-A. RECIPE - FOOD PREPARATION FORM (ICNND FORM #3)

Unit _____
Day _____
Meal _____

Menu Items	Ingredients	Weight As Purchased	Refuse		Edible Wt.	Cooked Wt.	Conversion factor[1/] Cooked weight to "As purchased"
			Kind	Amt.			

Description of preparation:

(Give actual recipe, include cooking time, method of cooking. Time prepared, time served, number of men prepared for, etc.)

1/ Note: See Sample calculation page.

TABLE 91-A. FOOD WASTE (ICNND FORM #4)

Unit _____ Number served _____

Day _____

Meal _____

Edible Food

Food	Plate waste, total pounds (Kgs.) food	Kitchen waste, total pounds (Kgs.) food	Ingredient list (from recipe)	Conversion factor to "as purchased"	Total foods wasted pounds (Kgs.) "as purchased"

Total fat and grease discarded = _____

TABLE 92-A. SUMMARY - NUTRITIONAL EVALUATION (ICNND FORM #5)

Unit _____ Physical Activity _____

Date _____

Food	Quantity per man per day	Calories	Protein gm.	Carbo-hydrate gm.	Fat gm.	Cal-cium gm.	Iron gm.	Vitamin A I.U.	Thia-mine mg.		Ribo-flavin mg.		Niacin mg.		Vitamin C mg.	
									a	b	a	b	a	b	a	b
Total																

Footnote

a = no cooking losses considered

b = corrected for estimated cooking losses (See Table 1)

TABLE 93-A. (The following are the contents of Dietary Questionnaire No. 1E, ordinarily making up a seven-page form)

CARD NO. DIETARY QUESTIONNAIRE NO. 1E (ICNND) DATE
Investigator No.

FAMILY NAME TOWN PROVINCE
ETHNIC GROUP RELIGION
FATHER'S OCCUPATION
NUMBER IN HOUSEHOLD: TOTAL ADULTS CHILDREN
MALES OVER 16 YEARS: NO. AGES
NO. PREGNANT WOMEN: AGES
NO. LACTATING WOMEN: AGES
NO. OTHER WOMEN (OVER 16 YEARS): AGES
NO. CHILDREN (UNDER 16 YEARS):
BABIES UNDER 1 YEAR BREAST FED YES NO
NO. OTHER BOYS AGES
NO. OTHER GIRLS AGES

QUESTIONS:

1. What is the total cash income for family per week?
2. How much is spent on food per week?
3. How many times per week do you buy food?
4. What are the main foods that you buy?

Food Item	Amount purchased per week	Value

(½ page blank for results)

5. Do you prepare your food on an open fire or stove ?
6. How long does it take to cook a meal? hours.
7. Do you breast feed your babies? Yes No
8. If there is no mother's milk, what is the young baby fed?
9. At what age are your babies weaned? months.
10. At what age are other foods given to the baby? months.
11. What foods would a breast fed baby receive at
    6 months of age?
    12 months of age?
12. What foods help produce more milk during nursing?
13. What foods should not be eaten during lactation?
14. What foods should be eaten during pregnancy?
15. What foods should not be eaten during pregnancy?
16. What foods, if any, are best during menstruation?
17. Do you give your children any special food? Yes No
    If yes, what kinds?

(½ page blank for results)

18. Are any of your children in school at any time during the year?
    Yes No
    If yes, do they receive milk at school? Yes No
    Any other foods?
19. At what age do your children begin to drink
    Coffee years
    Cocoa years
    Chocolate years
    Beer years
    Soft drinks years
    Other years.

(Continued on next page)

TABLE 93-A. (CONTINUED - page 2)

20. What foods did your family eat yesterday:
(Day of Week)

Meals	Menu Items	Food Items, Kinds	Amounts, if known	P,H,F,	Comments
Breakfast		(½ page blank for results)			
Lunch					
Supper					
At Other Times					

Notes:
P = Purchased
H = Home grown or gathered
F = Free gifts or supplements

	Breakfast	Dinner	Supper
No. guests present			
No. family members absent			

21. How often does your family eat the following foods? (In the actual form, item 21 occupies 2½ pages.)

Food	No. of Meals per Day	Week	Month	Remarks
Cereals and Cereal Products				
Corn				
Rice				
Wheat				
Bread				
Other				
Milk Products				
Milk, Fluid				
Milk, powdered				
Milk, evaporated				
Cheese				
Other				
Eggs				
Meats				
Fish				
Beef				
Pork				
Mutton				
Liver				
Poultry				
Shrimp				
Intestines				
Other				
Fats and Oils				
Butter				
Vegetable oil				
Animal fats				
Other				

Food	No. of Meals per Day	Week	Month	Remarks
Legumes				
Dried Beans				
Dried Peas				
Peanut				
Other				
Tomatoes				
Vegetables, Vit. A rich, leafy, green and yellow				
Spinach				
Parsley				
Carrots				
Lettuce				
Yellow squash				
Other				
Other L.G.Y. Vegetables				
Sweetpotatoes				
Green beans				
Green peas				
Cabbage				
Onion tops				
Turnip tops				
Other				
Other Vegetables (Vitamin A poor)				
Onions				
Beets				
Turnips				
Radish				
Other				

(Continued on next page)

629788 O - 62 - 17

TABLE 93-A. (CONTINUED - page 3)

Food	No. of Meals per Day	Week	Month	Remarks
Starchy Vegetables				
White Potatoes				
Other				
Citrus Fruits				
Oranges				
Limes				
Pineapple				
Other				
Starchy Fruits				
Banana				
Other Fruits				
Miscellaneous				
Sugar				
Cocoa				
Chocolate				
Coffee				
Soft Drinks				
Beer				
Other				

22. Food Inventory in the Home:

Item	Amount	Units	Estimated No.	Day's Supply

(½ page blank for results)

TABLE 94-A. DAILY DETERMINATION OF GROSS EXAMINER DISCREPANCIES

DAILY DETERMINATION OF
EXAMINER DIFFERENCES ON BRIEF EXAMINATIONS

Date _____

Location _____

LESIONS	PHYSICIANS								TOTAL	
	Pra-choom	Aree	Amara	Puang-tong	Vi-sarl	Din-man	Fryer	For-bes		
Bitot's spots										
Nasolabial seborrhea										
Angular lesions										
Angular scars										
Cheilosis										
Papillae - localized, red, swollen										
Papillae - diffuse, red, swollen										
FPA - slight										
FPA - moderate										
FPA - severe										
Glossitis										
Magenta colored										
Thyroid enlarged										
Foll. hyperkeratosis - arms										
Foll. hyperkeratosis - back										
Foll. hyperkeratosis - thighs										
Scrotal dermatitis										
Pellagrous dermatitis										
Bilateral edema										
Bilateral loss of ankle jerks										
Calf tenderness										
TOTAL NUMBER EXAMINED										

VI. SPECIAL STUDIES

A. BANG CHAN FOLLOW-UP STUDIES

By

Dr. Hazel M. Hauck
Professor of Food and Nutrition, Emeritus
Cornell University, Ithaca, New York

and

The 1960 ICNND Thai-American
Nutrition Survey Team

A general investigation of food habits and nutritional status in Bang Chan, Thailand was undertaken in 1952 under the auspices of the Cornell Thailand project. The community was revisited in 1960 by the Interdepartmental Committee on Nutrition for National Defense (ICNND) survey team.

1. The Food Situation

The food situation in Bang Chan in 1952-54 has been described in some detail (1b, 2b, 3b). Food was mostly home produced and an important factor in the standard of living was the number of productive hands available. The heavy work seasons occurred during transplanting in July and August, and harvest, from December through February. On the average, the per capita caloric consumption for the survey families was 25 percent higher during transplanting, and 20 percent higher during harvest, than for the growing season, when average caloric intake and rice consumption were lowest for the year.

Rice, the first essential for any meal, provided about four fifths of the calories in the diet as was again found to be the case by the ICNND team in 1960. Higher caloric intake during heavy work seasons was largely accounted for by larger amounts of rice eaten. Thus, for 11 families surveyed, the increase in average per capita caloric consumption during transplanting as compared to the growing season was about 430 calories, 87 percent of which came from increased rice consumption. The mean increase in caloric consumption during harvest could be entirely accounted for by increased consumption of rice. Home milled rice was used, even in part, only by a minority of households. Rice was cooked in excess water, and the cooking water was usually discarded. This procedure was still the usual practice in 1960.

Fish, fresh or preserved, was the food next in importance to rice. The highest intake of protein occurred in the post-harvest season, when fish ponds were drained. Some poultry, oxen, and other flesh foods were used. Nearly all of the families in

629788 O - 62 - 18

Bang Chan raised chickens, and some raised ducks, but about 3/5 of all eggs produced were sold. On the basis of replies to a brief qualitative dietary questionnaire by 8 families, eggs appeared to be used to a greater extent in 1960 than they were in 1953-54. Every family had some sort of kitchen garden, including banana trees and other plants, but seasonings and chilies were much more commonly grown than vegetables and fruit. Phag kacheed (Neptunia prostrata), a leafy water plant, was cultivated by some families, and swamp cabbage, the green leafy vegetable used most often, grew wild in the canals. The food items commonly used in Bang Chan in 1960 were essentially the same as in 1953-54.

Cash expenditures for food were small. When canals were navigable, boat vendors brought produce and during the busy work seasons farmers often bought fish as well as the usual foods: onions, garlic, limes, coconut, palm sugar and small amounts of vegetables.

For adults, two meals a day were usual, except during the heavy work seasons when a third meal might be eaten. Menus were similar for all. Two observations from records of school children were 1) that over 90 percent of them ate snacks, many of which were bought from vendors on the school grounds; and 2) that many school children ate no regular lunch. Sweets, usually made from coconut meat, flour or glutinous rice with a little added palm sugar, and fruit were the most common snacks. Fruits were seldom eaten except as snacks.

Untreated water was the usual beverage with meals. Rain water was preferred for drinking, but for 3 or 4 months of the year, water from the canal or fish pond was used.

2. Dietary Studies

Quantitative food intake for 11 families was recorded on a total of 44 survey days distributed throughout the year. Two groups of families, in which individuals were matched so far as possible as to age and sex, were selected on the basis of apparent difference in nutriture on clinical grounds. The sample was not stratified with respect to economic conditions, but those chosen for apparently better nutriture (Group B) proved to be, in general, more prosperous than those chosen because of signs of poor nutrition (Group A).

Food values were calculated on the basis of published analyses and compared to conservative nutrient allowances estimated for residents of Bang Chan. On the average, calories, protein, iron, niacin and ascorbic acid in the diets of persons in the apparently better nourished group approximated or exceeded these allowances. For the less well nourished group, this was true for niacin and ascorbic acid only. Average intakes of riboflavin were estimated to be about 1/3 or less of the allowances. Estimates of calcium intake were about 20 percent of the allowance for Group A and 30 percent of that for Group B. Vitamin A values of diets for both groups appeared to be low, and thiamine intakes marginal or low. The signs observed among persons in these families were generally those associated with low intakes of thiamine, riboflavin and vitamin A.

Rice was the major source of all nutrients except fat, calcium, vitamin A and ascorbic acid. It contributed over half of the protein in the diets of both groups, with animal foods, chiefly fish, providing about 2/5 of the protein. Families in Group B consumed more fat and sugar than those in Group A, but the overall average for 69 persons in these 11 families was only 18 grams of fat from all sources and less than 9 grams of sugar as such per person per day. Snacks of fruit contributed about 1/6 of the total ascorbic acid for Group A, and about 1/9 for Group B.

3. Health and Nutritional Status

The general condition of health and sanitation in the village of Bang Chan, and the nutritional status of 166 persons in a random sample including 31 village households and of 233 primary school children have been described (4b).

a. Height and weight. All children attending the Bang Chan primary school during the period of observation, November 1952 to November 1955, were weighed and measured at approximately 3-month intervals. In all, observations were made on 293 children, 143 boys and 150 girls, between 6 and 14 years old. Height-weight records of 217 children, 7 to 14 years of age, for whom at least 5 consecutive observations were available beginning with November 1952, 1953 or 1954, formed the basis of a cross sectional study. Height-age and weight-age tables were based on the observations made in November of each year (5b). At successive ages, mean heights and weights increased more or less regularly. From 11 to 14 years of age the girls were, on the average, slightly taller than the boys. In general, the children in Bang Chan were shorter and weighed less than western children of the same ages. Mean heights and median weights fell below the 10th percentile of Iowa school children whose measurements have been reported by Stuart and Meredith (6b). Both boys and girls in Bang Chan were somewhat less tall than urban Thai children of the same age.

Mean heights and weights by age for these children and for persons 15 years of age or older, from the random sample of village families, are shown in Table 4-B at the end of this chapter in comparison to the measurements made in 1960. In the Cornell study, mean and median weights for various age groups did not differ markedly nor consistently. Because of differences in techniques (Cornell: weights determined with minimal clothing after voiding; ICNND: weights determined without shoes and without attention to voiding) the weights as determined by the ICNND survey team for a given group of children would tend to be slightly greater than those determined by the Cornell group. Moreover, the ICNND age groups (age at last birthday) average 0.5 year older than the Cornell age groups (age at nearest birthday). If, to offset this, the ICNND figures for groups of 10 or more children are paired with those for the next older group in the Cornell study, the heights and weights for both boys and girls in 1960 are still somewhat greater than those observed in 1952-55, thus suggesting a modest increase in growth and development of Bang Chan children during the intervening years. A trend toward increase in height and weight for age, for Thai people in general, as compared to results of earlier studies is suggested by the observations on 12,234 people from 5 areas by Vachananda et al. (7b).

Seasonal variations in weight were conspicuous for both sexes and all ages observed (5b). Composite curves showing mean quarterly weights of Bang Chan school children, aged 8 to 13, for 1952-55 are shown in Figure 1-B. (See Table 5-B at the end of this chapter for original data.) Note the similarity in shape of the curves, with greater mean gains from May to November, during the rainy season, than from November to May. For 60 children, 28 boys and 32 girls, observations were made at 3-month intervals for the entire period of 3 years (5b). In Figure 2-B (see Table 6-B also) mean weights are shown for the age groups including the larger numbers of children (from 6 to 11 individuals per age group). The effect of individual variation on mean values for such small groups is apparent here: thus the weights of one large 9-year old and one small 10-year old girl place the curve for girls who were 10 years old in November 1952 between curves for those who were 8 and 9 years old. The less favorable growth in weight from November to May as compared to May to November, is clearly illustrated by the weight curves of these children for 3 successive years. In the year 1954, this seasonal variation was exaggerated; from February to May 1954, 27 of the 32 girls and 25 of the 28 boys lost weight. In consequence of this, for the group as a whole the entire annual increment was attained between May and November. Seasonal variation probably played no role in the weight-age differences observed in 1960 as compared to 1952-55, since observations made in December should be roughly comparable to those made in November.

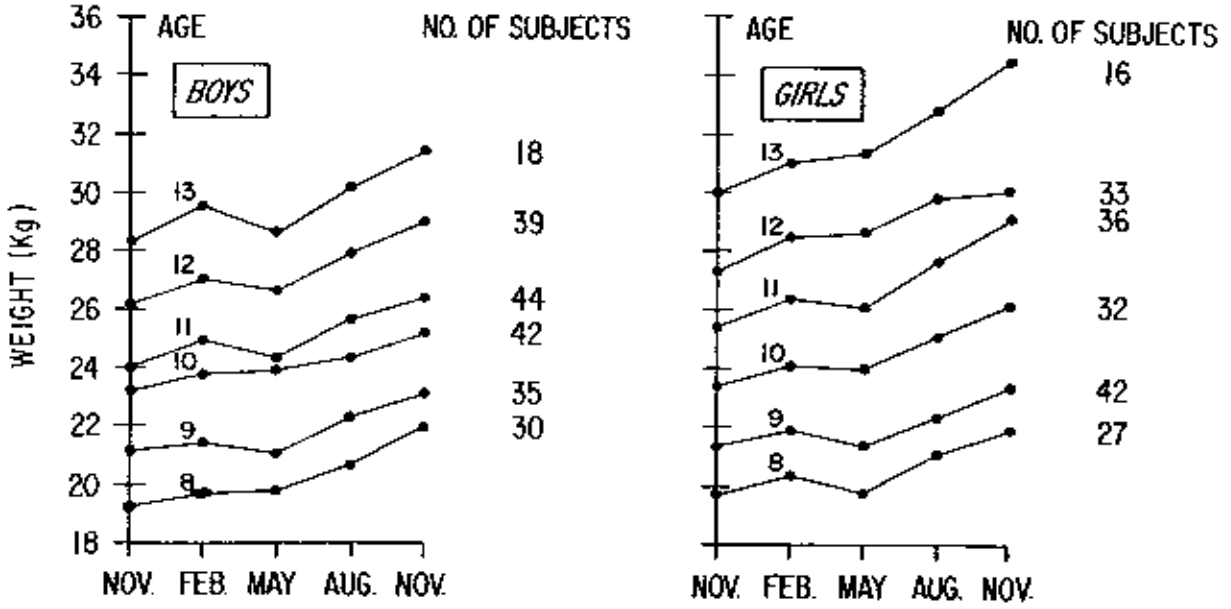


Figure 1-B. Mean Quarterly Weights of Bang Chan School Children – Composite Curves for 1952–1955

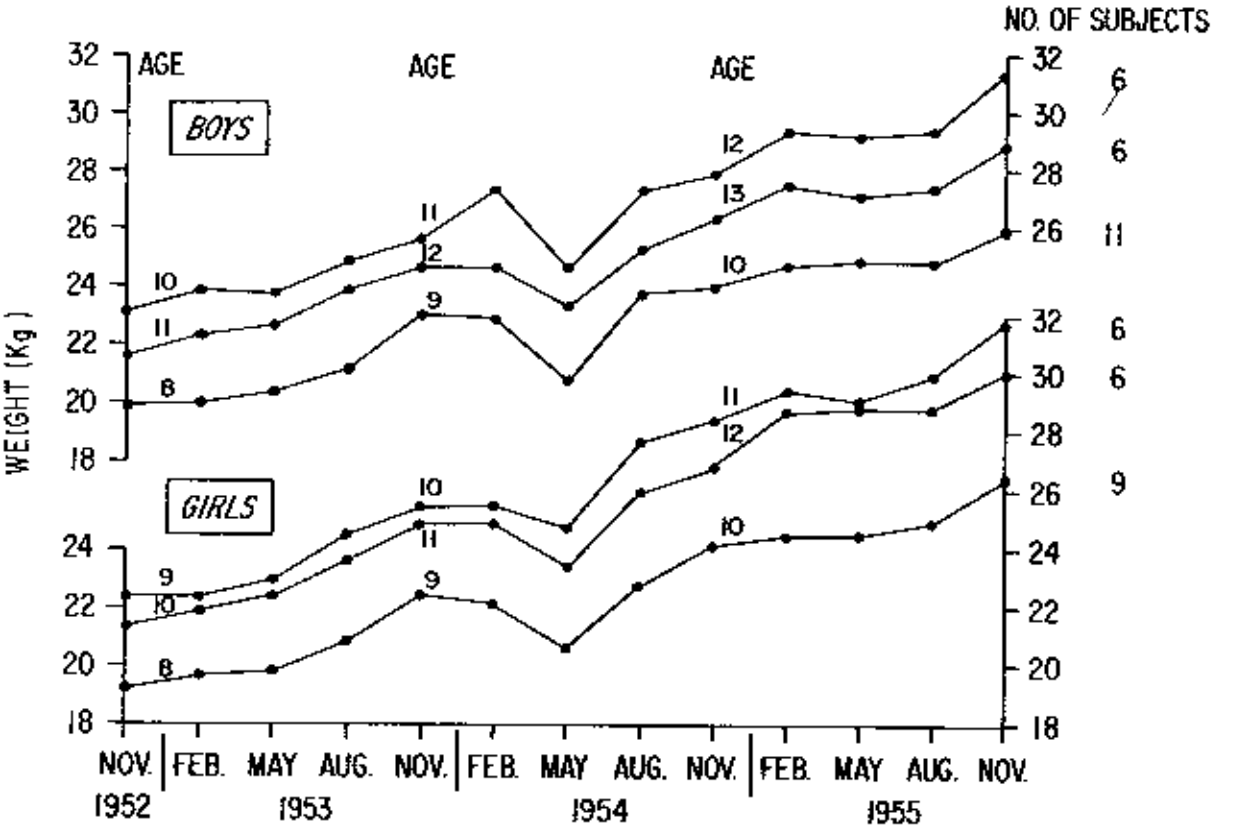


Figure 2-B. Mean Weights of Bang Chan School Children – Quarterly Observations from November 1952 Through November 1955

b. Signs of nutritional deficiency. (4b) Slightly over half the persons examined, 54 percent of the school children and 53 percent of the family sample, had possible signs of malnutrition. Individuals had from 1 to 7 such signs each. In general, more of the children and adolescents than the adults were free of possible signs of malnutrition, and the larger percentages of persons with 2 or more signs were among the older persons examined. Of 23 cases with absence of knee jerk, 16 had absence of ankle jerk also. Various changes in tongue and lips such as filiform papillary atrophy and angular lesions not only tended to occur together but these were often associated with absence of knee jerk and/or ankle jerk. Signs most often noted, namely changes in tongue, lips, skin and hair, and absence of knee and ankle jerk, might reasonably be associated with apparent deficiencies of riboflavin, vitamin A and thiamine in the diet.

Selected clinical findings of the 1960 ICNND study are presented in Table 1-B. (See Table 7-B at the end of this chapter for further details.) Of the 251 subjects examined three-quarters (192) were between the ages of 5 and 14 years. When the findings among these children were compared with those of similar age groups from the general survey throughout the country, a few differences were suggested. Angular lesions were definitely observed in Bang Chan but the prevalence was less than half that observed in the general survey. The prevalence of filiform papillary atrophy did not exceed 5% in any age or sex group in Bang Chan, but the limited number of observations suggested that the lesion was more common than in the general survey population. Goiter was rare in Bang Chan children except among the 10-14 year old girls, in sharp contrast to the high incidence of goiter observed to the north and east of the central plain of Thailand. No cases of complete absence of ankle jerks were seen in 1960. Comparing with the appreciable number of cases of deep tendon reflex loss in the Cornell studies, this result in 1960 may be explained in part at least on the basis of examination technique, in that the ICNND group took particular pains to verify the absence by manual reinforcement, examination in two positions, and usually verification by a second examiner. Therefore, on the basis of clinical examinations in Bang Chan, one's attention is drawn primarily to filiform papillary atrophy and the question of coexistent anemia.

TABLE 1-B. SELECTED [1] CLINICAL FINDINGS COMPARING 5-14 YEAR OLD CHILDREN FROM BANG CHAN AND THE GENERAL THAILAND SURVEY

ABBREVIATED EXAMINATIONS[2]	5-9 Year Olds				10-14 Year Olds			
	Males		Females		Males		Females	
	Bang Chan	Thai-land	Bang Chan	Thai-land	Bang Chan	Thai-land	Bang Chan	Thai-land
Number examined	59	189	53	186	41	196	39	225
	Percent Prevalence							
Angular lesions	5.1	12.2	3.8	12.4	7.3	10.7	2.6	4.4
FPA - slight	-	3.2	1.9	1.1	4.9	0.5	2.6	-
FPA - M/S	1.7	1.0	-	0.5	-	1.0	2.6	-
Goiter, Grade I	-	18.6	1.9	19.2	-	13.7	7.7	19.4
Goiter, Grade II	-	9.0	-	10.2	-	9.7	-	7.6
Bilateral AJ loss	-	1.0	-	0.5	-	0.5	-	0.9

1/ See Table 7-B at the end of this chapter for more complete details.
2/ Abbreviations: FPA = filiform papillary atrophy; M/S = moderate to severe; goiter grading is by WHO criteria; AJ = ankle jerk.

Beriberi was the only clearly defined deficiency disease observed among residents of Bang Chan in the course of the Cornell field study. Three cases were seen. One was a 49-year old man who complained of loss of sensation in the extremities, and some difficulty in walking. Knee jerk and ankle jerk were absent. The other two were cases of postpartum beriberi. Both had difficulty in rising and walking. One of them was observed to change the position of her legs, as she sat on the floor, by lifting them with her hands. These three patients were seen by a Thai physician who was familiar with beriberi. In 1960 the ICNND survey team saw no cases of beriberi in Bang Chan, and, curiously, found no individuals with loss of knee jerk or ankle jerk among 251 persons examined.

The physician with the Cornell research group also queried the parents of 58 infants and children who had died concerning the cause of death (4b). Six of 17 infants who had died between one month and one year of age had some of the symptoms of infantile beriberi such as convulsions and almost voiceless crying. In 2 cases, the mother had symptoms of beriberi, such as numbness or tingling of the extremities, or difficulty in walking, at the time. These infants were considered to have died of beriberi, whereas if the mother did not have beriberi at the time, death was attributed to "convulsions, cause unknown." Stahlie (8b, 9b) reported that in an area where pre- and/or postpartum beriberi was relatively common, beriberi was not mentioned in the medical history of children under four years old, although two babies were found to have chronic beriberi which was confirmed by a therapeutic test with thiamine injection.

The only biochemical determination made during the 1952 study was for hemoglobin. Values of 11.5 gms or less per 100 ml were observed in 9 percent of the school children 7 to 14 years of age who were examined, and in about 6 percent of the males and 25 percent of the females over 15 years of age. Of 337 persons examined, however, 2 only, one child and one adult female, were found to have hemoglobin values under 9.75 gms per 100 ml (4b).

The biochemical findings of the 1960 ICNND study are presented in Table 2-B for the 5-9 year old males in Bang Chan compared with the results of the general survey (see Table 8-B at the end of this chapter for further details). This sex-age group was selected because it was the only group in this very limited Bang Chan study with an appreciable number of subjects studied; the results were essentially the same for the 5-9 year comparisons as for the comparisons of all age groups combined. The total serum proteins were lower in Bang Chan than in the general survey for two reasons: both the serum albumins and the serum globulins were lower. The low serum albumins were particularly significant because the only subject in the entire Thailand study with a serum albumin in the "deficient" range (<2.5 gms/100 ml) was a female child of 5-9 years of age in Bang Chan, in addition to which the vast majority of subjects (18 of a total group of 21) fell in the "low" range in sharp contrast to only one-quarter of total subjects falling in this range in the general survey. These findings lend support to the report of Netraseri et al. (10b) describing the existence of protein malnutrition in children in Thailand, certainly not to the extent observed in many developing countries elsewhere in the world but nevertheless a clinical problem. It is difficult to explain the lower serum globulins; parasitological data would have been helpful. The other striking difference between Bang Chan and the general survey was the exceptionally severe degree of hypochromic anemia encountered in Bang Chan among all age and sex groups with hemoglobins approximating 6-7 gms/100 ml and MCHC values approximating 18-19%. This degree of anemia did not appear to exist in 1952. With the data available, it is only a matter of conjecture as to why Bang Chan stood out as the worst of the entire 1960 Thailand survey with regard to anemia. Further studies to verify these findings and to explore causal factors would certainly seem warranted. In most other respects, the Bang Chan biochemical data resembled those of the general survey.

TABLE 2-B. BIOCHEMICAL FINDINGS COMPARING 5-9 YEAR OLD MALES[1/] FROM BANG CHAN AND THE GENERAL THAILAND SURVEY[2/]

	5-9 Year Old Males			
	Number of Subjects		Mean Values	
BLOOD	Bang Chan	Thailand	Bang Chan	Thailand
TOTAL SERUM PROTEIN (gms/100 ml)	6	11	6.0	7.1
SERUM ALBUMIN (gms/100 ml)	6	11	3.2	3.5
SERUM GLOBULIN (gms/100 ml)	6	11	2.8	3.6
ALBUMIN/GLOBULIN RATIO	6	11	1.17	1.02
HEMOGLOBIN (gms/100 ml)	6	11	5.4	10.7
HEMATOCRIT (%)	6	21	30.0	34.0
MCHC (%)	6	11	18.0	31.1
SERUM VITAMIN A (mcg/100 ml)	6	11	16.7	17.9
SERUM CAROTENE (mcg/100 ml)	6	11	68	55
URINE			MEDIAN VALUES	
THIAMINE (mcg/gm C)	6	19	72	191
RIBOFLAVIN (mcg/gm C)	6	19	44	40
N'METHYLNICOTINAMIDE (mg/gm C)	6	18	8.0	4.4

1/ Comparisons limited to 5-9 year age group because only this group had more than three subjects in Bang Chan.

2/ See Table 8-B for more complete data on the general survey, tabulated under "Thailand" above; Bang Chan data are not included in the general survey results.

c. Dental. In the original report on the dental health of the people of Bang Chan village 1953, the children in the primary schools were reported to be relatively free of dental caries (11b). In this group of 226 children, boys and girls combined, 7-14 years of age, 42% were free of carious teeth; permanent and deciduous. Sixty-one children in the same age group were examined in 1960 by two Thai dentists, Dr. Pranee Sirikaya and Dr. Rajda Chandravejjsmarn, and 31% of those examined were found to be free of caries in deciduous and permanent teeth. When the permanent teeth alone were considered, 79% of the males and 66% of the females examined in 1960 were free of dental decay while in 1953, 74% of the males and 60% of the females were recorded as caries-free. In considering only the deciduous teeth, 56% of the males and 50% of the females were free of caries in these teeth in 1953. The examinations done in 1960 revealed an increase in caries of the deciduous teeth with 30% of the males and 20% of the females examined completely free of caries. It must be understood, however, that the number of children examined in 1960 was extremely small and for this reason, it would be hard to draw definitive conclusions or to make sound comparisons with the 1953 data. None of the children examined in either year had received professional dental care.

The mean numbers of decayed, missing and filled permanent teeth (DMF) per person were about the same or just slightly lower in 1960 when compared with the examinations done in 1953. (Table 3-B).

Of the persons over 15 years of age examined in 1960, about 70% retained almost a full complement of teeth. In 1953, 69% of those in this age span were reported as having nearly a full complement of teeth (11b).

From the gingival examinations done in 1960, the majority of the children and all of the adults were found to show some evidence of marginal gingivitis. This gingival condition was noted to begin at very early ages and rapidly progress to advanced stages of periodontal disease by middle age. This destructive periodontal disease probably accounted for most of the tooth loss seen in the adult population.

In summary, the examinations of the oral and dental structures of the inhabitants of Bang Chan in 1960 revealed practically the same conditions to exist as were reported in 1953. The incidence of dental caries among the children was quite low with a high percentage of those examined being completely free of dental caries in the permanent teeth. Gingivitis was common in practically all the younger ages and rapidly advanced until the middle forties when severe destructive periodontal disease was quite prevalent among this age group.

Table 3-B. CHILDREN FREE FROM CARIES OF PERMANENT TEETH AND CARIES INCIDENCE IN PERMANENT TEETH, 1953 AND 1960

Age (yr.)	No. Examined		No. Free From Caries		Total No. of Permanent Teeth		No. of Carious Teeth: Total		No. of Carious Teeth: Mean per Child	
	1953	1960	1953	1960	1953	1960	1953	1960	1953	1960
					Boys					
7	5	2	4	2	32	15	1	0	0.20	.00
8	18	5	15	3	141	55	3	2	0.22	.40
9	9	6	8	6	96	85	1	0	0.11	.00
10	21	5	17	3	290	98	9	3	0.38	.60
11	25	4	15	3	444	76	18	1	0.72	.25
12	20	4	15	4	423	104	15	0	0.75	.00
13	17	2	11	1	447	52	9	3	0.54	1.50
14	1	1	1	1	28	24	0	0	0.00	.00
Total	116	29	86	23	1,901	509	56	9	0.50	.31
					Girls					
7	8	5	6	2	44	44	3	6	0.37	1.20
8	16	7	15	6	144	97	1	2	0.06	.29
9	8	3	6	1	86	47	2	5	0.25	1.67
10	12	6	8	5	205	96	9	2	0.75	.33
11	24	5	12	3	474	112	27	8	1.10	1.60
12	19	4	8	3	425	101	26	2	1.30	.50
13	19	1	9	0	501	21	24	1	1.27	1.00
14	4	1	3	1	112	28	6	0	1.50	.00
Total	110	32	67	21	1,991	546	98	26	0.90	.81

4. Studies of Special Groups

a. Reproductive histories of women. The reported age at menarche for 94 females interviewed ranged from 13 to 19 years, with a median age of 15. Of these 77 percent were from 14 to 16 years old at menarche. Vachananda et al. (7b) reported the mean age at menarche for 682 Thai girls and young women as 14.5 years, but the mean for Bangkok girls with higher income was about 12 years.

Of 438 pregnancies reported by 84 mothers in Bang Chan, over 90 percent resulted in live births. Of the 397 living children born to these women, 81 percent survived at the time of interview (4b).

b. Diet during pregnancy and lactation. At the start of the investigation in 1952, inquiry concerning young infants and women who were expecting babies was made of the headman of each hamlet, of persons who came to a village store, and at each house visited while the investigators were becoming acquainted in the community. Thus a reasonably complete list of appropriate households was obtained. In all, 66 mothers of young children were interviewed. Information on diet during pregnancy, postpartum, and lactation was obtained from women who were either in the stage under discussion or had only recently passed through it.

During pregnancy most women in Bang Chan continued to eat as usual. A few expressed cravings for certain foods, and a minority thought some kinds of food should not be eaten during pregnancy.

During the postpartum rest period most women ate a very restricted diet. Rice and fish, with salt, were the foods considered by all informants to be appropriate for this period. Stahlie (8b, 9b) noted that in the survey area where postpartum beriberi was most prevalent, 81 percent of the women practiced some form of food restriction postnatally. If the mother has had subclinical beriberi during pregnancy, postpartum food restrictions might easily precipitate the full clinical picture.

As a rule, diet during lactation, after the mother resumed her usual work, was the customary family diet. A minority of informants mentioned foods which should not be eaten by a nursing mother.

Evidence of the need to improve diets in Bang Chan was provided by the occasional occurrence of beriberi or the history of beriberi among mothers as well as by medical inspection and family dietary studies.

c. Feeding of infants and young children. A description of child feeding practices was obtained from records concerning 57 children from birth to two years of age, a majority of whom were visited from 5 to 7 times (12b).

Breast feeding was the rule in Bang Chan. For a majority of infants observed, breast feeding was continued into the second year. Half had been weaned by 18 months, and 9/10 by the time they were 2 years old. Few received animal milk after weaning. Of the 8 families interviewed concerning diet in 1960, three had a total of 11 children born since the Cornell study was made. In one family the latest child was fed on sweetened condensed milk. In another, in which the mother was a school teacher, three children had been artificially fed. These infants were given dried whole milk for 3 months, then a sweetened condensed milk. Previous children in this family had been breast fed. The grandmother commented that the children who were not breast fed seemed stronger than those who were. The desirability of retaining breast feeding in areas where good sanitary practices are not well developed, is obvious. Moreover, if the use of sweetened

condensed milk should spread in Bang Chan, the fat but poorly nourished babies that were common in the United States 50 years ago might become common there.

A small, rather flavorless, banana was given to young babies, sometimes before they were put to the breast. This type of banana and soupy rice were the only supplementary foods given before 6 months of age. Stahlie (8b, 9b) commented that infantile beriberi was less common than one might expect in areas where pre- and/or postpartum beriberi occurred, and he attributed this to the fact that many infants are fed from 50 to 100 gms of this banana per day. Though its thiamine content is not high, this may provide enough thiamine, in addition to that in the breast milk, to prevent clinical beriberi.

Protein-rich foods, chiefly fish and egg, were generally introduced in small amounts during the second half of the first year. Few infants were given vegetables before one year of age, and even then none had them daily. At two years of age, some children had not yet been given green vegetables. Late introduction of vegetables into the child's diet may be due to the fact that vegetables were often prepared as hot curries which were considered unsuitable for young children.

A child was usually allowed foods commonly eaten by adults by the time he was weaned, although a few informants specified that the child could have anything but "hot tasting" foods, i.e. foods containing chili. A minority of informants mentioned other foods as not good for younger babies.

Except for dietary restrictions while the mother was lying by the fire, postpartum, no well established dietary taboos connected with the feeding of mothers or babies were encountered. The concept that a good choice of food is important to the health of both mother and child seemed to be entirely lacking.

d. Growth of infants and young children (12b, 13b). Serial measurements were made of height and weight of infants and small children and reasonably complete records were obtained for 71 individuals, 36 boys and 35 girls. Most of them were measured 6 or 7 times during the 18-month period of study.

Thirty-eight of the height curves for these children fell below, and only 15 were above the curves drawn to mean values reported from a well baby clinic in Bangkok.

Most infants gained in weight up to 6 months of age, but thereafter most children experienced periods of stationary weight or weight loss. Sixteen only of 68 infants and children who were weighed and measured over a period of a year or more gained at each successive observation.

From the information available, specific reasons cannot be given for the failure to gain in weight experienced by so many of the children observed. Weaning appeared not to be a major factor. Of 30 children observed over the weaning period, 14 had lost weight or failed to gain at some time before weaning, but only 7 lost or failed to gain at or near the weaning period.

Repeated periods of failure to gain in weight, or even weight loss, which were observed among school children 7 to 14 years of age in Bang Chan, as well as in infants and small children, may be evidence of unsatisfactory nutrition, and might account in some part for the relatively small size of adults. Extended longitudinal studies on growth of Thai children, both rural and urban, are needed, as are studies of food intake, intestinal parasitism and other conditions which may lead to growth failure. Controlled therapeutic trials would help in recognizing the more serious of many problems of child health in this region.

Since food is prepared at one time for all members of the family, improvement in the diets of mothers and small children would probably parallel any improvement in the general family dietary. Equally, efforts directed at improving the diets of pregnant and lactating women and the infant and young child should result in improvement in the nutritional status of the entire family.

APPENDIX

TABLE 4-B. MEAN HEIGHTS AND WEIGHTS, BY AGE, OF MALES AND FEMALES IN BANG CHAN, OBSERVATIONS IN 1952-55 COMPARED TO THOSE IN 1960[1/]

Age (Years)	Number Examined		Height (cm)		Weight (kg)	
	Cornell[2/] 1952-55	ICNND 1960	Cornell 1952-55	ICNND 1960	Cornell 1952-55	ICNND 1960
Males						
7	3	17	113	113	18.6	20.0
8	30	21	115	121	19.3	22.4
9	34	16	118	126	21.2	24.7
10	42	12	123	130	23.2	25.9
11	44	15	126	135	24.0	29.8
12	39	10	130	137	26.2	31.2
13	18	3	133	138	28.3	30.7
14	12	1	141	140	33.0	30.0
15+[3/]		25		161		54.2
15-19	9		154		45.1	
20+	37		159		53.0	
Female, NPNL						
7	6	15	109	116	17.3	19.7
8	27	21	115	122	19.6	22.9
9	42	16	119	126	21.3	24.7
10	32	12	123	130	23.3	25.9
11	36	14	127	134	25.4	27.6
12	33	6	131	137	27.4	31.8
13	16	3	136	141	29.9	33.0
14	15	1	142	153	34.2	50.0
15+[3/]		21		150		47.2
15-19	8		151		45.4	
20+	45		151		45.3	

1/ Techniques differed somewhat. The Cornell research group weighed and measured children in minimal clothing, after voiding, and grouped children by age at nearest birthday. The ICNND survey group used age at last birthday. They weighed and measured children without shoes, and without attention to voiding.

2/ This includes all children from 7 to 14 years of age for whom 5 consecutive records were available, beginning with November of 1952, 1953 or 1954. Observations for November only were used in constructing this table.

3/ Mean ages of ICNND examinees: M 15+ = 44 years; F 15+, NPNL = 40 years.

TABLE 5-B. MEAN BODY WEIGHT OF BANG CHAN SCHOOL CHILDREN, AGES 8 TO 13, FOR THREE YEARS, 1952-1955

Age	No. of Subjects	Nov.	Feb.	May	Aug.	Nov.
			BOYS (kg)			
8	30	19.3	19.6	19.7	20.6	21.8
9	35	21.2	21.4	21.0	22.3	23.1
10	42	23.2	23.8	23.8	24.3	25.2
11	44	24.0	24.9	24.3	25.7	26.3
12	39	26.2	27.0	26.6	27.9	29.0
13	18	28.3	29.5	28.6	30.2	31.4
			GIRLS (kg)			
8	27	19.6	20.3	19.7	21.1	21.9
9	42	21.3	21.7	21.4	22.3	23.4
10	32	23.3	24.0	24.0	25.1	26.2
11	36	25.4	26.4	26.1	27.7	29.2
12	33	27.4	28.5	28.6	29.8	31.1
13	16	29.9	31.0	31.3	32.9	34.5

TABLE 6-B. MEAN WEIGHTS OF BANG CHAN SCHOOL CHILDREN, QUARTERLY OBSERVATIONS FROM NOVEMBER 1952 THROUGH NOVEMBER 1955

Age 1952	No. of Sub-	1952	1953				1954				1955			
Nov.	jects	Nov.	Feb.	May	Aug.	Nov.	Feb.	May	Aug.	Nov.	Feb.	May	Aug.	Nov.
						BOYS (kg)								
8	11	19.9	20.0	20.4	21.1	23.0	22.8	20.7	23.7	23.9	24.7	24.9	24.8	26.0
10	6	23.1	23.8	23.7	24.8	25.7	27.3	24.6	27.3	27.8	29.4	29.2	29.3	31.3
11	6	21.7	22.3	22.6	23.8	24.6	24.6	23.3	25.2	26.3	27.5	27.1	27.4	28.8
						GIRLS (kg)								
8	9	19.2	19.6	19.8	20.8	22.4	22.0	20.6	22.7	24.1	24.3	24.3	24.8	26.4
9	6	22.4	22.4	23.0	24.5	25.3	25.4	24.7	27.6	28.3	29.3	29.0	29.9	31.7
10	6	21.4	21.8	22.4	23.5	24.3	24.3	23.4	25.8	26.7	28.7	28.8	28.7	30.0

TABLE 7-B. CLINICAL FINDINGS AMONG THE THAI CIVILIANS IN TERMS OF AGE AND SEX GROUPS - COMPARISON OF BANG CHAN WITH THE GENERAL THAILAND SURVEY[1/]

ABBREVIATED EXAMINATIONS[2/]	BANG CHAN					THAILAND				
	Males					Males				
Age (years)	0-4	5-9	10-14	15-44	45+	0-4	5-9	10-14	15-44	45+
Number examined	4	59	41	14	11	202	189	196	348	172
	Percent Prevalence					Percent Prevalence				
Bitot's spots	-	1.7	-	-	-	-	1.0	-	1.1	-
Nasolabial seborrhea	-	-	-	-	-	-	-	-	6.6	1.7
Angular lesions	-	5.1	7.3	-	-	3.0	12.2	10.7	6.3	2.3
Angular scars	-	1.7	2.4	-	-	-	0.5	0.5	0.3	0.6
Cheilosis	-	-	-	-	-	-	-	-	-	-
S.R.P. - localized[3/]	-	-	4.9	-	-	-	2.1	8.7	12.1	7.6
FPA - slight[3/]	-	-	4.9	-	9.1	-	3.2	0.5	1.7	2.3
FPA - M/S[3/]	-	1.7	-	-	-	0.5	1.0	1.0	0.3	0.6
Goiter, Grade I[3/]	-	-	-	-	-	3.3	18.6	13.7	19.4	8.4
Goiter, Grade II[3/]	-	-	-	-	-	2.0	9.0	9.7	8.3	5.8
Bilateral AJ loss[3/]	-	-	-	-	-	-	1.0	0.5	0.6	4.1

	Females, NPNL[3/]					F,PL[3/]	Females, NPNL[3/]					F,PL[3/]
Age (years)	0-4	5-9	10-14	15-44	45+	15+	0-4	5-9	10-14	15-44	45+	15+
Number examined	5	53	39	12	9	4	200	186	225	254	200	217
	Percent Prevalence						Percent Prevalence					
Bitot's spots	-	-	-	-	-	-	-	-	-	-	1.0	-
Nasolabial seborrhea	-	-	-	8.3	-	25.0	-	-	-	2.4	1.0	2.3
Angular lesions	-	3.8	2.6	-	-	25.0	4.5	12.4	4.4	4.3	3.5	4.6
Angular scars	-	-	-	-	-	-	-	-	-	0.8	1.0	-
Cheilosis	-	-	-	-	-	25.0	-	-	-	0.4	0.5	-
S.R.P. - localized[3/]	-	-	7.7	-	-	-	-	2.2	4.9	5.9	6.5	12.4
FPA - slight[3/]	-	1.9	2.6	8.3	-	-	1.5	1.1	-	3.1	9.0	7.8
FPA - M/S[3/]	-	-	2.6	-	-	25.0	-	0.5	-	2.4	7.5	2.8
Goiter, Grade I[3/]	-	1.9	7.7	8.3	-	75.0	4.1	19.2	19.4	27.4	14.5	27.6
Goiter, Grade II[3/]	-	-	-	-	-	-	2.0	10.2	7.6	24.4	15.0	26.7
Bilateral AJ loss[3/]	-	-	-	-	-	-	-	0.5	0.9	2.4	3.5	2.8

1/ See Table 31-A for more complete data on the general survey tabulated under "Thailand" above; Bang Chan data are not included in the general survey results.

2/ Clinical entities examined for but not listed above had negligible or zero prevalences

3/ Abbreviations: S.R.P. = swollen red interdental papillae; FPA = filiform papillary atrophy; M/S = moderate to severe; goiter grading is by WHO criteria; AJ = ankle jerk; NPNL = non-pregnant, non-lactating; F,PL = females, pregnant or lactating

TABLE 8-B. BIOCHEMICAL FINDINGS COMPARING BANG CHAN WITH CIVILIANS OF THE GENERAL THAILAND SURVEY[1/]

BLOOD	Males (Totals)		Females (Totals)	
	Bang Chan	Thai-land	Bang Chan	Thai-land
TOTAL SERUM PROTEIN				
No. of subjects	12	98	9	89
Mean (gms/100 ml)	5.6	7.2	5.5	7.6
% "Deficient"	83.3	-	88.9	-
% "Low"	-	-	11.1	-
SERUM ALBUMIN				
No. of subjects	12	97	9	89
Mean (gms/100 ml)	3.1	3.6	3.0	3.6
% "Deficient"	-	-	11.1	-
% "Low"	91.7	23.7	77.7	28.1
SERUM GLOBULIN				
No. of subjects	12	98	9	89
Mean (gms/100 ml)	2.4	3.5	2.5	3.9
% "Low"	25.0	1.0	-	1.1
% "High & Very High"	16.7	92.8	11.1	92.1
ALBUMIN/GLOBULIN RATIO				
No. of subjects	12	98	9	89
Mean	1.32	1.06	1.39	1.00
HEMOGLOBIN				
No. of subjects	12	97	8	88
Mean (gms/100 ml)	6.4	12.8	6.2	11.0
% "Deficient"	100	28.9	100	68.2
% "Low"	-	41.2	-	29.5
HEMATOCRIT[2/]				
No. of subjects	12	119	8	108
Mean (%)	33.3	37.5	33.4	33.0
% "Deficient"	58.3	25.2	50.0	50.9
% "Low"	41.7	40.3	50.0	39.8
MCHC[2/]				
No. of subjects	12	97	8	86
Mean (%)	19.2	32.4	18.8	32.5
% "Deficient"	100	8.2	100	8.1
% "Low"	-	11.3	-	15.1
SERUM VITAMIN A				
No. of subjects	12	97	9	87
Mean (mcg/100 ml)	21.5	25.8	19.3	21.9
% "Deficient"	-	1.0	-	5.7
% "Low"	58.3	32.0	55.6	34.5
SERUM CAROTENE				
No. of subjects	12	97	9	87
Mean (mcg/100 ml)	62	60	59	71
% "Deficient"	-	3.1	-	2.3
% "Low"	8.3	21.6	11.1	18.4
URINE				
THIAMINE				
No. of subjects	12	111	10	89
Median (mcg/gm C)	87	62	52	99
% "Deficient"	8.3	25.2	10.0	16.8
% "Low"	33.3	27.0	60.0	18.0
RIBOFLAVIN				
No. of subjects	12	106	10	88
Median (mcg/gm C)	46	31	45	36
% "Deficient"	-	46.2	10.0	40.9
% "Low"	75.0	44.3	80.0	44.3
N'METHYLNICOTINAMIDE				
No. of subjects	12	111	10	91
Median (mg/gm C)	6.1	4.2	6.1	5.0
% "Low"	-	2.7	-	4.4
% "High"	83.3	48.6	60.0	61.5

1/ See Table 41-A for more complete data on the general survey, tabulated under "Thailand" above; Bang Chan data are not included in the general survey results.

2/ Hematocrit values are somewhat low and MCHC values somewhat high compared with true values because of intermittent hemolysis.

REFERENCES

1b. Hauck, H. M., Sudsaneh, S. and Hanks, J. R. Food habits and nutrient intakes in a Siamese rice village. Studies in Bang Chan, 1952-54. Data Paper No. 29. Southeast Asia Program, Department of Far Eastern Studies. Cornell University, Ithaca, New York, 1958.

2b. Hauck, H. M., Hanks, J. R., and Sudsaneh, S. Food habits in a Siamese village. J. Am. Dietet. A., 35:1143-1148, 1959.

3b. Hauck, H. M. and Sudsaneh, S. Food intake and nutritional status in a Siamese village. J. Am. Dietet. A., 35:1149-1157, 1959.

4b. Hauck, H. M. Aspects of health, sanitation, and nutritional status in a Siamese rice village. Studies in Bang Chan, 1952-54. Data Paper No. 22. Southeast Asia Program, Department of Far Eastern Studies. Cornell University, Ithaca, New York, 1956.

5b. Hauck, H. M., Thorangkul, D., and Rajatasilpin, A. Growth in height and weight of elementary school children (with some observations on health and nutritional status in Bang Chan, Thailand, 1952-55). J. Trop. Pediat., 6:84-91, 1960.

6b. Stuart, H. C. and Meredith, H. V. Use of body measurements in the school health program: Part I. General considerations and the selection of measurements. Part II. Methods to be followed in taking and interpreting measurements and norms to be used. Am. J. Public Health, 36:1364-1386, 1946.

7b. Vachananda, R., Kittivija, K. and Snidvongs, W. An observation of body measurements of some Thai people. In: Proceedings of the Ninth Pacific Science Congress, Vol.15 (Nutrition) pp. 10-12, 1959.

8b. Stahlie, T. D. Thai Children Under Four. An essay in the evaluation of a maternal and child health service. Amsterdam, 1959. Scheltema and Holkema.

9b. Stahlie, T. D. Some aspects of child health in Thailand. J. Trop. Med. and Hyg., 64:79-87, 1961.

10b. Netrasiri, A. and Netrasiri, C. Kwashiorkor in Bangkok--an analytical study of 54 cases. J. Trop. Pediat., 1:148-155, 1955.

11b. Kamalanathan, G. S., Hauck, H. M., and Kittiveja, C. Incidence of caries among school children in Bang Chan, Thailand, 1953. Am. J. Clin. Nutr., 8:231-239, 1960.

12b. Hauck, H. M. Maternal and child health in a Siamese rice village: Nutritional aspects, studies in Bang Chan, 1952-54. Data Paper No. 39. Southeast Asia Program, Department of Far Eastern Studies, Cornell University. Ithaca, New York, 1959.

13b. Smith, B. J. and Hauck, H. M. Growth in height and weight of Thai infants and young children, Bang Chan, 1952-54. J. Trop. Pediat., 7:55-65, 1961.

B. STUDY OF AN INSTRUMENT FOR OBJECTIVE MEASUREMENT OF THE ACHILLES REFLEX

It was observed by the ICNND survey of Vietnam in 1959 that there appeared to be an association of absent Achilles reflex and an inadequate thiamine intake in the population under study. Because of the subjective nature of this finding it was accordingly decided that a more objective process of measuring the Achilles reflex response in relation to thiamine metabolism might be undertaken.

Thus, a device designed to deliver a blow of constant force to the Achilles tendon and capable of measuring response in an objective manner was utilized. Because of the necessity for a rugged instrument which would not be temperature or humidity dependent and not require expert attention and maintenance, an electronic device was ruled out in favor of a purely mechanical contrivance.

Method

The instrument illustrated in Figure 1-C was used to measure the ankle jerk response. The person to be tested was positioned so that the left leg was supported at the popliteal fossa by a bar linking two parallel members, so that the knee joint formed an approximately 70 to 90 degree angle. The heel was placed between an adjustable rest on the foot plate and toe plate, then the foot strap secured the foot to the plate. The popliteal support bar was drawn away from the foot until the plantar subcutaneous fascial-fat pad was observed to become less compressed than seen in the full weight-bearing position. Effectively this was intended to obtain support of the foot divided between the plantar surface and taloachilles portions of the heel.

The foot plate was then dorsi and plantar flexed alternately four to six times in an attempt to obtain optimum relaxation of muscles of the lower extremity. This was coincident with requests for relaxation of the fully supported leg in the national tongue. At this time adjustment of the hammer was obtained so that a movement of three divisions of the percussion bar was obtained before it struck the achilles tendon.

When it was believed that optimum relaxation was obtained, the foot plate was positioned at the last division of the rachet-pinion marker at the maximum degree of dorsiflexion, the percussion hammer was drawn back then allowed to strike the Achilles tendon.

These attempts at relaxation were repeated, the foot pressure on the plate rechecked and the stimulus was repeated in this manner until three to five responses of the same order of magnitude were obtained. The mean of these responses was then recorded as the Achilles reflex response.

Results

The villages of Padad, Ban Fon and San Pong in the Chiengmai area were found to have mean thiamine excretion significantly less than most other villages surveyed. The ankle reflex responses of these villages were compared with those recorded in other villages and one military base. Comparison was made on a sex and age basis, since it appeared reasonable to assume that this reflex may be age and sex dependent. It appears from Table 1-C that the ankle jerk response seems to be slightly lower at all ages and for both sexes in Padad,

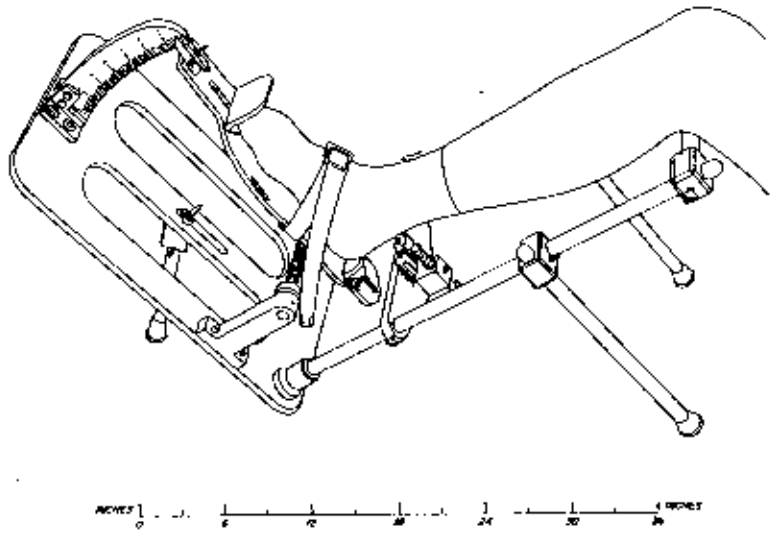


FIGURE 1-C An Instrument for Objective Measurement of the Achilles Reflex

URINARY THIAMINE EXCRETION VS ACHILLES REFLEX RESPONSE (MALE)

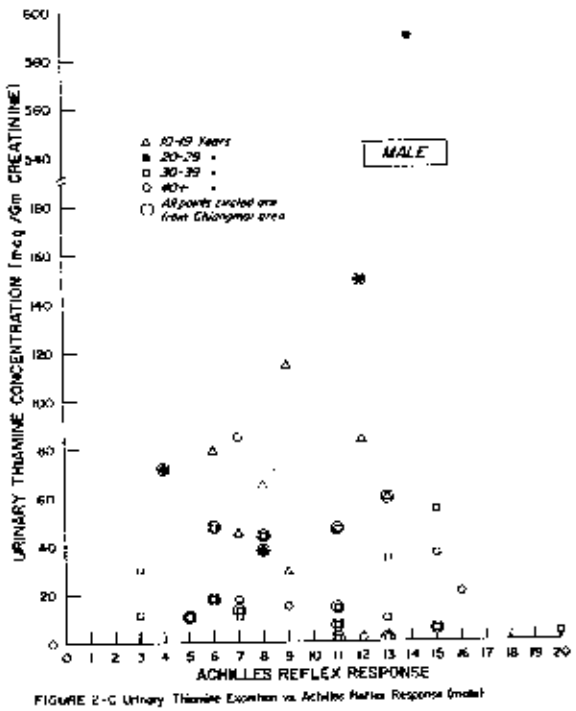


FIGURE 2-C Urinary Thiamine Excretion vs Achilles Reflex Response (male)

URINARY THIAMINE EXCRETION VS. ACHILLES REFLEX RESPONSE (FEMALE)

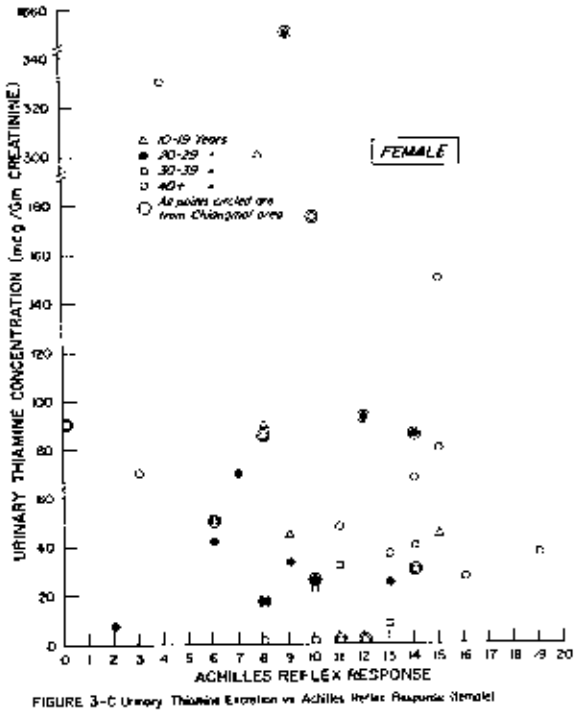


FIGURE 3-C Urinary Thiamine Excretion vs Achilles Reflex Response (female)

Ban Fon and San Pong ("low thiamine" villages) than in other villages ("normal thiamine" villages).

TABLE 1-C. MEAN ANKLE REFLEX RESPONSE[2/]

Males	Number of Subjects	"Normal thiamine" Villages	Number of Subjects	"Low thiamine" Villages
20-29 yrs.	91	12.0 units	14	10.4 units
30-39 "	44	11.3 " (P<0.01)	27	8.9 " (P<0.01)
30-49 "	59	11.3 " (P<0.01)	39	9.0 " (P<0.01)
Females				
20-29 yrs.	37	10.4 units	16	9.7 units
30-39 "	33	11.0 "	24	9.1 "
30-49 " 1/	53	11.3 " (P<0.01)	33	8.8 " (P<0.01)

1/ The age groups 40-49 for both sexes did not contain sufficient samples or sufficient resemblance to a normal distribution to justify application of statistical analysis.
2/ Probability data refer to differences of means between "normal" and "low" villages.

Urinary thiamine excretions of groups of subjects were determined in both "low thiamine" villages and other villages in an attempt to correlate the individual urinary thiamine excretions against amplitudes of ankle jerk response. Figures 2-C and 3-C show the results for both sexes and for various age groups. The scatter diagrams show a random distribution and do not indicate any clear relationship between low urinary thiamine excretion and diminished reflex response.

Discussion

It would appear that the diminished Achilles reflex may be dependent upon the decreased urinary excretion of thiamine. This statistical treatment cannot allow us to conclude that the dependent variable results only from a decrease in thiamine excretion or inadequate thiamine intake, since other factors unrelated to nutritional status may affect this reflex.

The failure to correlate individual thiamine excretion and ankle reflex is not unexpected. Several individuals who had a history of clinical beriberi in the past were found to have absent Achilles reflexes, yet their urinary excretion at the time of sampling was not low. Furthermore, individuals who had precedent or active neurological disorders unrelated to thiamine deficient states may show abnormal reflexes independent of urinary thiamine excretion. Thus, it is suggested that this tool may have applicability only on an epidemiological basis in the study of thiamine metabolism.

The question of the effect of age on this reflex cannot be adequately answered by this study. Further elucidation of this question would be dependent upon an adequate study of a larger age range of sufficient sample size in a population known to have adequate thiamine intake.

This device attempts to measure a complex reflex function which is dependent upon a multitude of variables. The uncontrollable nature of these variables ranges from the simple question of the adequacy of muscle relaxation at the time of testing to the more

complicated one concerning the meaning of reflex amplitude as against time-amplitude integrated quantitation. From the physiologist's point of view, simple amplitude measurements alone are open to serious question. As concerns the other variables involved in performance of this test, one must emphasize that the epidemiological approach using large population samples hopefully should tend to equalize individual variability unrelated to the pertinent questions under consideration.

C. FOOD CONCENTRATION AND URINARY EXCRETION OF STRONTIUM^{90} IN THAILAND

By

Dr. Arthur R. Schulert
Lamont Geological Observatory
Columbia University
Palisades, New York

Early studies on the concentration of strontium^{90} (Sr^{90}) in human bone from about 30 locations around the world indicated that individuals living in Thailand had the highest concentration of Sr^{90} in their bodies of all of the locations investigated. This was attributable to the predominance of rice in the diet since grains generally have the highest concentration of Sr^{90} in terms of micromicrocuries of Sr^{90} per gm of calcium (Ca) of all the common foodstuffs.

The concentration of Sr^{90} in composite diets from five of the Thailand survey locations is given in Table 1-D. The average for the five locations was 7.0 $\mu\mu c$ Sr^{90}/gm Ca which correlated closely with the values obtained in Vietnam one year earlier, i.e., in the fall of 1959. The Vietnam value at that time was 9.4 $\mu\mu c$ Sr^{90}/gm Ca and the approximately 25 percent differential was the drop one would expect over this time interval based on food radioactivity decay data from the United States.

The food/urine ratio for the five locations averaged 1.7 in fair agreement with values of approximately two obtained in Peru, Ecuador, and Vietnam on previous surveys. Actually as dietary levels decrease and the body becomes more closely equilibrated with the Sr^{90} in the environment, the food/urine ratio would be expected to decrease although the data thus far are not sufficient to document this trend with significance.

The Sr^{90} values for rice products are also shown in Table 1-D. These values are generally higher than those of the dietary composites in keeping with the fact noted above that grains have the highest concentration and practically any other foodstuffs would dilute this level. The rice sources are identified only by gross areas. There is general correlation between the high values for rice from the north in the area of Udorn and Ubol where the highest composites were found, and the lower value in the northwest where the lowest composite was found (Chiengmai). Bran, polishings and husks have higher concentrations than the milled final product as has been observed in previous studies.

TABLE 1-D. STRONTIUM^{90} IN FOOD COMPOSITES, URINE SAMPLES, AND RICE SAMPLES IN THAILAND

FOOD COMPOSITES AND URINE SAMPLES

Location	Food Composite ($\mu\mu c$ Sr^{90}/gm Ca)[1/]	Urine ($\mu\mu c$ Sr^{90}/ gm Ca)[1/]	Ratio
Chiengmai	3.17	2.07	1.5
Udorn	8.14	5.96	1.4
Ubol	12.94	7.22	1.8
Bangkok	5.89	2.18	2.7
Songkhla	4.83	3.97	1.2
Lopburi	no sample obtained	2.01	
Average	6.99	3.90	1.7±0.6

THAILAND RICE SAMPLES

Sample	General Area[3/]	Strontium^{90} Content	
		dpm/kg (wet)[2/]	$\mu\mu c$/gm Ca[1/]
Rice bran	Northwest	8.80	6.87
Glutinous rice	Northwest	1.68	6.32
Glutinous rice	North	5.10	24.10
"Ordinary" rice	North	6.37	23.20
Rice polishings	North	107.00	82.40
Rice husks	North	44.90	39.80
Rice husks	Southernmost	68.80	69.50

1/ Micromicrograms strontium90 per gm of calcium .
2/ Disintegrations per minute per kg.
3/ See Figure 1 for geographical areas.

D. EVALUATION OF RIBOFLAVIN AND THIAMINE LOAD TESTS

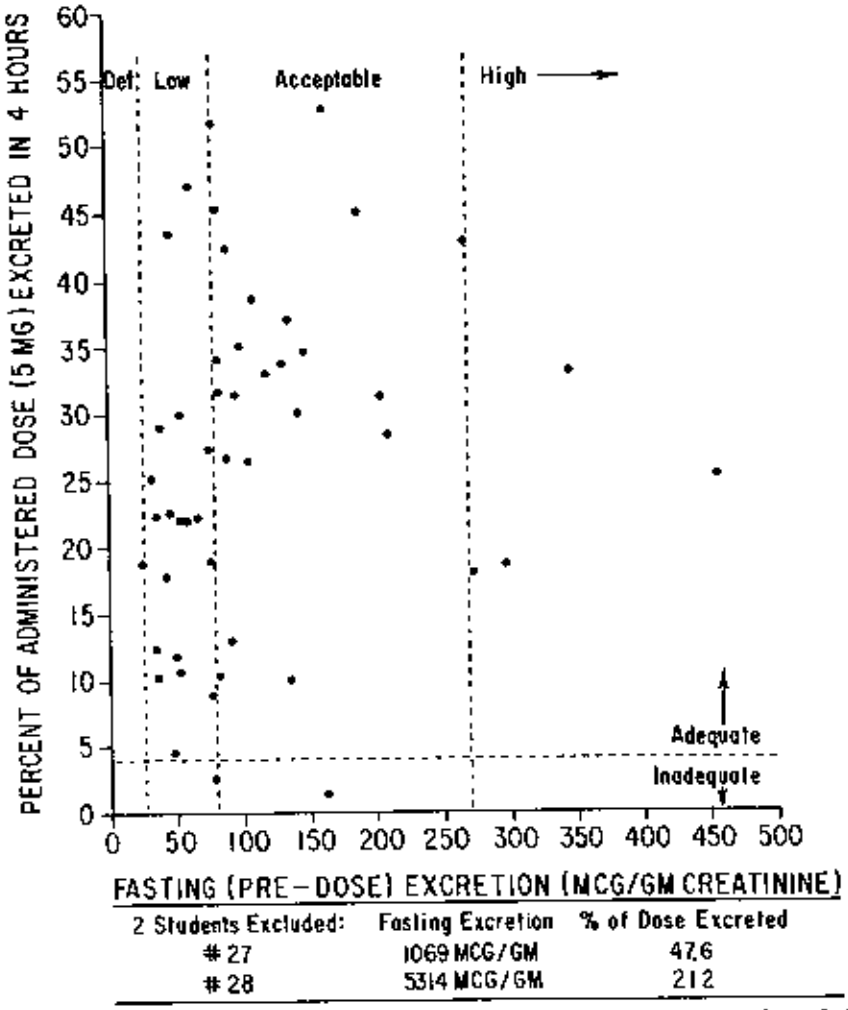
The results of a number of oral load test studies are presented in Figures 1-E, 2-E, and 3-E, and the individual data is presented in Tables 1-E through 4-E.

Considering the riboflavin load tests first, a group of students of the School of Public Health were given 5 mg riboflavin and the percent excreted in 4 hours was determined (Figure 1-E). Although no civilian dietary studies were done in Bangkok or among these students, it was assumed that their riboflavin intakes would be better than for most groups within the country because of higher socio-economic standards. On the basis of urinary excretions of riboflavin, this proved to be the case (only one student out of 51 excreting less than 27 mcg/gm creatinine). Utilizing the acceptability criteria for riboflavin load tests of Johnson et al. (1e) (4 percent excretion in 4 hours) only two of the 51 students excreted less than 4 percent of the administered dose. However, they both excreted appreciable amounts of riboflavin in the pre-dose specimen. In general, there was a degree of correlation between fasting riboflavin excretions and excretion of the load but the great scatter of data was disappointing. Both types of tests did substantiate the opinion that riboflavin nutriture in these students was better than average. It should be noted that none of these students had angular lesions.

The picture among a group of 37 soldiers of similar age to the students above but with and without angular lesions was quite different. The tests are not exactly comparable because the soldiers received 8 mg orally and urine was collected for 24 hours. However, 19 had pre-dose excretions of less than 27 mcg/gm creatinine, and 15 excreted less than 5 percent of the administered dose in 24 hours, suggesting very marked body unsaturation (Figure 2-E). As can be seen from Figure 2-E, there was no difference whatever in the percent of dose excreted between the group of 19 with angular lesions compared with the 18 soldiers without angular lesions (see also Table 2-E). This latter result resembles the picture found within the general survey when riboflavin excretion per gm creatinine rather than load test results were used to compare subjects with and without angular lesions (see Riboflavin Nutrition chapter). It might be mentioned that the soldiers in this load test group were selected so that there was no clinical doubt as to the presence or absence of angular lesions.

The results of these two sets of riboflavin load tests suggest that the procedure has merit, but in these limited series, it seemed to contribute little information not obtained by expressing excretion in terms of creatinine. Further studies are warranted, and the results might be considerably improved by utilizing the parenteral route of administration, avoiding the problems of gastrointestinal absorption.

The results of two series of oral 4 hour thiamine load tests in pregnant or lactating women in Chiengmai and Bangkok (Figure 3-E) are much less satisfactory and very confusing. The Chiengmai area was selected for one group for a number of reasons, all suggesting prevalent thiamine deficiency: (a) in the general survey, the median thiamine excretions were the lowest encountered among civilian groups; (b) in the general survey, one of the higher incidences of bilateral loss of ankle jerks was encountered in the



2 Students Excluded:	Fasting Excretion	% of Dose Excreted
# 27	1069 MCG/GM	47.6
# 28	5314 MCG/GM	21.2

Figure 1-E. Riboflavin Load Tests In 51 Students Of The School Of Public Health, Bangkok, Thailand

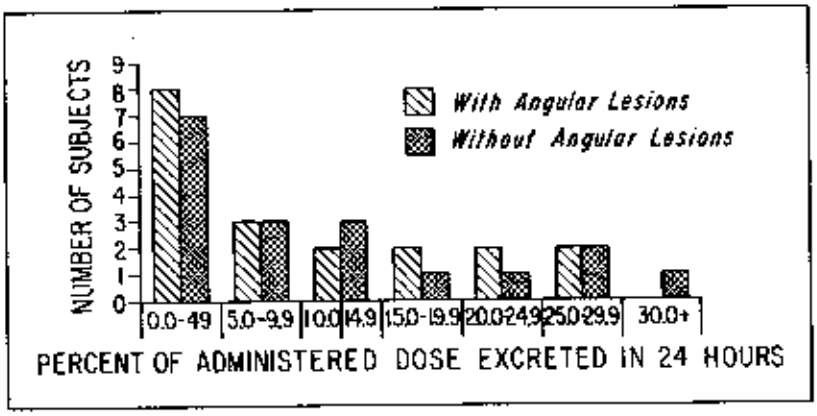
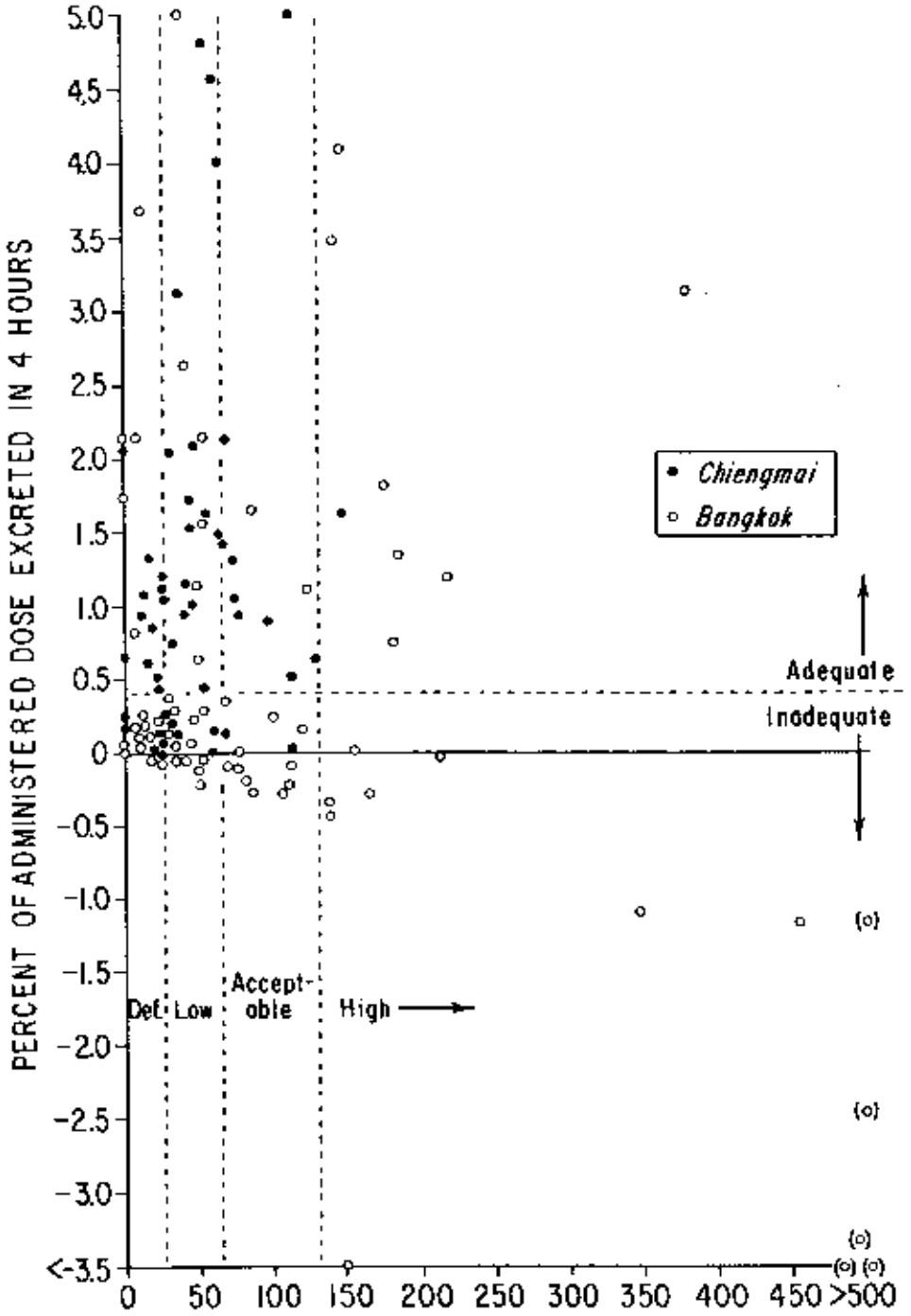


Figure 2-E. Oral Riboflavin Load Test (Dose = 8 MG) Among Chiengmai Military

Chiengmai area; (c) the Chiengmai area is the historical region for endemic beriberi. Women from Bangkok, attending the clinics at the Women's Hospital, were selected with the hope that they might serve as a group with a better state of thiamine nutriture. Pregnant and lactating women were selected for both series because of their well-established susceptibility to clinical beriberi. At this point, the results seem to defy interpretation, except that about one-third of the women involved appeared to have "low" or "deficient" thiamine excretion in terms of creatinine excretion as well as "inadequate" excretion of administered load by the criteria of Johnson et al. (1e). One of the fundamental problems with the thiamine (and any other) load test is that the false assumption has to be made that the pre-dose thiamine excretion remains as a constant throughout the period of urine collection. The absurdity of this assumption is brought out particularly by the Bangkok women known to be taking vitamin B complex supplementation who excreted less than zero percent of the administered dose (see Figure 3-E). Another obvious problem is that even the so-called "adequate" level of excretion is of the order of 0.4 percent of the administered dose, a very small proportion indeed. One certainly would wish for a chemicoanalytical procedure which would measure not only the intact thiamine molecule but also the metabolic end-products of thiamine, containing portions of the cleaved molecule. Of course, some more reasonably interpretable results might be obtained by parenteral administration of the dose, as suggested above for riboflavin. Evaluation of any technique to improve our current ability to estimate the state of thiamine nutriture in a given individual is warranted and strongly to be encouraged.

REFERENCES

1e. Johnson, R. E., Sargent, F., Robinson, P. F., and Consolazio, C. F. Assessment of nutritional and metabolic conditions in the field. War Medicine, 7:227-233, 1945.



*Some of these women were taking Vitamin B Complex; those known to be are marked ( ).

Figure 3-E. Thiamine Load Tests (5 MG. Orally – 4 Hour Excretion) In Pregnant Or Lactating Women – 50 Women In Chiengmai Province And 67 In Bangkok*

TABLE 1-E. RIBOFLAVIN EXCRETION IN STUDENTS OF THE SCHOOL OF PUBLIC HEALTH, BANGKOK BEFORE AND AFTER ORAL ADMINISTRATION OF 5 MG OF RIBOFLAVIN[1/]

	No.	Sex	Age (yrs.)	mcg/gm Creatinine	mcg/4 Hrs. Over Base	% of Dose
MPH Students	1	M	30	272.7	894.6	17.9
	2	M	28	77.6	947.1	18.9
	3	M	27	35.7	509.1	10.2
	4	M	29	135.8	499.0	10.0
	5	M	28	161.5	76.3	1.5
	6	M	29	162.7	2,641.7	52.8
	7	F	29	47.6	232.1	4.6
	8	M	30	84.3	1,577.2	31.6
	9	F	39	83.2	2,257.4	45.2
	10	M	28	148.1	1,725.3	34.5
	11	M	27	445.7	1,261.0	25.2
	12	M	33	295.9	931.5	18.6
	13	M	29	346.2	1,655.2	33.1
	14	F	31	269.2	2,137.9	42.8
	15	M	35	104.6	1,320.2	26.4
	16	F	39	210.0	1,416.5	28.3
P.H. Nurses	17	F	29	47.0	2,772.7	43.5
	18	F	23	63.9	2,351.9	47.0
	19	F	23	36.4	1,113.9	22.3
	20	F	25	45.8	1,124.9	22.5
	21	F	34	32.3	1,253.0	25.1
	22	F	26	82.8	1,700.1	34.0
	23	F	25	109.3	1,931.8	38.6
	24	F	26	50.0	583.5	11.7
	25	F	25	95.5	1,573.0	31.4
	26	F	25	39.0	1,456.8	29.1
	27	F	25	1,069.2	2,380.2	47.6
	28	F	25	5,314.5	1,060.3	21.2
	29	F	24	187.8	2,248.7	45.0
	30	F	24	118.8	1,765.2	33.3
	31	F	24	90.0	2,120.0	42.4
	32	F	24	54.4	1,092.0	21.8
	33	F	25	132.0	1,688.0	33.8
	34	F	34	135.7	1,852.1	37.0
	35	F	35	80.4	2,584.4	51.7
	36	F	26	77.8	132.9	2.7
Sanitarians	37	M	25	52.6	528.8	10.6
	38	M	31	42.7	888.9	17.8
	39	M	26	89.2	1,335.3	26.7
	40	M	23	34.6	619.1	12.4
	41	M	22	25.0	936.6	18.7
	42	M	20	75.8	1,363.4	27.3
	43	M	22	203.7	1,559.1	31.2
	44	M	23	143.2	1,496.1	29.9
	45	M	22	82.1	514.0	10.3
	46	M	23	78.1	442.7	8.9
	47	M	22	59.3	1,092.7	21.9
	48	M	21	99.0	1,743.5	34.9
	49	M	26	92.0	645.5	12.9
	50	M	23	54.3	1,491.0	29.8
	51	M	22	67.0	1,108.8	22.2
MEANS				234.2	1,332.2	26.6

1/ None of these students had angular lesions.

TABLE 2-E. RIBOFLAVIN EXCRETION IN CHIENGMAI MILITARY BEFORE AND AFTER ORAL ADMINISTRATION OF 8 MG OF RIBOFLAVIN

Sample No.	ml Urine/ 24 Hr.	Creatinine mg/24 Hr.	Riboflavin Excretion mcg/gm Creatinine Base	Riboflavin Excretion mcg/24 Hr. Over Base	Riboflavin Excretion % of Dose
WITH ANGULAR LESIONS					
4516	510	1,300	34	1,605	20.1
4530	1,470	1,200	57	1,004	12.6
4540	415	415	27	81	1.1
4556	420	970	25	1,993	25.0
4572	660	750	29	1,110	13.7
4574	400	1,180	26	594	7.4
4580	685	980	21	2,229	27.9
4626	660	945	18	1,669	20.9
4637	840	690	47	152	1.9
4694	1,075	1,180	8	1,251	15.7
4700	815	930	34	363	4.5
4701	415	850	19	189	2.4
4731	400	650	14	230	2.9
4798	510	1,020	9	537	6.7
4871	425	830	59	637	8.0
4872	440	880	29	258	3.2
4878	1,300	1,030	21	283	3.5
4891	385	1,010	13	91	1.1
4910	540	1,180	22	1,401	17.5
MEANS	651	947	27	825	10.3
WITHOUT ANGULAR LESIONS					
4501	455	1,550	28	229	2.9
4507	415	580	38	214	2.7
4518	510	510	38	222	2.8
4520	890	1,050	26	473	5.9
4523	990	780	68	1,310	16.0
4526	895	1,040	17	204	2.5
4538	1,190	1,190	15	1,767	22.1
4541	720	1,530	30	1,090	13.7
4554	540	1,090	48	750	9.3
4564	740	960	31	344	4.3
4566	890	1,370	43	2,250	28.0
4568	240	845	67	5,030	63.0
4576	370	518	30	418	5.3
4595	470	1,000	7	828	10.3
4598	560	1,250	0	2,220	27.7
4617	505	1,040	7	325	4.1
4641	590	1,580	4	1,030	12.9
4819	570	320	14	105	1.3
MEANS	641	1,011	28	1,045	13.1

TABLE 3-E. THIAMINE EXCRETION IN 50 PREGNANT OR LACTATING WOMEN FROM CHIENGMAI PROVINCE BEFORE AND AFTER ORAL ADMINISTRATION OF 5 MG OF THIAMINE (December 5, 1960)

No.	Village	Physiologic State	Age (yrs.)	Mcg/gm Creatinine	Mcg/4 Hrs. Over Base	% of Dose
C- 1	Fon	6 mos. preg.	32	128.0	52.80	0.63
C- 2	Fon	9 mos. preg.	37	114.3	45.22	0.52
C- 3	Fon	5 mos. preg.	23	66.0	82.18	1.42
C- 4	Fon	7 mos. preg.	34	46.4	111.93	2.08
C- 5	Rim	3 mos. preg.	22	44.1	93.44	1.72
C- 6	Rim	1 mo. lact.	30	21.7	25.08	0.43
C- 7	Rim	8 mos. lact.	29	111.9	4.40	0.26
C- 8	Rim	6 mos. lact.	30	38.5	162.69	3.13
C- 9	Sarapee	6 mos. lact.	32	147.8	105.90	1.63
C-10	Rim	7 mos. preg.	25	22.8	10.80	0.14
C-11	Rim	5 mos. lact.	24	106.4	31.62	0.28
C-12	Sarapee	9 mos. preg.	33	74.3	65.40	1.06
C-13	Rim	8 mos. preg.	27	36.4	0.78	0.11
C-14	Sarapee	6 mos. lact.	36	18.2	45.71	0.85
C-15	Rim	5 mos. lact.	28	12.5	55.97	1.08
C-16	Rim	2½ mos. lact.	27	30.3	107.44	2.05
C-17	Rim	6 mos. lact.	25	66.7	117.54	2.13
C-18	Sarapee	2 mos. preg.	23	26.0	61.95	1.15
C-19	Sarapee	2 mos. preg.	18	43.5	83.62	1.53
C-20	Sarapee	8 mos. preg.	30	60.5	17.67	0.15
C-21	Sarapee	2½ mos. lact.	33	55.0	89.91	1.63
C-22	Sarapee	9 mos. preg.	35	0.0	12.72	0.25
C-23	Sarapee	4½ mos. lact.	29	64.6	211.90	4.02
C-24	Sarapee	6 mos. preg.	28	15.8	32.85	0.60
C-25	Sarapee	6 mos. preg.	30	72.7	77.40	1.31
C-26	Rim	9 mos. preg.	20	63.5	82.06	1.42
C-27	Rim	3 mos. preg.	28	53.0	31.52	0.45
C-28	Rim	5 mos. preg.	35	45.7	57.60	1.00
C-29	Rim	5 mos. preg.	37	40.0	54.00	0.95
C-30	Rim	9 mos. preg.	20	25.0	3.32	0.02
C-31	Rim	2 mos. lact.	20	0.0	32.60	0.65
C-32	Rim	3 mos. lact.	31	30.9	14.88	0.19
C-33	Rim	8 mos. preg.	32	41.3	64.52	1.15
C-34	Rim	1 mo. lact.	24	25.0	3.25	0.02
C-35	Rim	1 mo. lact.	22	20.6	29.41	0.52
C-36	Rim	3 mos. lact.	32	28.9	15.20	0.21
C-37	Rim	5 mos. lact.	33	20.6	4.62	0.02
C-38	Rim	3 mos. lact.	24	67.8	17.49	0.12
C-39	Rim	1 mo. lact.	25	16.9	69.00	1.32
C-40	Rim	2 mos. lact.	36	11.4	48.98	0.94
C-41	Rim	2 mos. lact.	29	0.0	8.80	0.18
C-42	Rim	3 mos. preg.	26	60.5	238.88	4.58
C-43	Rim	2 mos. lact.	20	54.2	250.04	4.82
C-44	Rim	7 mos. preg.	29	98.5	61.02	0.89
C-45	Rim	6 mos. lact.	26	114.3	442.40	8.47
C-46	Rim	5 mos. lact.	25	60.5	9.60	0.01
C-47	Rim	5 mos. preg.	38	76.9	59.68	0.94
C-48	Rim	6 mos. preg.	28	32.5	42.60	0.74
C-49	Rim	4 mos. preg.	25	0.0	103.14	2.06
C-50	Rim	8 mos. preg.	24	112.7	16.63	0.04

TABLE 4-E. THIAMINE EXCRETION IN 67 PREGNANT OR LACTATING WOMEN FROM THE WOMEN'S HOSPITAL, BANGKOK BEFORE AND AFTER ORAL ADMINISTRATION OF 5 MG OF THIAMINE (Feb. 27 and March 13, 1961)

No.	Age (yrs.)	Physiologic State	mcg/gm Creatinine	mcg/4 Hrs. Over Base	% of Dose
1	22	Lact.	0	86.60	1.73
2	25	Lact.	52.80	77.80	1.55
3	21	Lact.	78.80	0.07	0.001
4	20	Lact.	217.80	59.70	1.19
5	27	Lact.	0	106.00	2.12
6	34	Lact.	53.00	-2.83	-0.06
7	29	Lact.	52.60	107.23	2.14
8	27	Lact.	30.80	10.87	0.22
9	23	Lact.	82.80	-9.90	-0.20
10	20	Lact.	52.80	14.45	0.29
(11	31	Lact.	1,840.50	-122.25	-2.45)*
12	33	Lact.	138.20	-16.43	-0.33
13	28	Lact.	22.80	4.15	0.08
14	26	Lact.	23.60	9.32	0.19
15	19	Lact.	26.00	-1.08	-0.02
16	25	Lact.	0	2.60	0.05
17	26	Lact.	33.90	3.65	0.07
18	24	Lact.	14.10	4.15	0.08
19	18	Lact.	45.50	3.02	0.06
20	29	Lact.	77.90	-6.22	-0.12
21	23	Lact.	348.70	-55.00	-1.10
(22	20	Lact.	1,573.80	-197.00	-3.94)*
23	24	Lact.	150.00	-17.56	-3.51
24	22	Lact.	13.00	12.43	0.25
25	23	Lact.	166.30	-13.88	-0.28
26	24	Lact.	26.50	-2.86	-0.06
(27	27	Lact.	1,254.40	-194.23	-3.88)*
28	20	Lact.	106.00	-13.77	-0.28
29	36	Lact.	60.20	-4.73	-0.09
30	19	Lact.	124.30	55.28	1.11
31	29	Preg.	113.04	-4.44	-0.09
32	20	Preg.	140.90	173.77	3.48
33	24	Preg.	213.00	-0.76	-0.02
34	27	Preg.	165.60	0.65	0.01
35	28	Preg.	72.20	-6.03	-0.12
36	23	Preg.	175.70	90.72	1.81
37	16	Lact.	0	1.06	0.02
38	23	Lact.	8.60	107.03	2.14
39	27	Lact.	68.97	18.21	0.36
40	29	Lact.	85.50	83.05	1.66
41	24	Lact.	49.13	56.13	1.12
42	22	Lact.	39.00	257.76	5.16
43	28	Lact.	28.90	18.94	0.38
44	22	Lact.	40.80	130.96	2.62
45	20	Lact.	30.10	11.33	0.23
46	21	Lact.	50.50	-6.37	-0.13
47	25	Lact.	23.30	-2.63	-0.05
48	27	Lact.	185.20	66.86	1.34
49	22	Lact.	101.20	11.71	0.23
50	25	Lact.	11.80	3.86	0.08
51	25	Lact.	139.10	-18.38	-0.37
52	25	Lact.	40.50	-0.99	-0.02
53	32	Lact.	8.80	40.29	0.81
54	22	Lact.	379.30	157.30	3.15
55	30	Lact.	85.50	-13.69	-0.27
56	27	Lact.	48.10	12.31	0.25
57	23	Lact.	11.80	1.86	0.04
58	21	Lact.	12.50	184.57	3.69
59	20	Lact.	454.80	-57.41	-1.15
60	22	Lact.	6.60	8.74	0.17
(61	19	Lact.	1,297.30	-57.82	-1.16)*
62	24	Lact.	110.70	-10.35	-0.21
63	25	Lact.	50.50	31.10	0.62
64	29	Lact.	182.10	36.70	0.73
65	20	Lact.	121.20	8.80	0.16
66	23	Lact.	145.50	204.55	4.09
(67	23	Lact.	1,272.10	-176.16	-3.52)*

* Numbers 11, 22, 27, 61 and 67 were subjects known to be receiving vitamin B complex tablets.

E. VESICAL CALCULI IN UBOL

A group of team members (Drs. Forbes, Harshbarger, Aree, and Amara, Miss Anderson, Miss Chamnean, and Lt. Seri), working in cooperation with 11 colleagues from Ubol and Bangkok performed a study of bladder stones among the population of the village of Ban Kao about 20 kilometers from Ubol. Because of the complexity of this study, it will be reported as a supplement to this report. Prior to this, three of the manuscripts of Dr. Cholvit Chutikorn, Director, Ubol Provincial Hospital, originally published in the Thai language, have been translated into English for submission for re-publication so that they may achieve wider circulation.

The general scope of the Ubol study is outlined below: (1) complete geneological review of the entire village population (approximately 350 persons); (2) complete history and physical examination on every child through ten years of age (approximately 145 children); (3) KUB X-ray film on every child by transporting each child to the provincial hospital; (4) microscopic urinalysis on all of the children, plus 100 control children of the same ages and sexes in Bangkok; (5) complete "routine" blood analyses in the nutrition survey laboratory on three males and three females of each year of age through 10 years, including newborns by jugular puncture (66 children); (6) complete dietary studies on 35 families with a number of food composites and unusual food items collected for chemical analyses; (7) collection of urines for oxalate analyses from 66 of the village children and 35 controls from Bangkok; (8) economic and sociological survey of the village; (9) collection of stones for histological and histochemical studies.

F. BODY COMPOSITION STUDIES

These studies involved: (1) skinfold thickness measurements on individuals receiving detailed clinical examinations throughout the course of the survey (2) more sophisticated studies of body composition utilizing a body volumeter (manufactured in Bangkok and utilized in the School of Public Health) and estimates of total body water with heavy water (D_2O), analyses of the latter being conducted by mass spectrometry at the U.S. Army Medical Research and Nutrition Laboratory, Denver, Colorado, under the direction of Dr. Thomas H. Allen, Chief, Physiology Division. Final interpretations of the body volumetry and total body water determinations are not yet completed. Hence, this chapter by Drs. Fryer and Allen will appear in complete form as a supplement to this report along with the study of vesical calculi in Ubol. For the present, the skinfold thickness data are presented in the following figure and tables.

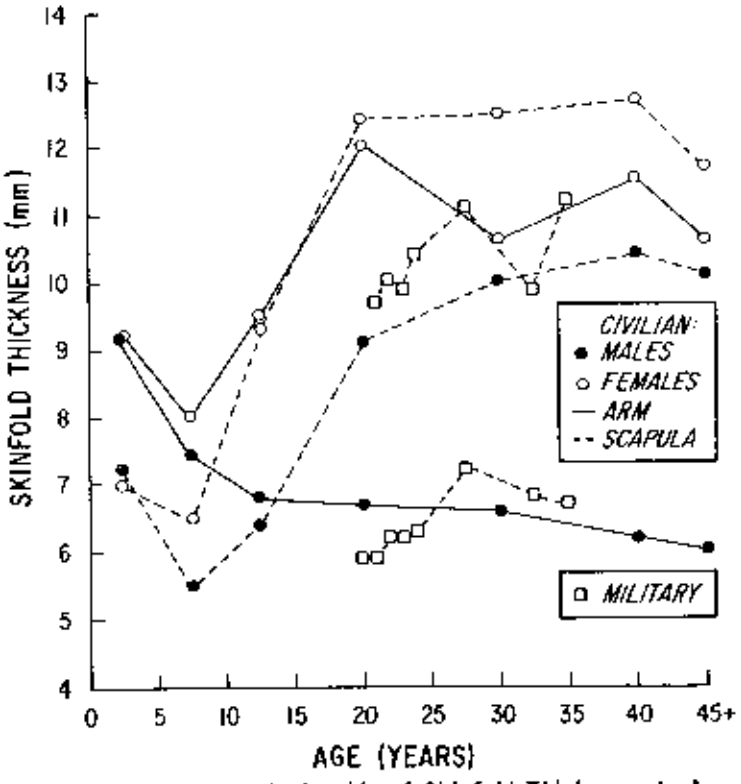


Figure I-6. The Relationship of Skinfold Thickness to Age among the Thai Military and Civilians.

TABLE 1-G. SKINFOLD THICKNESS AMONG THE THAI MILITARY (DETAILED EXAMINATIONS) IN TERMS OF VARIOUS PARAMETERS

VARIOUS PARAMETERS	No. of Subjects	Skin Fold Thickness (mm)	
		Arm	Scapula
LOCATIONS			
ARMY			
Bangkok	109	5.3	8.8
Songkhla	122	5.9	9.8
Chiengmai	184	5.7	9.4
Udorn	129	7.6	11.4
Ubol	66	5.0	9.3
TOTAL	610	6.0	9.8
AIR FORCE (Lopburi area)			
Kokethiem - enlisted	100	5.4	8.8
Koketbiem - NCO's	94	7.7	11.5
TOTAL	194	6.5	10.1
NAVY			
Sattaheep (TOTAL)	80	7.2	10.9
COMBINED SERVICES	884	6.2	10.0
AGE (years)			
21	422	5.9	9.7
22	270	6.2	10.0
23	62	6.2	9.9
24	16	6.3	10.4
25-29	83	7.2	11.1
30-34	19	6.8	9.9
35+	12	6.7	11.2
% STANDARD WEIGHT			
70-79	24	4.7	7.9
80-89	274	5.5	8.9
90-99	425	6.2	10.1
100-109	140	7.2	11.3
110+	21	9.4	14.8
EXAMINER			
Dr. Amara	159	5.8	9.5
Dr. Aree	167	5.0	8.6
Dr. Dinman	258	5.6	9.2
Dr. Fryer	90	6.4	11.1
Dr. Prachoom	29	7.5	9.8
Dr. Puangtong	99	8.0	12.2
Dr. Visarl	82	8.5	11.9

TABLE 2-G. SKINFOLD THICKNESS AMONG THE THAI CIVILIANS (DETAILED EXAMINATIONS) IN TERMS OF VARIOUS PARAMETERS

Age and Sex--->	M < 15			M 15+			F < 15			F 15+, NPNL		
	No. of Subj.	Thickness (mm)		No. of Subj.	Thickness (mm)		No. of Subj.	Thickness (mm)		No. of Subj.	Thickness (mm)	
		Arm	Scapula		Arm	Scapula		Arm	Scapula		Arm	Scapula
LOCATIONS												
Bang Dan	17	5.5	4.7	25	5.8	9.2	10	6.5	5.8	17	16.5	22.1
Don Kee Leg	2	5.5	7.5	35	5.9	9.5	5	6.4	8.2	18	12.0	13.2
Ban Fon	12	6.3	6.9	32	5.9	10.9	11	5.9	5.3	19	9.5	10.3
San Pong	7	5.1	4.6	21	4.1	5.0	7	6.3	7.3	26	9.5	9.7
Padad	11	8.1	7.4	23	7.7	11.4	8	10.3	8.6	14	10.5	11.6
Ta Kae	11	9.4	7.3	19	6.9	10.0	6	11.7	10.7	17	11.2	12.2
Rachinutis H.S.	19	7.2	6.0	-	-	-	26	11.6	11.2	7	12.3	10.7
Phon Ngam	17	7.1	6.0	26	7.1	10.3	19	7.3	7.0	7	8.2	10.0
Marg Yah	17	6.5	5.0	12	5.2	8.8	19	7.7	5.5	4	9.0	9.2
Sri Kai	4	8.5	7.5	22	7.5	8.8	12	9.4	8.2	14	11.3	11.8
Ban Kao	9	8.3	6.0	10	7.9	10.2	13	9.4	7.3	8	10.5	12.0
Nong Manao	14	9.5	7.0	5	8.0	11.2	10	10.0	7.6	8	11.8	12.0
TOTAL	140	7.4	6.1	230	6.4	9.9	146	8.8	7.8	159	11.2	12.2
EXAMINER												
Dr. Amara	14	6.4	5.1	13	7.5	10.6	4	6.5	8.2	5	12.6	11.8
Dr. Aree	5	7.8	5.8	2	9.0	15.0	5	7.8	5.8	-	-	-
Dr. Dinman	28	5.9	4.9	73	5.1	9.4	24	6.7	5.2	43	9.9	11.6
Dr. Fryer	11	4.7	5.0	25	5.0	8.5	10	6.0	7.1	20	15.0	17.6
Dr. Prachoom	24	6.2	6.1	42	6.5	9.7	31	9.1	8.4	36	10.7	11.4
Dr. Puangtong	12	8.8	7.7	7	6.3	10.0	9	9.1	9.2	7	9.3	10.0
Dr. Visarl	46	9.0	7.1	68	8.0	10.9	63	10.0	8.5	48	11.6	12.1
WEIGHT (kg)												
20-29				5	5.2	5.6				-	-	-
30-39				5	4.4	6.0				40	8.0	8.0
40-49				89	5.8	9.3				93	11.2	12.3
50-59				117	6.8	10.3				17	13.9	16.1
60+				14	7.7	13.9				9	20.8	25.4

	Males			Females, NPNL		
	No. of Subjects	Thickness (mm)		No. of Subjects	Thickness (mm)	
		Arm	Scapula		Arm	Scapula
AGE (years)						
0-4	18	9.2	7.2	23	9.2	7.0
5-9	60	7.4	5.5	58	8.0	6.5
10-14	62	6.8	6.4	65	9.5	9.3
15-24	50	6.7	9.1	48	12.0	12.4
25-34	64	6.6	10.0	30	10.6	12.5
35-44	55	6.2	10.4	26	11.5	12.7
45+	61	6.0	10.1	55	10.6	11.7
Pregnant				21	10.4	11.7
Lactating				76	11.2	12.4

629?AS O - 62 - 20

REFERENCES

1. Interdepartmental Committee on Nutrition for National Defense. Manual for Nutrition Surveys. Washington, D. C., 1957. United States Government Printing Office.

2. Interdepartmental Committee on Nutrition for National Defense. Manual for Nutrition Surveys. 1962 Revision. To be published.

3. Bisolyaputra, Uthai. Nutrition activities in Thailand--past and present--1930-1959. A Publication of the Nutrition Division, Department of Health, Ministry of Public Health, pp. 1-77, 1960.

4. Anderson, M. M. A brief summary of the data collected on nutrition in Thailand. A report by the Food and Agriculture Organization nutritionist, pp. 1-5. Bangkok, Thailand, March 1959.

5. Blanchard, W., Ahalt, H. C., Bell, A. D., Gresham, M. E., Hoffman, B. G., McEwen, J. H., and Scharr, J. H. Thailand--Its People, Its Society, Its Culture. Country Survey Series. Edited by Thomas Fitzsimons. New Haven, Connecticut, 1957. HRAF Press.

6. Kingshill, Konrad. Ku Daeng--The Red Tomb--A Village Study in Northern Thailand (a Cornell Southeast Asia Research Project). Published at The Prince Royal's College, Chiengmai, and distributed by The Siam Society, 60 Asoka Road, Bangkok, Thailand, 1960.

7. Bibliography of Thailand (a selected list of books and articles with annotations by the staff of the Cornell Thailand Research Project). Data Paper No. 20, Southeast Asia Program, Department of Far Eastern Studies. Cornell University, Ithaca, New York, May 1956.

8. Public Health in Thailand. A Publication of the Ministry of Public Health, Bangkok, Thailand, 1960.

9. Blumenthal, H. T., Dutra, F. N., Paschal, H., and Kuhn, L. R. The significance of Endamoeba histolytica in stools of individuals with acute diarrhea of moderate severity. Am. J. Trop. Med., 27: 711-721, 1947.

10. Martin, G. A., Garfinkel, B. T., Brooke, M. M., Weinstein, D. P., and Frye, W. W. Comparative efficacy of amebicides and antibiotics in acute amebic dysentery. J.A.M.A., 151: 1055-1059, 1953.

11. Elsdon-Dew, R. Endemic fulmination amebic dysentery. Am. J. Trop. Med., 29: 337-340, 1949.

12. Getz, H. R., Long, E. R., and Henderson, H. J. A study of the relation of nutrition to the development of tuberculosis. Am. Rev. Tuberc., 64: 381-393, 1951.

13. Downes, J. An experiment in the control of tuberculosis among Negroes. Milbank Mem. Fund Quart., 28: 127-159, 1950.

14. Layton, G. B. Effects of slow starvation. Lancet, 2: 73-79, 1946.

15. Faber, K. Tuberculosis and nutrition. Acta tuberc. Scandinav., 12: 287, 1938.

16. Scrimshaw, N. S., Taylor, C. E., and Gordon, J. E. Interactions of nutrition and infection. Am. J. Med. Sc., 237: 367-403, 1959.

17. World Bank. A Public Development Program for Thailand. Baltimore, 1959. The Johns Hopkins Press.

18. Varavej, P. and Bunnag, K. Thai processed food products. Proc. Ninth Pacific Science Congress, 15: 117-124, 1957.

19. Seale, P. S. Fruit juice manufacture development in Thailand. United Nations Technical Assistance Report, in press.

20. Tollenaar, F. D. Development of food industries and food technology research. Food and Agriculture Organization Report No. 1138, 1958.

21. Van Eekelen, M. Development of food industries and food technology research. Food and Agriculture Organization Report No. 594, 1957.

22. Thai Food Products of the Preserved Food Organization. A publication of the Preserved Food Organization, Bangkok, Thailand, 1960.

23. Kertesz, Z. I. Some Basic Consideration in the Design of Packaged Emergency Field Food Rations. A publication of the Interdepartmental Committee on Nutrition for National Defense, 1959.

24. Laurent, L. Röle de l'insuffisance en matières grasses de la ration alimentaire dans l'étiologie du béribéri. Arch. Med. Nav., 71: 194, 1899.

25. Takaki, K. Three lectures on the preservation of health amongst the personnel of the Japanese navy and army. Lancet, 1: 1369-1451-1520, 1906.

26. Highet, H. C. Beriberi in Siam. Philippine J. Sci., 5: 73, 1910.

27. Hepburn, H. H., McGill, C. M., and Edin, S. R. C. S. Clinical analysis of 100 cases of early beriberi. Brit. Med. J., 1: 466, 1920.

28. Ramalingaswami, V. Summary Report on Nutritional Situation in Thailand. World Health Organization Regional Office for Southeast Asia, SEA/Nut/2 Rev. 1, March 1956 (restricted).

29. Klerks, J. V. Final Report on Nutrition in Thailand (WHO Project: Thailand 36). World Health Organization Regional Office for Southeast Asia, SEA/Nut/5, March 1959 (restricted).

30. Williams, Robert R. Toward the Conquest of Beriberi. Cambridge, Mass., 1961. Harvard University Press.

31. Vorderman, A. G. Onderzoek Naar Het Verband Tusschen der Aard der Rijstoeding in de Gevargenissen op Java en Madoera en Het Voorkomer van Beriberi Onder de Geinterneeden. Batavia, 1897.

32. McLaughlin, A. J. and Andrews, V. L. Studies on infant mortality. Philippine J. Sci., 5: 149, 1910.

33. Tu, Tran Van. Contribution à l'Etude du Béribéri Infantile au Vietnam, Saigon (thesis). Hanoi, 1954.

34. Interdepartmental Committee on Nutrition for National Defense: Republic of Vietnam: Nutrition Survey. Bethesda, Maryland, National Institutes of Health, July 1960.

35. Burgess, R. C. Deficiency diseases in prisoners of war at Changi, Singapore. Lancet 2: 411, 1946.

36. Sadun, E. H. Studies on Opisthorchis Viverrini in Thailand. Am. J. Hyg., 62: 81-115, 1955.

37. Sadun, E. H. Studies on the distribution and epidemiology of bookworm, ascaris, and trichuris in Thailand. Am. J. Hyg., 62: 116-155, 1955.

38. Joint FAO/WHO Expert Committee on Nutrition. Fifth Report. World Health Organization Technical Report Series No. 149, 1958.

39. Joint FAO/WHO Expert Committee on Nutrition. Fifth Report. Iron deficiency anemia. World Health Organization Technical Report Series, No. 182, 1958.

40. Parodi, L. Sur les syndromes gastroduodenaux et peritoneaux de l'ancylostomiase. Med. Trop. Revue du Corps de Sante Coloniale, 18: 937, 1958.

41. Perez, C., Scrimshaw, N. S., and Munoz, J. A. Classification of goiter and technique of endemic goiter surveys. Bull. World Health Org., 18: 217-232, 1958.

42. Sem Pring-puang-geo. Summary of 18 years study of thyroid disease in Thailand. Med. News, Thailand, 4: 551, 1955.

43. Ramalingaswami, V., cited by Kelly, F. C. and Snedden, W. W. Endemic goiter. World Health Organization Monograph Series, No. 44 Geneva, 1960.

44. Klerks, J. V., cited by Kelly, F. C. and Snedden, W. W. Endemic goiter. World Health Organization Monograph Series, No. 44, Geneva, 1960.

45. Suwanik, R., Nondhasuta, A., and Nondhasuta, A. Field studies on iodine metabolism in an endemic goiter village, Prae, Thailand. J. Nat. Res. Counc., Thailand, 2: 1, 1961.

46. Netrasiri, A. and Netrasiri, C. Kwashiorkor in Bangkok--an analytical study of 54 cases. J. Trop. Pediat., 1: 148-155, 1955.

47. Oomen, H. A. P. C. An outline of xerophthalmia. In: International Review of Tropical Medicine, Volume 1, pp. 132-214. New York, 1961. Academic Press.

48. National Academy of Sciences--National Research Council. Meeting Protein Needs of Infants and Children. Publication No. 843. Washington, D. C., 1961

49. Katsilambros, L. Asymptomatic enlargement of the parotid glands. J.A.M.A., 178: 513-514, 1961.

50. Woodbury, L. A., Terayanont, S., Sribhoga, R., and Jakabhiromya, S. Semi-Annual Report, January-June 1960 of the Children's Hospital, Bangkok. Thailand-World Health Organization Cooperative Project on Hospital Statistics (Thailand; 44), 1960.

51. Recommended Dietary Allowances. A Report of the Food and Nutrition Board, National Academy of Sciences--National Research Council, Washington, D.C., Publication No. 589, revised 1958.

52. Kanchanalaksana, P. and Prasertsom, S. Dietary Survey in 9 Provincial Garrisons of the Royal Thai Army, 1955-1956. A publication of the Preventive Medicine Division, Royal Thai Army Medical Department, 1956.

53. Chalawyoo, S. and Tansathit, P. Dietary Survey in the Royal Thai Navy, 1956. A Publication of the Medical Department, Royal Thai Navy, November 1957.

54. Hauck, H. M. and Sudsaneh, S. Food intake and nutritional status in a Siamese village. J. Am. Dietet. Assoc., 35: 1149-1157, 1959.

55. Studies on Nutrition in the Far East. I - XII. In: Symposium on Nutrition, Herbert Pollack, Ed. Metabolism 5: 203-301, 1956.

56. Interdepartmental Committee on Nutrition for National Defense: Republic of China: Nutrition survey of the armed forces. Bethesda, Md., National Institutes of Health, June 1961.

57. Interdepartmental Committee on Nutrition for National Defense: Republic of Pakistan: Nutrition survey of the armed forces. Bethesda, Md., National Institutes of Health, April 1957.

58. Interdepartmental Committee on Nutrition for National Defense: Republic of Korea: Nutrition survey of the armed forces. Bethesda, Md., National Institutes of Health, September 1956.

59. Seminar on the role of salt in cardiovascular hypertension (part I), Am. J. Cardiol., 8: 1961, 526-602, and (part II), Am. J. Cardiol., 8: 1961, 684-756.

60. Meneely, G. R., Lemley-Stone, J., and Darby, W. J. Changes in blood pressure and body sodium of rats fed sodium and potassium chloride. Am. J. Cardiol., 8: 1961, 527-532.

61. Dahl, L. K. Possible role of chronic excess salt consumption in the pathogenesis of essential hypertension. Am. J. Cardiol., 8: 1961, 571-575.

62. Dahl, L. K., and Heine, M. The enhanced hypertensogenic effect of sea salt over sodium chloride. Am. J. Cardiol., 8: 1961, 726-731.

63. Cho, K. H., Nahm, C. C., Suh, C. S. and Lee, D. Y. Distribution of the blood pressure of Koreans. The Korean Journal of Internal Medicine, 4: 1961, 23-34.

64. Woodbury, L. A., Terayanont, S., Sribhoga, R. and Jakabhiromya, S. Semi-Annual Report, January-June, 1960, Women's Hospital, Bangkok (prepared as part of the Thailand-WHO Cooperative Project on Hospital Statistics).

65. Report of the Division of Vital Statistics, Ministry of Public Health, Bangkok, 1960.

66. Russell, A. L. Oral health study of children in Suburban Washington, D. C. Pub. Health Report, 71: 626, 1956.

67. Russell, A. L. A system for classification and scoring for prevalence surveys of periodontal disease. J. Dent. Res., 35: 350, 1956.

68. Greene, J. C. and Vermillion, J. R. The oral hygiene index--a method for classifying oral hygiene status. J. Am. Dent. Assn. 61: 28, 1960.

69. McCombie, F. and Chua, S. C. Dental Epidemiology in Malaya. Part II. A survey of Chinese, Malay, and Indian adult males in Singapore. Canad. Dent. Assn. J. 23: 687, 1957.

70. Dean, H. T. The investigation of physiological effects by the epidemiological method. Fluoride and Dental Health. Amer. Assn. for the Advancement of Sc., p. 23, 1938.

71. Stahl, S. S. and Morris, A. L. Oral health conditions among army personnel at the Army Engineer Center. J. Periodont. 26: 185, 1955.

72. Standard Methods for the Examination of Water and Sewage. Amer. Pub. Health Assn., 170 Broadway, New York. 11th Ed., 1960.

73. Kinser, C. A. Fluoride in Domestic Water. II Fluoride content of urine in relation to fluoride in drinking water. Pub. Health Rep., 59: 1575, 1944.

74. Interdepartmental Committee on Nutrition for National Defense: Republic of the Philippines: Nutrition survey of the armed forces. Bethesda, Md., National Institutes of Health, November, 1957.

75. Height and Weight Data for Men Inducted into the Army and for Rejected Men. Report No. 1-BM, Army Service Forces, Office of the Surgeon General, Medical Statistics Division, United States Army.

76. Build and Blood Pressure Study, Volumes 1 and 2. A publication of the United States Society of Actuaries, October 1959.

77. Woodbury, L. A., Terayamont, S., Sribhoga, R., and Jakabhiromya, S. Semi-Annual Report, January-June 1960, Children's Hospital, Bangkok (prepared as part of the Thailand-World Health Organization Cooperative Project on Hospital Statistics).

78. World Health Organization. Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death (and intermediate list of 150 causes for tabulation of morbidity and mortality), 7th Revision, 1955.

79. United States Bureau of Census. Historical Statistics of the United States--Colonial Times to 1957.

80. United States National Office of Vital Statistics. Vital Statistics of the United States. Volumes 1 and 2, 1958.

81. Best, W. R. An improved caliper for measurement of skinfold thickness. J. Lab. Clin. Med., 43: 967-970, 1954.

82. Association of Life Insurance Medical Directors and Actuarial Society of America: Medico-actuarial mortality investigation, Vol. 1, p. 38, New York, 1912.

83. Lowry, O. H., Lopez, J. A., and Bessey, O. A. The determination of ascorbic acid in small amounts of blood serum. J. Biol. Chem., 160: 609, 1954.

84. Slater, E. C. and Morrell, D. B. A modification of the fluorometric method of determining riboflavin in biological materials. Biochem. J. 40: 644, 1946.

85. Marine, D. and Kimball, O. P. The prevention of simple goiter in man. J. Lab. & Clin. Med. Vol. 3, p. 40, 1917.

86. Munoz, J. A. and Anderson, M. M. Endemic goiter in Basutoland. Bull. World Health Organization. Vol. 21, p. 715, 1959.

87. Zak, B., Willard, H. H., Myers, G. B., and Boyle, A. J. Chloric acid method for determination of protein-bound iodine. Analytical Chem. Vol. 24, pp. 1345-1348, 1952.

88. Benotti, J. and Benotti, N. Personal communication.

89. United States Department of Agriculture. Composition of Foods Used in Far Eastern Countries. Agriculture Handbook No. 34, Washington, D. C., March 1952.

90. Food and Agriculture Organization of the United Nations. Tables of Food Composition. Rome, March 1954.

91. United States Department of Agriculture. Composition of Foods. Agriculture Handbook No. 8. Washington. D. C.. June 1950.

U.S. GOVERNMENT PRINTING OFFICE : 1962 O - 629788