JUNE 1959

THE JOURNAL® OF NUTRITION

VOLUME 68 SUPPLEMENT 1

WALTER CHARLES RUSSELL

Official organ of the American Institute of Nutrition

PUBLISHED MONTHLY BY
THE WISTAR INSTITUTE OF ANATOMY AND BIOLOGY
PHILADELPHIA 4, PA.

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FOREWORD

Concerning Supplements to

The Journal of Nutrition

To meet the need for publication of meritorious but unusually long manuscripts the Journal of Nutrition instituted in April 1954 the policy of publishing such papers in the form of supplements to regular issues. The authors provide the full cost of such publication. For a more complete statement regarding this policy see volume 52, Supplement 1, April, 1954.

George R. Cowgill, *Editor*

PUBLISHED BY
THE WISTAR INSTITUTE OF ANATOMY AND BIOLOGY
PHILADELPHIA
1959

A NUTRITION SURVEY OF THE ARMED FORCES OF THE REPUBLIC OF KOREA

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THE WISTAR INSTITUTE OF ANATOMY AND BIOLOGY

PHILADELPHIA · 1959

COMPOSED, PRINTED, AND BOUND BY
THE WISTAR INSTITUTE PRESS
PHILADELPHIA, PENNSYLVANIA, U.S.A.

CONTENTS

A NUTRITION SURVEY OF THE ARMED FORCES OF THE REPUBLIC OF KOREA [1]

In response to a request from President Syngman Rhee and Ambassador Yang of the Republic of Korea (ROK), a nutrition survey of the ROK Armed Forces was conducted under the auspices of the Interdepartmental Committee on Nutrition for National Defense (ICNND). The objective of the survey was to assess the current nutritional status of the troops. A survey was conducted during June and July, 1956. A similar survey of the ROK Armed Forces was conducted in 1953 by H. R. Sandstead and C. J. Koehn but has not been published.

The team assigned to this task consisted of a Survey Director (R.R.W.), a nutritionist and Deputy Survey Director (G.F.C.), a clinician (W.J.M.), and a food technologist (Z.I.K.). In addition, 7 U.S. military personnel stationed in

[1] The Interdepartmental Committee on Nutrition for National Defense was organized in 1954 under the chairmanship of Frank B. Berry, M.D., Assistant Secretary of Defense (Health and Medical). The late Harold R. Sandstead, M.D., became its first Executive Director. After his death, Arnold E. Schaefer, M.D., succeeded him. The Committee offices are located at the National Institutes of Health, Bethesda, Maryland.

The Committee includes representatives from the U.S. Departments of Defense including Army, Navy, and Air Force; State; Agriculture; Health, Education, and Welfare; the Atomic Energy Commission and the International Cooperation Administration. The Committee retains as consultants some 18 professional persons in the field of nutrition recruited from numerous research agencies, medical schools, and universities. The surveys, such as that here reported, are conducted by personnel whose services are obtained for the period of the survey from their respective institutions. The Korea survey was conducted by the following persons:

Robert R. Williams, retired Chairman of the Williams-Waterman Fund for the Combat of Dietary Diseases, Summit, N. J.

Gerald F. Combs, Professor of Poultry Nutrition, University of Maryland, College Park, Maryland.

William J. McGanity, M.D., Associate Professor of Obstetrics and Gynecology, Vanderbilt University School of Medicine, Nashville, Tennessee.

Z. I. Kertesz, Professor of Chemistry, New York State Agricultural Experiment Station, Cornell University, Geneva, New York.

Korea and 13 ROK personnel were assigned to work with the team (see acknowledgments). The survey included the assembling of informaton on agriculture and food production; clinical observations; biochemical tests and collection of dietary information supported by food analyses. The present report describes the procedures used and the major findings together with minimum background information.

KOREAN BACKGROUND

Agriculture and food production

During the survey an effort was made to collect up-to-date background information on Korean agricultural practices and production, on food storage and preservation techniques, on economic conditions and various other subjects pertaining to the food supply and feeding practices of the ROK Armed Forces. In this effort the United Nations Korean Reconstruction Agency (UNKRA, '54a) was of inestimable help to the team as were also the recent Korean studies of Osgood ('51) and McCune ('56). The latter work has a good discussion of the literature on Korea. Much additional information has been obtained from the current reports of the Agent General of UNKRA ('54) and from U. S. and U. N. personnel engaged in assisting the Korean Goverment. Finally, much information was supplied to the team by Korean Government officials, educators, and technical personnel in the food industries. All this assistance is gratefully acknowledged. Such information was sought in order to help the team in an understanding of the problems encountered and to allow a broad approach in the presentation of the results of dietary and clinical studies, and in making recommendations.

As the aftermath of the destructive Korean War (1950–1953) ranging all over the country and the partitioning near the 38° N parallel, much of the national effort during the past 4 years went into reconstruction and rehabilitation, rather than development. By the time of the team's visit in the summer of 1956, reconstruction was said to be about 80% completed and substantial efforts were directed towards the

agricultural, economic and social development of the Republic. In this undertaking, the UNKRA survey report of 1954 serves as both a base line and as an over-all pattern. The United States and United Nations agencies as well as a large number of other organizations provide (in proportion to the size of Korea and her population) a vast amount of assistance to the ROK Goverment.

There are a number of Korean institutions dealing with nutritional problems and food analysis, notably the Ministry of National Defense Scientific Research Laboratories, and the National Chemical Laboratories, both in Seoul. Both institutions are well equipped and well staffed, and publish especially on Korean foods. A Table of Korean Food Composition (in Korean and English) was published by the National Chemical Laboratories (Chai, '54).

About two-thirds of the population live on farms or in nearby villages. A large part of the remaining third of the people make their living from the processing or handling of agricultural products. Agriculture plays the dominant role in Korea's economy and way of life. Korea is a mountainous country of which only 25% of the total area is agricultural land. Korean agriculture is characterized by small subsistence-type farms, the average size being a little over two acres. The chief crops are rice, barley, soybeans, wheat, millet, tobacco, and cotton. Fishing, mining (tungsten, graphite, gold, coal, iron, copper), the manufacture of cotton textiles and of rubber footwear, and fertilizers are the main industries.

As elsewhere, the development of agricultural production in Korea is inseparably a part of a large effort involving dams and irrigation, seed improvement, agricultural research and extension, development of marketing schemes, and many other factors. Fortunately Korea has well-established institutions and tradition to carry on such activities although in the past such efforts were not always directed for the benefit of Koreans. The reports of the Agent General of UNKRA and of the various Government departments leave little doubt that sub-

stantial progress is being made in the development of agriculture and in increasing food production.

Korean farmers have traditionally a meager animal economy. Even before the war of 1938, livestock accounted for only 6% of the gross value of agricultural production. The recent Korean hostilities have drastically reduced the number of farm animals. As a result, meat is consumed infrequently and in small quantities. Fishing is important along the coast and as a secondary occupation of farmers. The volume of the catch, the handling of the fish in transport and merchandising are susceptible to further development. The establishment of ice manufacturing and refrigeration plants have already resulted in substantial improvement. The general appreciation of food quality by Koreans (which is in contrast to customs in many other parts of the East) ought to be a major catalytic factor in such developments, once the means for improvements become available. This appreciation of quality was certainly obvious in the various markets visited during the survey. The fine quality of vegetables offered for sale was particularly noteworthy.

Although previously an exporter of food (chiefly rice), Korea is now a net importer. In 1954–55 nearly all of the wheat and some rice, barley and soybeans were imported. The population of Korea was about 23 million in 1956 with an annual net population growth of 1.7%. Thus the annual harvest must be substantially increased from year to year in order to keep pace with the rapidly increasing population. Insufficient food during the past several years caused very large fluctuations in the prices of cereals, particularly rice, and has been a factor in the mounting inflation which is adversely affecting the daily life of people as well as the development of a sound national economy. The 1957 bumper harvest of rice (Hailey, '57) contributed to the Government's stabilization program.

The chief natural resources of the Republic of Korea are agricultural. The export of rice seems to offer the greatest

potential source of much needed foreign exchange and a balance of international trade. However, this will be difficult as Korean agriculture generally is intensive, requiring large inputs of labor and fertilizer per unit of land. On a caloric basis, imported wheat is cheaper delivered in Korea than homegrown Korean rice is at the price which this rice commands on the export market. One of the recognized aims, therefore, is to export rice and to consume more wheat, barley and soybeans even if these must be imported.

Public health affairs

Medicine in Korea persists as a curious parallelism of oriental metaphysical diagnosis and therapy on the one hand, and modern western medical science on the other. The latter was introduced during the 1880's and has been developed primarily by the Japanese and by American missionaries. Modern medicine has been stimulated more recently by the World Health Organization, various United States and United Nations missions, and other volunteer international groups and agencies. Prior to very recent times, there have not been valid morbidity or mortality statistics available regarding public health problems in Korea. Since liberation in 1945, it has been reported that the death rate has declined approximately 50%; however, life expectancy of the entire population remains in the 40's.

Diseases attributable to the unsatisfactory sanitary surroundings, unhygienic food handling, and particularly to the unsafe disposal of waste material, produce the major sources of high neonatal, infant, childhood and adult morbidity and mortality. Smallpox, diphtheria, typhoid, typhus and other infectious communicable diseases are endemic in Korea. Parasitic infestation is said to be present in at least 95% of the civilian population (Voice of Korea, '54). An estimated 6% of the population has active tuberculosis (WHO/UNKRA

Report, '53). In 1951, another 6% were reported as infected by venereal diseases, and there were in excess of 50,000 victims of leprosy (Korean Report of Governmental Ministeries, '48–'55).

Official statements have indicated that 1.56% of the national budget goes for Public Health affairs: actually about 20 cents per capita (Voice of Korea, '54). In spite of the limited financial resources, some strides have been made since 1951 in the control of infectious communicable diseases. There has been significant reduction in the mortality caused by these diseases from a rate of 845.5 in 1951, to 13.4 in 1954 per 100,000 population (Korean Report of Govermental Ministeries, '48–'55).

Food and the dietary pattern

In the Korean language, the common word for food is "rice" and rice indeed is the main item of the Korean diet. However, poorer people eat more millet, barley and grain sorghum than rice and practically no rice is eaten in a few isolated parts of Korea, such as Cheju Island. Cereals contribute four-fifths of the caloric intake and in 1954–1955 apparently only Laos exceeded Korea among Asian nations in the proportion of calories derived from cereals (fig. 1). In Korea, rice is usually washed three times and then boiled in about 120% of its weight of water. This is just enough so that when the rice is cooked there is no excess liquid. The wash water is fed to pigs. Rice is commonly eaten in mixture with other cereals particularly barley, sorghum, and millet or with beans or potatoes. Rice or rice flour cakes are very popular.

The cereals which are served at all meals are customarily supplemented with any one of a variety of other foods, notably soup, various soybean products, cooked fish or, if available, meat such as beef or chicken. Vegetables are extensively used and seemed to be of high quality. A unique food served with almost every meal is kimchi, a fermented vegetable dish which

Fig. 1 Much of the rice and other cereals are still hand-milled in Korea.

will be discussed below in detail. The large kimchi pots are a distinctive feature of the Korean scene. Soups are mostly served in the winter. They have endless varieties which approach our stews and usually contain some soy products in addition to other ingredients. Seaweed is a delicacy used in cooking or eaten with soy sauce and salt. Milk consumption is negligible. It is not clear whether breakfast or supper is the principal meal of the day and it will be seen that in military feeding three essentially identical meals are served. There are a great many elaborate special and ceremonial dishes, and many of these show Chinese or Japanese influence. The Westerner's main impressions of the diet of a well-to-do Korean family are the great variety of food items used, the omnipresence of kimchi, and the strong spices and flavorings which find their way into almost all dishes. Fruit is usually eaten for dessert by those who can afford it.

According to a recent estimate (U.S.D.A. Foreign Agricultural Service, '55) the calculated average civilian calorie intake is about 2,058 of which 81% is contributed by cereals, 5% by meat, fish, eggs and milk, 4% by oilseed oil and fats, 2% by fruits and nuts, 4% by white and sweet potatoes, 1.6% by vegetables and seaweed, and 1% by sugar. These figures refer to disappearance of food at or near retail level and are not necessarily the amounts ingested. Since the majority of Koreans are engaged in agriculture, much food does not pass through commercial channels and is not reported. From our own observations it would seem that the vegetable intake is very much higher than indicated by this assessment.

The food of the ROK Armed Forces is a simplified version of the national diet adjusted for mass feeding. It includes many food items considered essential from the standpoint of nutrition or highly favored by Koreans. Basically, the military diet consists of a mixture of rice and pressed barley (barley takes a longer time to cook than rice but the cooking time of pressed barley is very similar to that of rice) cooked

together and a thick soup served at the three meals each day. These two main items are served separately in mess kits or two bowls of about 800 ml capacity, usually made of pressed aluminum. Additional foods (canned pork, buns, etc.) are either put on the top of the rice bowl or issued in bags (biscuits of cracker type). The Army soup usually contains fish, soy products, vegetables and seasoning and is a thick nutritious dish. Attempts are now being made to develop a three-part mess kit to hold the cooked rice-barley, soup and additional foods issued. In the following typical formula for Army soup, the quantities are given in grams per man for one meal:

Cabbage	70	Soybean curd	30
Onion	3	Soybean mash	30
Melchi (dried small fish)	2	Red pepper mash	10
Large white radishes	30	Salt	10
Red pepper powder	1		

Since a knowledge of the various Korean foods is essential to an understanding of the diet pattern, some important food items not well known outside Korea will be discussed briefly.[2] Additional information collected on important diet ingredients also will be given below. For the amounts of various foods used in military feeding, see tables 3 and 4 of this paper.

A. Rice. Rice now constitutes about 54% of the cereals consumed in Korea. Korean rice is of short grain type and of fine quality. The Government collects some of its taxes in rough (i.e. unhulled) rice. This rough rice is held in Government stores, and eventually all of the rice as issued by the Government is "undermilled." The Armed Forces use only undermilled rice. The extent of nndermilling is defined as "70% milled," which in Korea means that the brown rice has received only 70% as much milling as is required to produce "white rice." This is accomplished by either reducing the length of time for which the "brown rice" is milled or the number of milling steps.

Goverment milling standards state that the 92 kg of polished rice obtained from 100 kg of "brown rice" will be "white

[2] Osgood ('51) describes in some detail the food of a Korean village.

rice.'' This loss of 8% in weight is taken as ''100% milling.'' In milling brown rice for ''70% milled'' rice, 100 kg will yield 94.4 kg of undermilled rice. The undermilling is rigorously enforced and the Government Agricultural Operations Bureau sends out inspectors with printed handbooks describing the above manner of undermilling. The control is usually done by comparison with authentic ''official'' 70% milled rice samples and by examination of milling records.

One great handicap of the use of nndermilled rice in many areas is its liability to weevil infestation. While no systematic study of this problem was undertaken in Korea, all observations indicated that weevils are remarkably well controlled both in rice mills and in warehouses. This is accomplished in part by retaining the rice in unhulled form until actually needed for early use. In part it is achieved by fumigation of brown rice which must be systematically applied in Korea as weevils were rarely seen in all inspections by the team.

Several analyses of ''70% milled'' rice were obtained. Data from the National Chemical Laboratories, Seoul, indicated thiamine contents as follows:

Brown rice	0.437 mg per 100 gm
30% milled	0.312 mg per 100 gm
70% milled	0.232 mg per 100 gm
100% milled	0.177 mg per 100 gm

Analysis of three further samples at the Ministry of National Defense Laboratories gave an average of 0.257 mg per 100 gm for ''70% milled'' rice. Seven samples of ''70% milled'' rice were collected by our team and subsequently analyzed in the United States at the National Institutes of Health. The thiamine values of these were closely similar and averaged 0.245 mg per 100 gm. This figure, in good agreement with Korean analyses, was used in all calculations.

All rice in ROK Armed Forces messes is mixed (''extended'') with pressed barley. The ratio of barley to rice is around 1:5.7 in the Fiscal Year '56 Basic Food Allowance. This ratio was observed in the Navy and Marine units, whereas the current Army menus indicate a ratio of 1:4.1. The

latter proportion was observed in all ROK Army kitchens where the food was weighed in the course of our study.

Rice privately milled for civilian consumption (not that issued by the Government to civilian employees) is "100% milled" white rice. Home-pounded rice is still extensively used in rural districts. As in other countries, the popular preference is for machine-milled white rice.

B. Wheat flour. The Koreans like bread. The ROK Armed Forces use biscuits (crackers) and buns (rolls) as well as doughnuts. The increasing use of wheat flour has far-reaching implications since there is agreement among experts that Korea's economic future depends to some extent on the export of her high quality rice and the importation of less expensive wheat or wheat flour (United Nations Korean Reconstruction Agency, '54b). Wheat is a much cheaper source of calories than rice. According to a calculation made by our team on the basis of Bank of Korea prices on June 25, 1956, the cost of 1,000 Cal. from rice was 75 hwan and from wheat flour only 43 hwan. Putting this on a different basis, $1.00 (U.S.) will buy 11,627 Cal. of wheat flour but only 6,645 Cal. of rice.[3] Korea has several modern flour mills and milling capacity is now being increased from an estimated 20 gm per caput per day in January, 1956 to 57.7 gm in 1957. Bread and bun (roll) baking ovens of an ingenious and simple design exist in all cities and many villages and can be constructed at a low cost. A variety of other foods such as noodles and dumplings made from wheat flour are also well known and popular in Korea.

At the time of this survey, ROK Government plans called for an increase in the importation of wheat. Although the ROK Armed Forces use buns, these were at the time of the survey commercially baked. The present training schedule at the ROK Quartermaster Training School in Pusan teaches

[3] The official exchange rate of 500 hwan to the dollar was used in these calculations. This rate has been maintained since 1955 although the ratio does not correctly express the comparative purchasing value of the hwan and dollar in Korean markets.

the preparation of noodles, dumplings and bread in Army messes. At the time of our visit only 6% of the kitchen personnel had such training but this proportion is expected to reach about 30% in two years. Present mess equipment is suitable for making and serving noodles and dumplings and plans are being made for obtaining baking equipment. The biscuits (crackers) now used by the ROK Armed Forces are issued in bags at times when other wheat flour products are not available or for use as an emergency ration.

C. Soybeans and soybean products. Soybean products are extensively used in the Korean diet and by the ROK Armed Forces. At the time of our visit all soybean products for the Armed Forces were made from imported U.S. soybeans. Since the latter were purchased in the United States on the basis of specifications designed for soybeans to be used for industrial purposes rather than to serve as food or in the manufacture of food products, often the beans were not well suited for the latter purposes. The major objections were low germination, broken seeds, and excessive foreign matter. This problem was investigated after the team's return and it is understood that now requests from Korea designate the specific requirements necessary to their anticipated use of the soybeans. Some of the commonly used foods made from soybeans and used by both civilians and the Armed Forces are as follows:

Soybean curd (the Japanese "tofu") is a calcium or magnesium-precipitated gel made from the liquid expressed from cooked soybeans. Soybean curd is used almost daily in making soups. This curd is also fried in deep fat and used in a composite ROK Army food called "seasoned vegetable and bean curd" containing small fish (12%), soy sauce (23%), bean curd (25%), seaweed (16%), dry radish (14%), and red pepper, sugar and cottonseed oil. This latter product was observed in one ROK Army mess only.

Soybean sprouts are a favorite civilian food in Korea but the extent of use in troop feeding is limited, presumably mostly because of the low germination of the soybeans avail-

able at the time of our visit. From the nutritional standpoint, the use of soybean sprouts in troop feeding is highly desirable.

Soybean sauce is a well-known and nutritions seasoning obtained by fermentation.

Seasoned soybeans are a delicacy much liked by Koreans and obtained by hoiling soybeans in sweetened soybean sauce. The weight proportions used in the preparation are said to be cooked and roasted soybeans 70%, soybean sauce 25%, and sugar 5%.

Soybean mash and pepper mash are fermented foods popular in this part of East Asia. Barley is cooked, allowed to cool and then treated at about 90°F for one day with a commercially prepared enzyme made from *Aspergillus orizae*. The barley is then milled together with cooked soybeans and salt, and fermented in concrete tanks for about three months. The finished paste-like product is rich in amino acids and protein and is extensively used directly and in cooking. Pepper mash is a similar preparation which contains in addition 10% powdered red pepper.

Soybean milk is not used in Korea.

D. Kimchi (kim-chee). There is much misunderstanding concerning the nature and value of kimchi in the Korean diet, civilian or military. This is a class designation for salted and fermented acidic products akin to sauerkraut and pickles, apparently produced with the participation of several microorganisms. Winter kimchi is made in the fall, mostly from "mu" or large-rooted radish *(Rephanus sativus),* cabbage, Chinese cabbage, and a large variety of spices and flavorings, including liberal amounts of leeks, onions, garlic, red pepper, ginger and salt. "Winter kimchi is made in large stoneware crocks into which the vegetables are packed with salt or salt brine (fig. 2). The mixture is allowed to ferment for several weeks or months before being used. Then it is consumed throughout the next 4 or 5 months. Summer kimchi is made from young radish and radish leaves, cucumbers, cabbage, lettuce, etc., and some of the above noted minor ingredi-

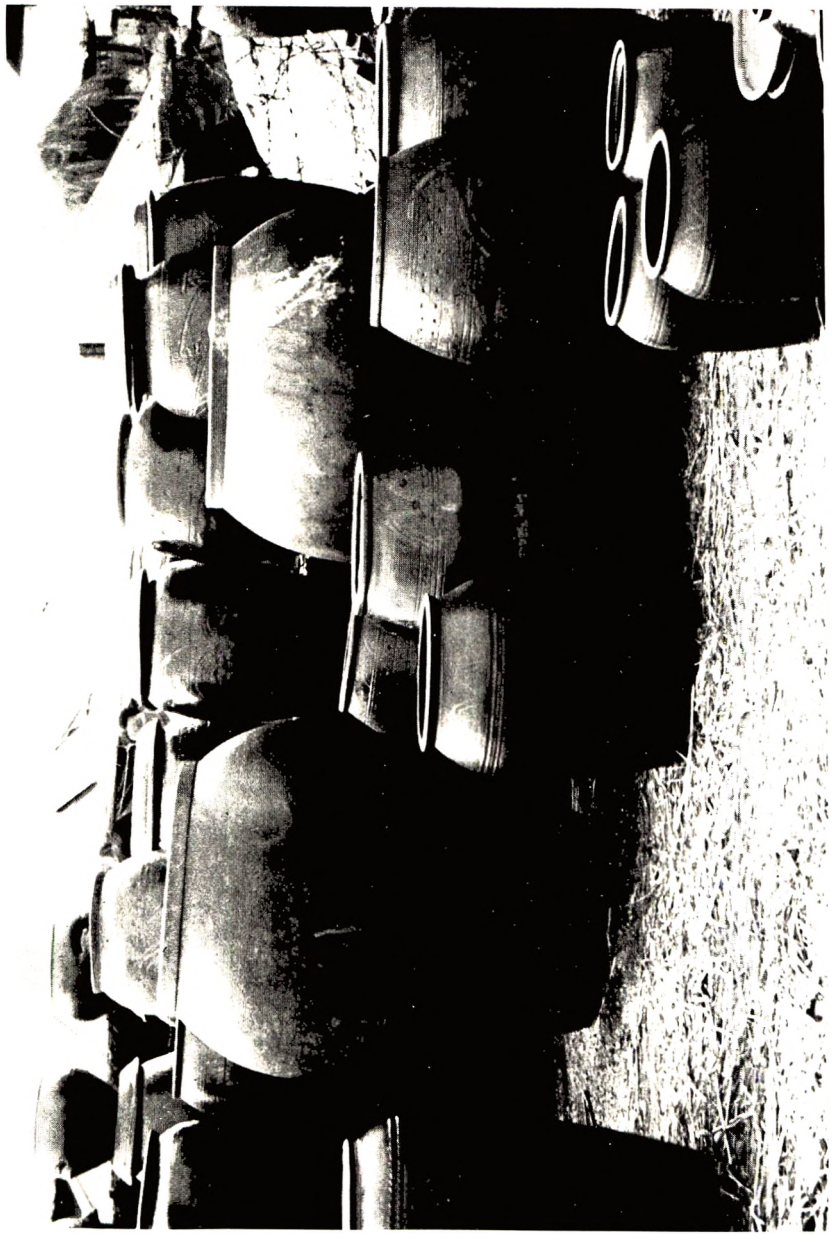

Fig. 2 The kimchi pots, often man-sized, are a part of the Korean scenery and important from the standpoint of nutrition. The larger pots in this picture are almost 5 feet tall. The pots are used for soybean paste as well as for kimchi. When in use, the pots are often dug into the ground or are carefully shaded to prevent large fluctuations in temperature.

ents, and is allowed to ferment for only two or three days before serving. There are many types of kimchi. Some form of kimchi is eaten with almost every meal. Between seasons supplies of kimchi, of course, may be exhausted, especially in the homes of the poor or improvident.

Kimchi represents an indigenous and ingenious preserved food for supplying vegetables, particularly important during the winter months when no fresh green vegetables are available. There is sufficient scientific information on hand to indicate that vitamins are fairly well preserved in both winter and summer kimchi. The civilian consumption per person per day has been estimated by the team, on the advice of well-informed Koreans, to be 200 to 300 gm or more and therefore the amounts of nutrients derived from this traditional food are substantial. Since kimchi is invariably prepared in the home, it is difficult to estimate actual consumption but it is more than likely that the kimchi alone will provide more vegetables in the diet of Koreans than indicated in the food balance sheets.

Although kimchi is used in ROK Armed Forces feeding, the quantities supplied are much smaller than those consumed by civilians. The reasons may be time-consuming methods of preparation and particularly the excessive storage facilities required. However, the lower kimchi intake is, in part at least, compensated for by the use of generous amounts of vegetables in soups prepared in ROK Armed Forces messes.

Based on the meager information available, it is suspected that kimchi (and takuwan) may be a source of intestinal parasites and harmful microorganisms. This is particularly possible with summer kimchi which is fermented to a slight extent only.

E. Takuwan. This food should be noted because its yellow color might lead to a fallacious assumption of high carotene content. Takuwan is made by the fermentation of large-rooted radishes (mu) in concrete tanks with a large proportion of crude sea salt. A synthetic yellow dye (said to be auramine

C, subject to verification) is sprayed on the radishes as layer after layer is placed in the tank. The mixture is allowed to undergo fermentation (pickling) for about 15 days in summer but 30 days or longer in winter. In ROK Armed Forces feeding the takuwan is consumed as is or used in soups.

F. Dried, salted and pickled fish. There is a considerable variety of such products sold on the civilian market and used in ROK Armed Forces messes but they hardly need any special description. Melchi is a small dried fish produced without gutting and highly valued as a flavoring ingredient in soups. Canned fish is being used in small quantities. At the time of our survey, the complete Korean canned fish production was purchased with U. S. funds for use in ROK Armed Forces mess feeding.

G. Salt. Both crude and refined salt are used in Korea. All salt used in ROK messes is crude sea salt obtained by complete evaporation and contains (on dry basis) about 1.8% calcium sulfate and about 1.9% magnesium sulfate. Mess personnel and troops were questioned on their preference for crude or refined salt. Crude salt seems to be unanimously preferred because "it gives better flavor to food." Crude salt is used in the preparation of all fermented products (kimchi, takuwan, soybean sauce, soybean mash, etc.) because the presence of the naturally occurring minor elements is believed to enhance fermentation and, again because of the "better flavor." The salt issue in the ROK Armed Forces is high (30 gm per man per day) but, in addition, up to double this amount of crude salt is ingested in "prepared" food issued. Examples are soya bean and red pepper mash, 15% salt and soya sauce, 20% salt. Almost all other items are either salted (shrimp, fish, etc.) or pickled (onion, radish, takuwan, kimchi). The 1953 survey (Sandstead and Koehn, '53) estimated about 2 gm magnesium sulfate intake per man per day from crude salt. This equals about 4 gm of Epsom salt, $MgSO_4 \cdot 7H_2O$. The high salt and magnesium sulfate intake is of interest because, as noted by the 1953 survey, this might throw light on the high incidence of diarrhea in Korean military personnel.

PROCEDURES

Sampling

Dietary. The kitchens of an Army Training Regiment, an Army Engineer Battalion, an Army Infantry Battalion, and a Marine Infantry Battalion were surveyed. These unit kitchens were selected by the team nutritionist from those kitchens available in the major units selected by lot for clinical study, as described below, without any specific knowledge concerning them. Thus the selection was essentially a random one. These 4 unit kitchen surveys represent a total of 17,026 rations (51,078 meals) prepared and consumed.

Clinical. During the period of the survey (June 22–July 18, 1956) 1514 male subjects, aged 17 to 35, from all components of the Republic of Korea (ROK) Armed Forces were examined for clinical evidence of nutritional inadequacies. The sample was designed to represent a random cross section of the *enlisted* personnel of the ROK Armed Forces. The number and types of groups examined were substantially in proportion to their respective strengths in ROK Armed Forces. The distribution of the troops was as follows:

	NUMBER	LOCATION
New inductees	180	2
Recruits at completion of basic training	161	3
Headquarters troops	22	1
Army troops		
Corps A	342	4
Corps B	335	5
Marine troops		
Corps C	349	7
Air Force	64	8
Navy	61	9
	Total 1,514	

At the basic training camp, the new inductees were selected from those taken into the ROK Army on the day preceding the team's arrival. It must be realized that these subjects [4]

[4] In 1956, 78% of draft-eligible males were admitted to the ROK Armed Forces (Official Republic of Korea release in The Korean Republic, June 29, 1956).

represented civilians who had been screened medically during the induction process by methods similar to those used in the United States Armed Forces. The troops selected at the completion of their basic training (16 weeks post-entry) came from the placement battalion awaiting assignment to line divisions.

The preliminary selection of the Corps and Divisions to be surveyed was done by lot while the team was in Seoul (June 20, 1956). It so happened that of the divisions selected, one was in active reserve, and two were in the line. One additional division (location 6) was eliminated due to the limitation of time. Notification of these divisions was delayed until the last possible moment (approximately 24 hours before the examination started) so that there was the least possible chance of preparation, stockpiling, or bias of the sample. The selection of the regiment and battalion was randomly determined upon the team's arrival at Divisional Headquarters. Organic platoons of troops were used as a basis of subject material and were selected systematically so as to include all principal types of services.

Design of platoon sampling of Republic of Korea Army (1956)

UNIT	NUMBER
Combat elements:	
Infantry rifle platoons	3
Infantry battalion mortar platoon	1
Infantry battalion machine gun platoon	1
Heavy mortar co. platoon	1
Engineer co. platoon	1
Tank co. platoon	1
Reconnaissance co. platoon	1
Artillery firing battery 105 mm Howitzer section	1
Sub-total, combat	10
Service Elements:	
Quartermaster Co. (Transportation Platoon)	1
Ordinance Co. (Service Platoon)	1
Military Police Co. (Traffic Platoon)	1
Total	13

In the Infantry Platoon selection, one came from each battalion of the regiment designated. From each organic platoon, either all the troops were examined, or where the numbers were excessive, the clinical team randomly selected 26 to 28 individuals from each platoon. All of these subjects received the same basic food issue and hwan allowance with the exception of those in the tank battalion, who received an extra 100 hwan per man per day. No evidence of attempts to weight the sample with either inferior or superior troops was detectable in either the Army or the Marine Forces.

The sample from the Navy (excluding the Marine Division) and the Air Force was not as satisfactory. The total number of troops, their location, and segments receiving extra hwan allowance produced circumstances that made choice by lot unfeasible and possible bias in sampling could not be avoided completely. While on sea duty, each Navy man drew an extra 100 hwan per day allowance for secondary foods. In the Air Force the pilots received an extra 600 hwan per day. To have proportionate representation, one half of the Navy subjects and one fifth of the Air Force sample were drawn from these troops drawing the extra hwan allowances.

Biochemical. Of the troops examined clinically, 303 (20%) had blood drawn for biochemical analysis. While selection of subjects was mostly on the basis of a 1-in-5 systematic sampling as the subjects were entered for clinical examination, it was necessary on occasion to vary this procedure due to the necessity of meeting transit deadlines.

A 6-hour fasting specimen of urine was collected from 198 (14.5%) of the total survey population. Randomly selected representative platoons were used as a basis of subjects, and these were gathered together in closely located sleeping quarters at 5 locations (2, 3, 4, 5, and 7) on the last night of the survey in each site. In three locations (2, 3, and 7) the blood and urine specimens were not taken necessarily from the same individuals.

Methods

Dietary. For the dietary appraisal of the food intake, the following procedures were used:

1. Copies of basic food allowances, Army master menus and revised Army district menus as well as information concerning food issues and purchases were obtained. Food issue records were obtained for the months of January and June, 1956 from Division, Regiment and Battalion supply officers, together with the number of troops fed. The latter figures were based on the strength reports. From this information the amount of each food item issued per man per day was computed. Nutritional value of the food was computed by the use of nutrient composition tables. (ICNND, '57b, Appendix 4)

2. The average amount of each food item consumed per man per day during three three-day and one two-day periods at 4 different units was measured. The survey was done by weighing on a quartermaster folding scale the amounts of various foods (edible portion) used in the preparation of meals as well as determining the number of men fed. Plate waste was measured at the start, but this procedure was discontinued since plate waste was found to be essentially nonexistent. Most of the food weights were taken by ROK Army officers assigned to work with the team.

3. Composite samples of food, consisting of representative aliquots of each food served also were prepared for subsequent chemical analysis. Two samples were taken at each meal from each cooking pot and combined by food item. These were stored on ice during the day, then homogenized in a Waring Blendor and combined in proportions based on the average amount of each food item consumed per man per meal. Then 5% oxalic acid was added as a preservative. At the end of each two- or three-day survey, a final composite was made for the entire period. A triple beam balance was used for these weighings.

Aliquots of the above mentioned samples were sent (iced) within 24 to 48 hours after the samples were taken to the

406 Medical General Laboratory, Japan, where vitamin C determinations were performed. Other aliquots were later shipped to the United States for thiamine, vitamin A, riboflavin and carotene assays. They were not refrigerated during this period (from two to three weeks), but were again put under refrigeration upon arrival at the laboratory. The samples which are recorded in table 1 as having been analyzed at the National Institutes of Health were one to three months old at the time of analysis; those analyzed at the Wisconsin Alumni Research Foundation were about 5 months old before all analyses were completed. The methods of analysis used at all three laboratories were those set forth in the Manual for Nutrition Surveys (ICNND, '57a).

Clinical. The clinical team was comprised of 10 members, 5 American and 5 ROK Army personnel. Included among the Korean personnel were two physicians, who measured and recorded all blood pressures, examined the lower extremities and questioned subjects concerning the history of tuberculosis, trachoma, malaria, and chronic diarrhea; one secretary-interpreter; and two orderlies. Among the American personnel were one physician who performed the nutritional physical examination on all subjects, and 4 drivers who were used as scribes and clerks in the clinical examination team in addition to their driver duties. A U-shaped floor system established to utilize fully each individual's talents allowed the examination of from 120 to 140 subjects per working day.

Physical examinations were made by a physician experienced in nutritional survey work. A standardized check-list of findings on punch cards was used and all standards of physical findings were as outlined in the Manual for Nutrition Surveys (ICNND, '57a). Height without shoes was recorded to the nearest inch. Where the measurement was exactly on the half-inch, it was recorded to the nearest even numbered inch. Weight in shorts only without shoes or other clothing was recorded to the nearest pound. Where the measurement was exactly on the half pound, it was recorded to the nearest even

numbered pound. Standard weight was taken from the modified Medico-Actuarial Tables adjusted to nude weight, no shoes (Medico-Actuarial Tables, '12) and per cent standard weight computed.

On an additional 520 men only height, weight, and age were recorded in locations 1 through 5. These raw data were corrected for shoes (height) and clothing (weight) and per cent standard weight and used as supplementary data.

Biochemical. The field biochemical team comprised one American laboratory technician who drew all blood samples, and also performed the determinations of hemoglobin, total plasma protein and a calculated hematocrit.

During the first week samples of 15 to 18 ml of heparinized whole blood were drawn and the determinations of hemoglobin and total plasma protein were performed in the field. An aliquot was shipped to the 406 Medical General Laboratory in Japan. With the arrival of the vacuum tubes which were used for the last 236 determinations, an oxalated (potassium and ammonium) 5 ml sample and an 18 to 20 ml sample of whole clotted blood were drawn. The former was used in the field determinations of hemoglobin and plasma proteins, and the latter was immediately packed for trans-shipment to the Base Laboratory. This heparinized or clotted aliquot of whole blood (15 to 18 ml) was packed in iced thermos bottles and transported by car or airplane to Seoul, and then via regular U. S. Air Force courier planes to Japan where the vitamin determinations were performed. The time elapsing between the drawing of the blood specimen and the arrival of the samples at the Base Laboratory in Japan varied from 12 to 48 hours. Further delay before analysis was sometimes occasioned at the Laboratory due to the shortage of personnel and the arrival of specimens at weekends. However, all specimens were kept continuously refrigerated from the time of drawing until actual determination. One would anticipate no difficulty with the vitamin A or carotene determination due to this delay. However, one might expect that the ascorbic acid (vitamin C)

levels, would be lower than if the procedure had been carried out immediately. The results of test studies indicated that if left alone in the vacuum tube as whole clotted blood and continuously refrigerated, there was no appreciable loss of ascorbic acid (vitamin C) from the samples. The consistently high level of this vitamin in the specimens from the present survey is additional evidence in support of this conclusion.

Aliquots of the 6-hour fasting urine specimens, in addition to the refrigeration, had added 0.1 ml of concentrated hydrochloric acid to protect from deterioration. These aliquots were shipped to the 406 Medical General Laboratory in Japan for assay.

The biochemical analysis of blood for serum carotene and vitamin A and vitamin C and of urine for thiamine, riboflavin and *N'*-methylnicotinamide were performed at the 406 Medical General Laboratory in Japan.

The methods used both in the field and Base Laboratory are described in the Interdepartmental Committee on Nutrition for National Defense Manual for Nutrition Surveys (ICNND, '57a).

Hemoglobin and total plasma proteins. The copper sulfate specific gravity method of Phillips et al. ('50), specific gravity intervals of 0.001 units, was used and the levels recorded. The recommended correction was made for oxalate when present.

Serum ascorbic acid. A photoelectric procedure (Bessey, '38; The Association of Vitamin Chemists, '51) which employed 2, 6-dichlorophenolindophenol as an indicator, metaphosphoric acid as a protein precipitant and citrate buffer was used. These reagents were prepared in deionized water. All samples were stabilized immediately upon receipt in the 406 Medical General Laboratory and completed within 4 days.

Serum carotene and vitamin A. The serum was extracted with petroleum ether, the carotenoids estimated photoelectrically, and vitamin A determined by an adaptation of the Carr-Price reaction (Dann and Evelyn, '38; Gyorgy, '50, Vitamin methods, Vol. I Academic Press p. 158).

Urinary thiamine. Thiamine was adsorbed from urine in acid solution by means of activated zeolite. It was eluted with concentrated potassium chloride and was converted to thiochrome by ferricyanide in alkaline solution. Thiochrome was extracted into isobutyl alcohol and measured photofluorometrically as described by Consolazio, Johnson and Marek ('51).

Urinary riboflavin. The riboflavin was measured fluorometrically (Conner and Straub, '41) after interfering substances were destroyed. An internal standard was used and the blank was determined after reduction of riboflavin to the leukoform which is not fluorescent.

Urinary N'-methylnicotinamide. The urine was treated with acetone in an alkaline aqueous solution to produce a green fluorescent material. To this was added an excess of acid which converted it to a more stable substance with a blue fluorescence which was measured in the photofluorometer, (Huff, Perlzweig and Tilden, '45).

All the clinical and biochemical data were transcribed onto edgepunch cards for field analysis and subsequently onto one 80 column card for the final tabulations.

RESULTS

Dietary findings

Military messing. Cooking facilities in ROK Armed Forces kitchens consisted primarily of large round-bottom iron pots mounted over a dried clay firebox. One series of pots was used for preparation of the rice-barley dish while another was used to prepare soup (fig. 3). Most kitchens prepared food for battalions, although regimental, company, platoon and even squad-size kitchens were also used. One large pot of approximately 35-gallon capacity was used per 150 to 180 men for preparing the rice-barley dish and another for the soup. Smaller pots, suitable for cooking rice or soup for approximately 25 men, were also provided.

Timing of the food preparation was almost universally poor. Prolonged heating was observed in the preparation of both the

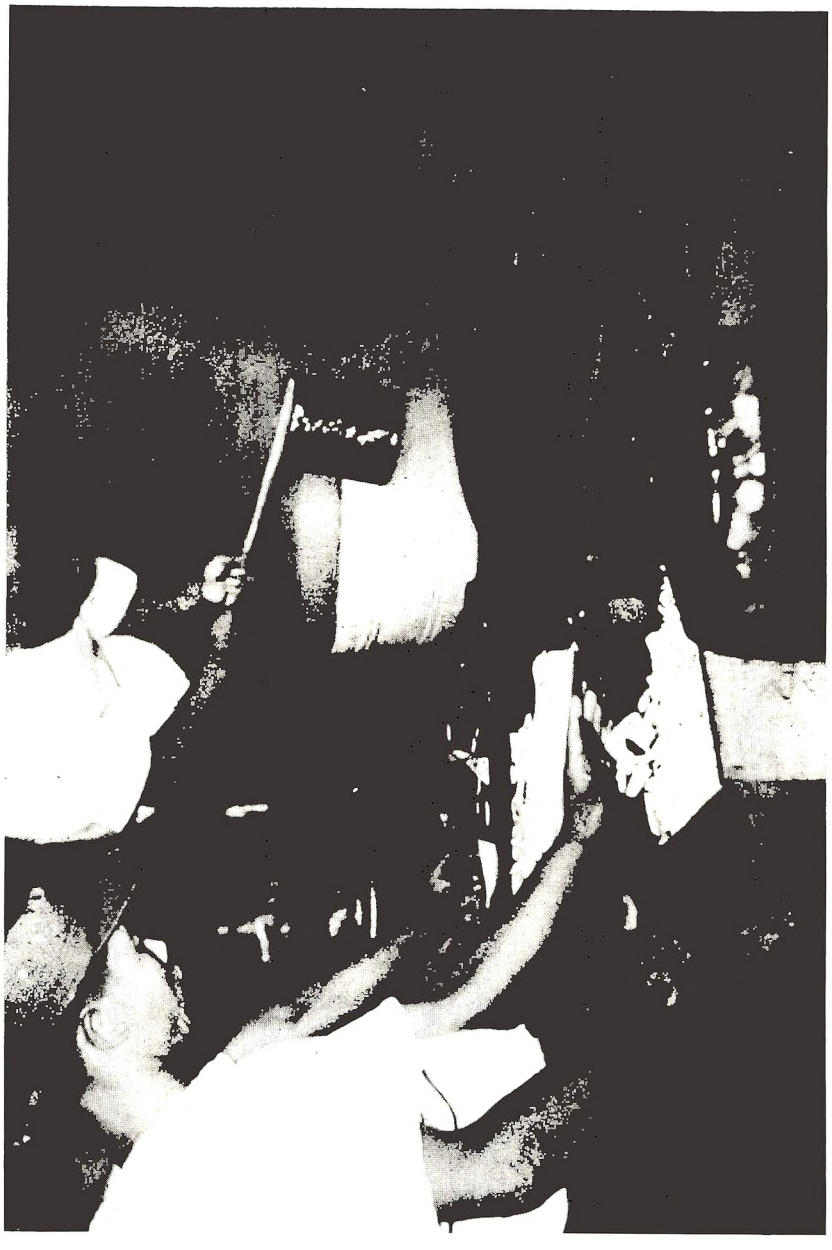

Fig. 3 Interior of a Korean Army kitchen, showing typical facilities for food preparation. The large cooking container is used for preparation of rice or soup.

rice-barley dish and the soup. Coal, wood, and oil were used in various ROK Armed Forces mess kitchens. The fuel was used with skill, but because of the available equipment it was not always used to the best advantage. This was particularly true during the extended periods when the prepared food was kept hot.

Soap was not available in ROK Armed Forces messes for washing mess gear or kitchen utensils. Hot water was sometimes provided for this purpose but since fuel was scarce, this frequently was not the case.

Other equipment in the kitchens was meager, consisting usually of shovels for stirring rice, dippers made from no. 10 size cans provided with wooden handles, knives, and a limited miscellaneous collection of containers. These containers were very limited in number, varied in size greatly, had no tops or only improvised ones, and were difficult to clean. Tables for food preparation were available in some of the kitchens, but many had only cutting boards for use in vegetable preparation. In most permanent kitchens running water was provided, but in others the nearby stream was used as both the water supply and as the only place for washing kitchen utensils and mess gear. Flies were rather abundant, yet only one kitchen visited was provided with screens and doors. In most instances there were no satisfactory toilets or handwashing facilities for cooks. One notable exception to the above was found in the ROK Navy kitchens afloat. Here the facilities were excellent and included refrigerators, steam, and proper equipment.

Mess halls were available for the troops in only a few instances. Instead, the cooked food (rice-barley and soup) was carried to their quarters where they ate. Distributing the food in various size buckets and other containers, frequently not covered, to several separated eating points was not easy. In spite of the limitations, this phase of the food service appeared to be well organized and carried out.

In addition to the rice-barley dish and soup, side dishes were occasionally available. The most common of these were sea-

soned soybeans, fried bean curd, pickled radish (takuwan), canned meat, canned fish, salted shrimp and kimchi. Biscuits, buns or doughnuts also were used. The biscuits were issued in 250 gm bags, one to each man every three days.

Cooking facilities appeared to be less adequate with smaller units. At platoon and squad level, the cooking facilities were often very primitive. Some observations made along the D.M.Z. indicate that the troops in the front line at times had only a pot of some sort which was propped up on stones (fig. 4). These were the "end of the supply line" troops whose food issue did not always include all the more desirable and nutritious food items. Considering the fact that these men were apparently stationed in such locations for periods as long as 5 or 6 months, it is quite possible that a combination of primitive facilities and limited food supplies might contribute to their nutritional detriment. This might be particularly true during periods of inclement weather.

Both kitchen and plate wastes observed in the messes surveyed or visited were extremely small. For example, in one mess surveyed the average plate waste was found to be 0.15%. It is believed that the total food waste from kitchens and plates did not exceed 0.5%. Also no significant damage or spoilage of food was encountered in its handling and distribution. An estimated total loss of 5% due to spoilage and waste would seem entirely adequate.

Basic food allowances and food rationing system. The basic ration system of the ROK Armed Forces did not insure that adequate amounts of all essential nutrients would be provided. The basic ROK Army food allowance consisted of "main food items" (676.8 gm of rice, 70% milled; 163.8 gm of pressed barley; and 83.3 gm of biscuit and 10 cigarettes per man per day) and "secondary dishes." The secondary dishes included vegetables, meat and fish, soybeans and soybean products, vegetable oil, red pepper and salt. The canned meats, vegetable oil, biscuit ingredients, red pepper and soybeans were provided by the U. S. Direct Forces Support

Fig. 4 In this outpost the cooking was done on two iron bars put across stones and provided with an inclined stove pipe for draft.

(DFS) Funds. The rice (70% milled), barley and cigarettes were supplied by the ROK. These additional ration items were procured within a set monetary allowance of 57.91 hwan per day per man. From this, ROK central procurement also supplied soybean mash, red pepper mash, soy sauce, and salt for all components of the Armed Forces, leaving 44.73 hwan for additional items. The ROK Army, through its central procurement agency (Market Center System) purchased all remaining foods to be issued to Army units. The nutrient composition of the basic food allowances as calculated are given in table 1.

The ROK Navy, Marine, and Air Force units received the hwan allowance and purchased these additional perishable items locally. This was done at unit level by the Marine Division, at the 9 Air Force bases, and by the other separate Navy and Marine components. The ROK Army prepared a monthly "Master Menu" which was later modified by menu boards at each of the 8 Field Buying Offices. The Navy and the Air Force provided monthly menus for use as a guide in the procurement of local foods. In addition, an extra 100 hwan per man per day was authorized for tank units and Navy units afloat. Air Force pilots also received an additional 600 hwan allowance per day for food. Hospital patients received no additional food allowance.

Nutritional adequacy. Information obtained concerning the nutritional adequacy of food issues to various units is summarized in table 1. Separate food issue periods were selected for the months of January, April, May, or June, and include military units from the ROK Army, Navy, and Marines. The food issue data collected involve approximately two million rations, as issued. The calorie content of the food as issued per man per day as calculated ranged from 3429 to 4350. The Marine tank battalion, which received 4350 Cal. per man per day as issued, received an additional ration allowance of 100 hwan per man per day. The calorie evaluation of the food issued for the ROK Army units shown in the tables averaged

TABLE 1

Summary of dietary evaluation data of the Republic of Korea armed forces [1]

(Amount per man per day)

SOURCE OF DATA	CALORIES	PROTEIN	FAT	CARBO-HYDRATE	CALCIUM	IRON	VITAMIN A	THIAMINE	RIBO-FLAVIN	NIACIN	VITAMIN C
		gm	*gm*	*gm*	*mg*	*mg*	*I.U.*	*mg*	*mg*	*mg*	*mg*
Basic food allowances:						Calculated values					
Ministry Nat. Def.	3955	183	51	713	1118	25.7	3027	3.16	1.80	35.0	104
Army, July, '56	3903	133	36	762	602	29.8	1121	2.52	0.97	22.5	93
Master or guide menus:											
Army (March–July, '56)	3929	126	43	764	646	30.7	1100	2.63	1.08	24.4	75
Navy, ashore (May–July, '56)	3435	93	27	710	687	32.7	5000	2.53	1.02	18.6	133
Navy, afloat (May–July, '56)	3732	106	44	727	669	36.6	3850	2.71	1.12	21.6	110
Army district menus:											
Field buying office A (July, '55–June, '56)	4039	139	41	784	688	44.4	3093	3.05	1.30	23.8	77
Field buying office B (Aug., '55–July, '56)	4042	138	51	767	667	32.3	2402	3.03	1.28	24.9	79
Av.	4040	138	46	776	678	38.4	2748	3.04	1.29	24.4	78
Food issues:											
Army (Jan., '56)											
Regiment A, Div. A	4188	141	43	818	806	28.9	3134	3.26	1.60	28.7	89
Regiment A, Div. B	3429	107	40	668	558	33.9	1139	2.72	1.27	22.6	76.3
Division B	3811	117	35	760	577	30.0	765	2.72	1.12	23.5	72.7
Av.	3809	122	39	748	647	30.9	1679	2.90	1.33	24.9	79.2
Army (June, '56)											
Regiments A and B replacement training center (av.)	3674	124	41	708	619	38.0	630	2.46	1.06	24.1	74
Regiment A, Div. A	4332	143	40	848	552	29.2	1300	2.71	1.02	25.5	67
Division B	3688	130	34	721	564	29.3	2541	2.32	1.10	23.5	87
Regiment A, Div. B	3694	126	34	724	596	27.0	3240	2.35	1.04	22.9	92

Regiment B, Div. B	4267	136	37	850	586	29.0	1204	2.70	1.01	24.5	92
Engineer Bn:, Div. B	4219	143	50	834	606	30.7	1374	2.79	1.12	26.4	89
Av.	3979	134	40	780	587	30.5	1715	2.56	1.06	24.5	83
Overall av. (Army)	3922	130	39	770	607	30.7	1703	2.67	1.15	24.6	82
Navy and Marines:											
Navy, landing ship medium (July, '56)	3732	110	40	733	445	23.2	304	2.95	1.03	22.6	49
Marine regiment A (April, '56)	3649	102	27	754	479	20.6	2108	2.83	1.06	20.6	74
Marine regiment A (May, '56)	3619	116	21	742	592	22.3	17,405	2.65	1.23	21.1	188
Marine regiment A (June, '56)	3910	106	24	788	663	19.7	4605	2.62	1.18	24.9	165
Av.	3726	108	24	761	578	20.9	8038	2.70	1.13	22.2	142
Tank Battalion, Marine Div. C (June, '56)	4350	172	57	786	988	45.8	6781	3.05	1.61	29.5	331
Kitchen survey (as consumed)											
Army replacement training center regiment	4057	142(49) [2]	38	787	903	57.4	2108	2.52	1.26	29.6	83
Army infantry battalion	3689	117(5)	36	747	655	25.2	294	3.20	0.95	20.9	119
Army engineer battalion	4119	154(17)	63	772	1022	34.5	447	3.94	1.37	29.0	135
Marine infantry battalion	3392	98(17)	35	680	544	17.9	2023	2.40	0.86	19.8	97
Av.	3814	127(22)	43	746	781	33.7	1218	3.01	1.19	24.8	109
				Laboratory Analyses							
Composite food samples											
Army infantry battalion								1.43 [3]	0.83 [3]		280 [4]
Army engineer battalion								1.39 [3]	1.15 [3]		312 [4]
Marine infantry battalion							1650 [3]	1.07 [3]	0.54 [3]		—
Av. (combined composite samples)	3947	117 [5]	13 [5]	841 [5]	410 [5]	—	1650	1.30	0.84	23.8 [5]	136 [5]

[1] For assumed food composition values, see Appendix 4, Korea Nutrition Survey, a report by the Interdepartmental Committee on Nutrition for National Defense, April, 1957b. No cooking losses have been considered, except in laboratory analyses values.

[2] Figures within parentheses are for animal protein, including fish.

[3] Assays by National Institute of Arthritis and Metabolic Diseases, National Institutes of Health, Bethesda, Maryland.

[4] Assays by 406th General Medical Laboratory, Japan.

[5] Assays by Wisconsin Alumni Research Foundation, Madison, Wisconsin.

3809 for the month of January and 3979 for the month of June, 1956. The issues to the Marine regiment during the three monthly periods averaged 3726 Cal. per man per day as issued. In general, the levels of vitamin A and riboflavin contained in the food as issued per man per day were suboptimal; otherwise the nutritional contributions of the food issues appeared to be quite satisfactory.

The data obtained in the 4 unit kitchen surveys are also shown in tables 1 and 2. The remarkable agreement, in general, between the calculated levels of nutrients prescribed by the menu, issued to the units, and consumed during the survey of unit kitchens is indeed impressive. The calculated intake of riboflavin was low in three of the 4 kitchens surveyed, and the calculated intake of vitamin A (carotene) was low in all 4 unit kitchens during this period. This is similar to the observations made with respect to these nutrients on the basis of foods issued. The calculated levels of other vitamins and minerals listed are considered quite satisfactory.

The calculated calorie intake varied appreciably between unit kitchens surveyed, ranging from 3392 to 4119 (average 3814) Cal. per man per day. Again these values are in close agreement with those obtained from the calculated analysis of food issues to various units. This range is considered reasonable in view of the relatively short period of each survey, and the average is deemed adequate to meet the requirements. This assumed adequacy is supported by the observation that the body weights obtained in the clinical study were satisfactory.

The protein intake was quite ample in quantity in all unit kitchens. The amount from animal (or marine) sources averaged 22 gm (range 5 to 49 gm) per man per day. Nevertheless the relatively high level and high proportion of protein from soybeans is considered sufficient to provide satisfactory levels of the various essential amino acids. This is confirmed by the amino acid analysis values obtained from the composite food samples (table 2).

The calculated fat intake is considered satisfactory, averaging 44 gm per man per day for the 4 kitchens surveyed. This amounts to approximately 10% of the total energy supplied by fat.

TABLE 2

Comparison of chemical analyses and kitchen survey calculations on combined composite samples for nutrient intake levels

NUTRIENT	AMOUNT PER MAN PER DAY		
	Kitchen survey	Chemical analysis [1]	Proposed acceptable range [2]
Calories	3733.0	3947.0	3200–3800
Protein ,gm	122.7	117.2	60–90
Fat, gm	44.7	13.1	
Carbohydrate (NFE), gm	733.0	841.0	
Crude fiber, gm		16.2	
Ash, gm		37.9	
Total solids, gm		1025.2	
Calcium, mg	740.0	410.0	400–800
Vitamin A (carotene), I.U.	1100.0 [3]	1650.0	3500–5000
Thiamine, mg	2.33 [3]	1.30	1.2–1.9
Riboflavin, mg	0.95 [3]	0.84	1.2–1.5
Niacin, mg	23.2 [3]	23.8	10–15
Vitamin C, mg	117.0	136.0	30–50
Pyridoxine, mg		5.0	
Pantothenie acid, mg		1.41	
Biotin, mg		0.08	
Folacin, mg		0.04	
Vitamin B_{12}, μg		< 0.5	
Lysine, gm		5.4	
Threonine, gm		4.2	
Valine, gm		6.4	

[1] Analyses performed approximately 1 to 5 months after food samples were taken.

[2] As consumed, for 25-year-old physically active males of 67 inches in height and 143 pounds in weight living in a temperate climate and consuming a varied diet. Reference: "Manual for Nutrition Surveys," ICNND, Bethesda, Maryland, 1957a.

[3] Corrected for estimated cooking losses as follows: thiamine, 30%; niacin, 15%; riboflavin, 10%; and vitamin C, 50%.

The results obtained from the analyses of composite food samples representing the average food consumed are given in tables 1 and 2. Table 3 gives the amounts and kinds of food eaten during the survey. Table 4 shows the amounts of princi-

TABLE 3

Average daily food consumed during mess survey period
(Grams per man per day)

FOOD ITEM	ARMY REPLACEMENT TRAINING CENTER REGIMENT (3 DAYS)	ARMY INFANTRY BATTALION (3 DAYS)	ARMY ENGINEER BATTALION (3 DAYS)	MARINE INFANTRY BATTALION (2 DAYS)
Rice	667.7	645.0	648.0	640.0
Pressed barley	165.3	152.0	155.0	108.3
Wheat flour, enriched	68.0	—	—	—
Corn meal	16.5	—	—	—
Sugar	6.7	—	—	—
Biscuits	—	83.3	83.3	83.3
Vegetable oil	8.6	—	6.2	—
Fresh lean pork	—	—	—	25.2
Canned fish	91.1	— [1]	61.6	—
Dried melchi (fish)	7.0	6.3	4.8	12.6
Dried fish, salted	25.8	—	—	—
Shrimp, salted	31.8	—	—	—
Canned ham chunks	3.2	—	—	—
Canned frankfurters	—	—	—	23.9
Soybean mash	67.0	90.6	67.5	118.5
Red pepper mash	20.9	25.2	36.0	9.8
Soybean curd	72.7	8.5	—	94.4
Soybean curd, fried	—	8.0	26.5	—
Soy sauce	51.4	—	30.7	4.3
Red pepper	2.2	4.5	5.9	2.5
Seasoned soybeans	—	96.4	162.0	—
Kimchi cabbage	28.2	—	—	—
Chinese cabbage (E.P.)[2]	—	—	—	38.1
White radish (E.P.)	193.0	323.0	357.0	216.0
Pickled radish (E.P.)	62.3	—	—	—
Pickled garlic (E.P.)	32.5	—	—	—
Pumpkin (E.P.)	—	—	—	34.8
Onions, green	—	—	—	7.6
Dried seaweed	54.5	—	—	—
Salt	16.3	25.5	16.4	22.0

[1] Ordinarily 93.3 gm of canned fish would have been issued but was not during the survey period.

[2] E.P. refers to edible portion. Other values expressed on "as purchased" basis.

pal food items consumed by meals for the three different kitchens studied by this method. The marked similarity of foods consumed at each meal is evident. For example, the Marine infantry battalion personnel consumed essentially the

same amounts of rice and soup each meal for the two consecutive days studied. Food habits which embody similar nutrient intakes at each meal would appear to have obvious practical advantages (fig. 5).

A direct comparison of the nutrient intake values obtained by the analysis of composite food samples for three units and those obtained by calculation based on amounts of food con-

TABLE 4

Average amounts of prepared food consumed at each meal
(Grams per man per day)

	RICE	SOUP	SWEETENED SOYBEANS	FISH	KIMCHI
	Army Infantry Battalion (3-day period)				
Breakfast	616	714	—	—	—
Lunch	601	718	76	—	—
Supper	613	715	24	—	—
Total	1,830	2,147	100		
	Army Engineer Battalion (3-day period)				
Breakfast	680	803	—	—	—
Lunch	609	—	152	69	91
Supper	626	715	—	—	—
Total	1,915	1,518	152	69	91
	Marine Infantry Battalion (2-day period)				
Breakfast	566	612	—	—	—
Lunch	562	645	—	—	—
Supper	559	637	—	—	—
Total	1,687	1,894			

sumed during the kitchen surveys performed is given in table 2. Again it is evident that good agreement exists between the values obtained by the two methods except for fat, calcium, and thiamine. Although thiamine may be unstable during prolonged storage, it is difficult to understand such major discrepancies as those found for fat and calcium. Particularly with regard to calcium, the chemical assay value would include any calcium supplied by the crude sea salt and water used in

cooking which was not considered in the calculated analysis. Despite this, the value obtained was appreciably lower. The oxalate added to the sample should not have interfered with the calcium assay since the sample was ashed preparatory to analysis. The values obtained by analysis, for the most part, however, tend to indicate that calculation of the nutrient intakes from amounts of foods consumed is a relatively good method of determining nutritional adequacy of dietaries.

The results obtained for riboflavin (by analyses) are of particular interest since this vitamin was supplied in suboptimal amounts based on the calculated values. The riboflavin intakes obtained by analysis are in excellent agreement with those obtained from the field surveys corrected for estimated cooking losses and further substantiate the suboptimal riboflavin intake. Although the values for thiamine are appreciably lower than those obtained by calculation, they are still adequate. The values obtained for vitamin C are even greater than those calculated. The carotene value obtained is also somewhat higher, although this value is still quite low. The higher than calculated values obtained for both vitamin C and carotene suggest that the assumed values for various foodstuffs used in calculation of dietaries may not be entirely accurate. However, where the values are appreciably lower (e. g. thiamine), destruction may have occurred in the sample after it was collected and before the assay was conducted. This appears likely for thiamine since several samples of rice were assayed for thiamine content and found to supply approximately 0.245 mg of thiamine per 100 gm or approximately 1.5 mg per man per day.

The advantage of the food composite method of determining adequacy of nutrients consumed is evident since the intake of many nutrients can be determined by assay which could not be satisfactorily handled by using tabulated nutrient values for individual foods. Assays for the amino acids, lysine, threonine and valine, which were considered to be the most likely limiting amino acids, revealed that the

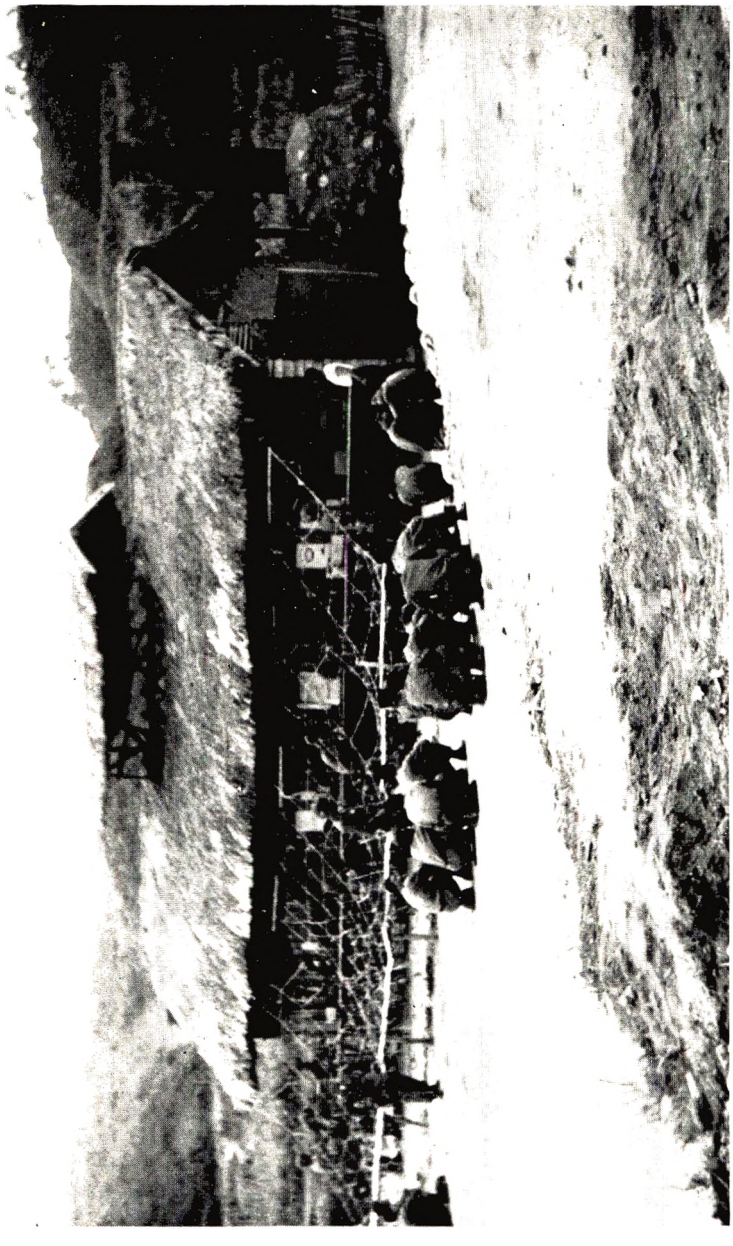

Fig. 5 A typical kitchen in one of the Army divisions. Soldiers wait to carry food to their units.

intakes were quite adequate. The levels of folacin and vitamin B_{12} appeared to be minimal although no requirements have been determined for man for these two vitamins. It is of interest to note that the levels of biotin, pantothenic acid and pyridoxine also appear to be adequate.

In order to determine the approximate destruction of ascorbic acid content with prolonged cooking, the ascorbic acid and dehydroascorbic acid contents of a typical soup prepared in an Army kitchen were determined by the Ministry of National Defense Laboratory, Seoul. These analyses were performed in duplicate on homogenized aliquots of the soup at the start of cooking, one hour later, and at the time of serving (after 4 hours of cooking). The results indicated that approximately 80% of the initial vitamin C activity remained at the end of the 4-hour cooking period. It is assumed that this low loss may result from putting all the vegetables into boiling water and from the comparatively small exposed surface for a large volume of soup. No losses in cooking have been considered in the calculated nutrient intakes shown in table 1.

Auxiliary food supplies: military gardens, etc. Early in the survey attention was called to the fact that many military units in Korea produce some food. Subsequently many inquiries were made on this point. It seemed to be a generally accepted system in Korea for military units to establish gardens where many vegetables and some cereals were produced. The appearance of many of these fields and gardens indicated much agricultural skill and considerable effort. Some of the large fields near the D.M.Z. were particularly impressive. Animals, principally pigs and chickens, also were raised at times by military units.

There are many questions which may be raised in connection with these production schemes. After such a brief survey it is far from clear just where these foods fit in with the issuing of perishables and just what bookkeeping system, if any, is used to account for the income derived from these efforts. Therefore, observations will be restricted to the nutritional aspects of military-produced food.

Such military food production schemes have a certain educational value since, if conducted under proper guidance, they can provide training in better agricultural practices. Food growing can be pursued by troops only during a part of the year. Because of the borderline adequacy of riboflavin and carotene of the food issued in two areas, such unit-produced foods might be of considerable importance in supplementing the nutrient intake of troops. There is little doubt, for instance, that consumption of the extra green and leafy vegetables produced in military gardens is a factor in the intake of carotene, riboflavin and ascorbic acid. Similarly, any pigs or chickens produced will presumably contribute to the animal protein intake (fig. 6).

The survey team had an opportunity to observe only one ROK post exchange (PX). From the kind of goods available, the stated volume of sales, and particularly from the pay scale of the ROK Army private it is doubted if the food intake from items purchased in the PX is a significant factor in the nutrition of the troops.

Physical findings

Very limited information is available pertaining to the health and clinical nutritional status of the civilian or military population in the Republic of Korea. The present report is an attempt objectively to study and assess the nutritional status of a random cross-section of the ROK Armed Forces.

The results of the dietary surveys have indicated suboptimal nutrient intakes of vitamin A and its precursors, and of riboflavin. The procedures which were used in the clinical and biochemical sampling have been outlined. The age, length of time in service, area of origin, height, weight, and weight status characteristics for the 8 locations are given in table 5. The sample size is adequate to allow consideration of meaningful subgroups (tables 6 to 11).

Interrogations into the history of tuberculosis, trachoma, malaria, and chronic diarrhea were carried out by the Korean

Fig. 6 A military mess storage cabinet for vegetables built over a creek to keep them cool.

TABLE 5

Korea nutrition survey, June–July 1956
Description of sample

	LOCATION								
	1	2	3	4	5		8	9	TOTAL
Number of examinations	22	180	161	324	335	349	61	64	1514
				Per cent by age					
17–19 years	0.0	0.0	0.0	0.3	0.9	2.9	4.9	0.0	1.1
20–24 years	45.6	96.1	91.9	40.6	46.0	62.5	68.9	73.4	61.5
25–29 years	31.8	3.9	8.1	35.4	37.3	30.4	24.6	26.6	27.1
≧ 30 years	22.7	0.0	0.0	23.7	15.8	4.3	1.6	0.0	10.2
				Per cent by length of service					
3 months	0.0	100.0	0.0	0.0	0.3	0.3	0.0	0.0	12.0
3 months–6 months	0.0	0.0	78.9	0.0	0.3	4.0	3.3	3.1	9.6
6 months–1 year	4.6	0.0	21.1	9.4	5.4	7.2	1.6	4.7	7.5
1 year–2 years	40.9	0.0	0.0	26.3	34.6	14.6	8.2	6.2	18.2
2 years–3 years	31.8	0.0	0.0	28.7	24.2	23.7	29.5	60.9	24.0
3 years–5 years	22.7	0.0	0.0	35.4	34.9	36.4	41.0	9.4	26.5
≧ 5 years	0.0	0.0	0.0	0.3	0.3	2.9	16.4	15.6	2.1
				Average height (inches)					
Mean	64.6	64.0	64.4	64.4	64.6	65.0	64.8	65.9	64.6
				Average weight (pounds)					
Mean	122.7	121.2	124.1	129.4	133.2	132.0	131.1	133.9	129.5
				Average per cent of "standard weight"					
Mean	91.4	93.5	94.4	96.0	98.9	97.9	100.0	97.1	96.7
S. D.	6.3	6.1	7.5	6.8	7.2	6.6	6.4	6.4	7.1
S. E. ±	1.4	0.5	0.6	0.4	0.4	0.4	0.8	0.8	0.2

PROVINCES	RURAL	URBAN	CLASSIFICATION BY AREA OF ORIGIN								
			LOCATION								
			1	2	3	4	5	6	7	8	9
	%	%	%	%	%	%	%	%	%	%	%
Kyonggi-Do	87	13	9.1	1.1	13.7	9.6	14.9	19.8	19.7	17.2	13.3
Ch'unch'ong North	92	8	27.3	1.1	18.0	8.8	6.0	1.7	1.5	4.7	6.4
Ch'unch'ong South	93	7	4.6	35.0	7.5	14.9	7.8	12.9	6.5	10.9	13.8
Kyongsang North	84	16	31.8	21.1	26.7	16.1	20.9	18.6	9.8	20.3	19.6
Kyongsang South	70	30	13.7	13.3	17.4	15.2	14.0	19.2	18.0	17.2	16.1
Cholla North	92	8	0.0	25.5	0.0	12.9	11.3	5.7	1.5	4.7	10.0
Cholla South	92	8	0.0	1.7	6.2	16.7	19.1	9.4	19.7	1.6	11.9
Kwangwon-Do	90	10	4.6	0.0	8.7	4.4	3.9	3.4	3.3	6.2	4.0
Seoul	0	100	0.0	1.1	1.9	1.2	1.8	5.7	13.1	17.2	3.6
Cheju Island	100	0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total (all locations)	83.2	16.8									

TABLE 6

Physical findings by location, Republic of Korea armed forces 1956

PHYSICAL FINDING	RECRUITS			DIV. A	DIV. B	DIV. C	NAVY	AIR FORCE	TOTAL	
	Hdq.	New	Finished							
Location	1	2	3	4	5	7	8	9	NO.	%
Number	22	180	161	342	335	349	61	64	1514	100.0
Per cent "standard weight":										
Mean	91.4	93.5	94.4	96.0	98.9	97.9	98.0	97.1		96.7
S. D.	6.3	6.1	7.5	6.8	7.2	6.6	6.4	6.4		7.1
S. E. ±	1.4	0.5	0.6	0.4	0.4	0.4	0.8	0.8		0.2
History of:					Per cent					
Chronic diarrhea	0.0	10.0	5.6	7.6	6.6	15.2	9.8	23.4	149	9.8
Malaria	0.0	8.9	0.6	3.5	1.5	16.0	0.0	1.6	91	6.0
General appearance:										
Good	45.4	41.7	39.8	43.9	54.3	55.0	50.8	51.6	737	48.7
Fair	50.0	50.6	45.3	47.4	43.3	42.7	41.0	45.3	685	45.2
Poor	4.5	7.8	14.9	8.8	2.4	2.3	8.2	3.1	91	6.1
Cachexia	—	—	—	—	—	—	—	—	1	0.1
Glands enlarged:										
Thyroid	0.0	3.3	0.6	0.6	0.3	0.3	0.0	1.6	12	0.8
Parotid	22.7	2.8	1.9	2.0	2.1	2.6	1.6	1.6	38	2.5
Skin, face:										
Nasolabial seborrhea	18.2	11.1	7.5	1.2	2.4	2.0	3.3	9.4	63	4.2
Pigmentation	0.0	20.6	34.2	28.4	22.4	26.1	24.6	18.8	382	25.2
Skin, general:										
Follicular keratosis	0.0	5.0	3.7	6.4	3.6	2.3	11.5	18.8	76	5.0
Xerosis	0.0	0.6	0.6	1.1	0.0	0.6	0.0	0.0	8	0.5
Acneform	4.5	7.2	4.3	2.0	0.9	2.3	4.9	1.6	43	2.8
Pigmented pressure points	0.0	13.3	5.0	0.0	0.0	0.0	0.0	0.0	32	2.1
Eyes:										
Thickened conjunctiva I	59.1	35.5	70.8	69.3	70.1	53.0	44.3	51.6	908	60.0
Thickened conjunctiva II	18.2	2.2	3.7	2.3	1.1	0.9	1.6	3.1	32	2.1
Circumcorneal injection	4.5	0.5	0.0	0.3	3.9	4.9	3.3	7.8	40	2.6
Conjunctival injection	4.5	1.7	0.6	0.9	0.9	1.1	3.3	0.0	17	1.1
Blepharitis	0.0	0.0	2.5	6.7	8.4	9.8	6.6	9.4	99	6.5

TABLE 6 *(Continued)*

PHYSICAL FINDING	RECRUITS			DIV. A	DIV. B	DIV. C	NAVY	AIR FORCE	TOTAL	
	Hdq.	New	Finished							
Location	1	2	3	4	5	7	8	9	No.	%
Number	22	180	161	342	335	349	61	64	1514	100.0
Lips and buccal mucosa:										
Angular fissures	4.5	18.9	28.6	14.0	11.9	7.2	3.3	4.7	199	13.1
Angular scars	36.4	14.4	20.5	12.3	5.1	5.7	18.0	11.0	164	10.8
Cheilosis	4.5	4.4	5.6	1.2	0.0	1.1	0.0	1.6	27	1.8
Leukoplakia	0.0	0.0	0.0	0.6	1.8	2.6	1.6	0.0	18	1.2
Tongue:										
Filiform papillary atrophy	0.0	3.3	2.5	0.9	0.3	0.6	0.0	1.6	17	1.1
Papillary hypertrophy	0.0	0.6	1.2	1.8	4.8	0.0	0.0	1.6	26	1.7
Magenta	0.0	0.6	0.0	0.3	0.3	2.6	0.0	1.6	13	0.9
Teeth:										
No caries	90.9	72.8	74.0	70.8	69.2	68.0	70.5	59.4	1062	70.1
1–2 caries	0.0	5.0	6.8	8.8	6.6	7.2	13.1	7.8	110	7.3
≧ 3 caries	9.1	6.1	8.7	8.2	11.0	8.9	1.6	7.8	129	8.5
Worn	0.0	7.2	14.3	7.6	8.1	5.2	3.3	1.6	110	7.3
Malposition	0.0	8.3	11.2	7.6	7.2	4.9	8.2	10.9	112	7.4
Gums:										
No finding	—	—	—	—	—	—	—	—	1092	72.1
Redness and/ or swelling	13.6	35.0	31.7	21.6	21.8	9.7	19.7	9.4	316	20.9
Recession	0.0	4.4	10.6	6.7	7.5	4.0	1.6	6.2	92	6.1
Other	9.1	1.7	1.2	0.0	0.9	0.9	0.0	1.6	13	0.9
Abdomen:										
Splenomegalia	0.0	1.1	0.6	0.6	0.3	0.3	3.3	3.1	11	0.7
Lower extremity:										
Loss of knee jerk	0.0	1.7	0.0	1.5	0.9	1.7	0.0	0.0	17	1.1
Cardiovascular:				mm mercury						
Mean systolic B.P.	123.6	117.2	117.6	123.3	124.3	117.4	116.9	115.8		120.3
Mean diastolic B.P.	82.6	73.9	76.9	79.9	77.4	73.7	73.5	75.4		76.5
mm mercury				Per cent of troops						
≧ 150/100	0.0	0.0	0.0	6.4	4.2	0.0	0.0	1.5		2.4
≧ 140/90	4.5	2.8	2.5	11.7	8.0	1.7	1.6	4.7		5.8

physicians. Tuberculosis and trachoma were recorded in less than 0.2% of the sample. A positive history of malaria was elicited in 6.0% with a greater incidence among the new inductees (location 2) and among the Marine troops (location 7). However, malaria was not strongly associated with a concomitant frequency of splenomegalia.

A history of chronic diarrhea was given by 9.8% of the individuals. This was more commonly recorded for men in the Marines (location 7) and for men who originated from Kyongsang South Province. The prevalence of chronic diarrhea in a rural Japanese poulation has been reported (Japan Ministry of Health and Welfare, '57) as 0.5 to 1.0%. A few parasitologic studies have been carried out in South Korea by others (Yung, '54) on both the civilian population and among the ROK Army and Air Force personnel. The rate of parasitic infestation in both groups has been reported at 80 to 95%. *Ascaris* was isolated most frequently (85%); hookworm was ranked second with a 26% prevalence. The likelihood of endemic acute diarrheal diseases is always present in such a population.

In the whole sample there was not an individual with frank clinical evidence of either beriberi or pellagra. A few individuals (table 7) revealed "scorbutic gums" (4) and Bitôt's spots (5), but there was not widespread evidence of either vitamin C (ascorbic acid) or vitamin A insufficiency. However, active fissuring at the angles of the mouth, usually regarded as attributable to ariboflavinosis, was present in 13.1% of the troops (table 6).

Among the physical lesions of less clearly demonstrated nutritional origin, there were minor deviations for location, activity, time in service, and area of origin (tables 6 to 11). None of these variations were indicative of an overall pattern of either inferiority or superiority for any of the subgroups. Certain physical findings which may be considered to result from exposure to the wind, sun and dust were present as pigmentation over the malar bones and thickening of the ocular conjunctiva.

Among 1514 men who were examined at 8 different locations the mean height was 64.6 inches and ranged from 58 to 71 inches. Troops of urban origin were one-half inch taller than those from rural areas. A similar trend was apparent in the post-war height data of the Japanese (Japan Ministry of Health and Welfare, '57). The Navy (location 8) and Marines

TABLE 7

Physical findings[1] *in Republic of Korea armed forces 1956*

PHYSICAL FINDING	NUMBER	PER CENT	PHYSICAL FINDING	NUMBER	PER CENT
Glands:			Tongue:		
Enlarged sub-maxillary gland	1	0.1	Fungiform papillary atrophy	1	0.1
Skin, face:			Geographic	3	0.2
Other seborrhea	3	0.2	Red, scarlet,beefy	2	0.1
Erythema	5	0.3	Red, tip and/or sides	4	0.3
Hair:			Fissures and furrows	3	0.2
Staring	1	0.1	Gums:		
Depigmentation	2	0.1	Atrophy of papillae	6	0.4
Alopecia	1	0.1	Bleeding gums	6	0.4
Skin, general:			"Scorbutic type"	4	0.3
Perifolliculosis	4	0.3	Abdomen:		
Bluish-red extremities	8	0.5	Hepatomegalia	3	0.2
Hyperpigmentation	2	0.1	Ascites	0	0.0
Pellagrous	0	0.0	Lower extremity:		
Eyes:			Bilateral edema	2	0.1
Bitôt's spots	5	0.3	Calf tenderness	1	0.1
Lips and buccal mucosa			Loss of vibratory sense	4	0.3
Ulcers	3	0.2			

[1] For items in total sample with a frequency of less than 0.5%.

(location 7) were one-half inch, and the Air Force (location 9) one and one-half inches taller than the Army troops (table 5).

Weight ranged from 98 to 177 pounds with a mean of 129.5 pounds. As would be expected the weight increased with height, but between age groups the mean weight did not signi-

ficantly increase. The height, weight and per cent of "standard weight" by age were as follows:

	20 yr.	20–24 yr.	25–29 yr.	30 yr.	TOTAL
Number	17	931	411	155	1,514
Mean height	65.2	64.6	64.6	64.4	64.6
Mean weight	133.5	128.3	131.3	131.2	129.5
Mean per cent Standard weight	104.0	96.8	96.7	95.0	96.7

Comparison of the average height and weight data of the ROK Armed Forces with data from similar rice-eating populations, Canadian and Navajo Indian samples reveals several interesting relationships. In the Formosan sample (Crowley, Ryer and Pollack, '56) of 1049 men with an average age of 26.8 years, the mean height was 64.8 inches and the mean weight 123.2 pounds — 6 pounds lighter than the corresponding ROK soldier. For the various age groups the Korean male is 2.5 to 3.7 inches shorter and from 5.5 pounds (in the group under 20 years) to 30.8 pounds (in the group from 30 to 34 years) lighter than the Canadian male (Pett, '55). The Navajo male (Darby et al., '56) was 0.4 inches shorter and 10 pounds lighter under 20 years of age, but up to 2.5 inches taller and 14 pounds heavier in the other age grouping than the comparable Korean male. All the above data have been adjusted to nude weight, no shoes.

The height-weight data were compared to the adjusted Medico-Actuarial Standard (nude weight, no shoes) and expressed as per cent of "standard weight." The mean per cent "standard weight" was 96.7 $\pm$ 0.2 ranging from 77 to 125. This weight status lagged 3 to 5% below the American reference standard for their respective age groups (fig. 7), but was 1 to 3% above the mean induction standard used by both the ROK Army and Air Force which originated from a Filipino standard. It was noted that in the age group 30 years and over the deviation from the adjusted Medico-Actuarial Standard reached its maximum extent. This results from the lack of increase in weight as age advances in the Korean. The signi-

ficance of this is not clear, but it is to be emphasized that this reference standard does not truly represent the height-weight-age status of the Korean.

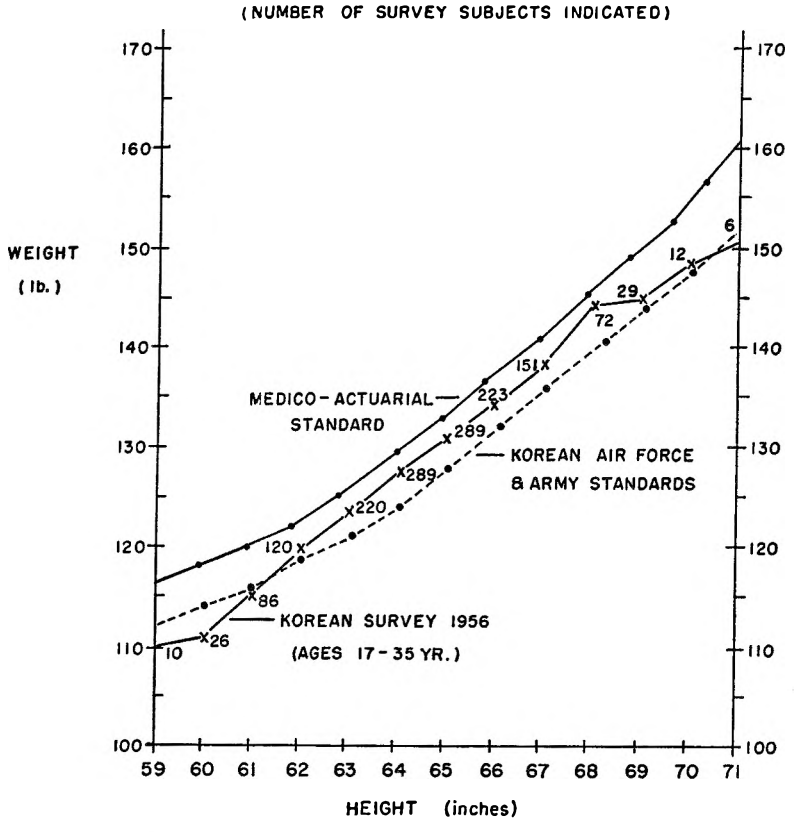

Fig. 7 Weights for height. Comparison of survey findings with Korean Air Force Standards and the adjusted Medico Actuarial Tables.

Only 5 individuals (0.3%) were less than 80% of standard; another 16.4% were between 80 and 89.9% of the standard. The great majority of the troops (79.9%) were between 90 and 110%. It is readily apparent that obesity or overweight was not a problem among the ROK Armed Forces as only 51 men (3.3%) exceeded 110% of our Reference Standard.

TABLE 8

Physical findings by activity for line troops, Republic of Korea armed forces 1956

PHYSICAL FINDING	RIFLE	MORTAR	MACHINE GUN	HEAVY MORTAR	ENGINEER	TANK	RECON-NAISSANCE	ARTILLERY	QUARTER-MASTER	ORDNANCE	MILITARY POLICE	TOTAL
Number examined	241	79	77	74	80	80	79	73	83	79	81	1026
Per cent standard weight:												
Mean	96.5	97.5	98.1	97.8	96.1	96.2	98.8	99.7	98.4	97.4	99.3	97.6
S.D.	7.4	6.4	6.6	6.1	7.2	6.8	6.8	8.0	6.6	6.1	7.1	7.0
S. E. ±	0.5	0.7	0.7	0.7	0.8	0.8	0.8	0.9	0.7	0.7	0.8	0.2
					Per Cent							
History of:												
Chronic diarrhea	10.0	8.9	9.1	12.2	7.5	11.2	6.3	8.2	15.7	12.7	6.2	9.8
Malaria	7.9	0.0	1.3	5.4	10.0	10.0	3.8	8.2	9.6	12.7	7.4	7.1
General appearance:												
Good	51.5	53.2	51.9	52.7	42.5	50.0	40.5	52.1	59.0	53.2	55.6	51.1
Fair	42.7	45.6	44.2	41.9	45.0	50.0	58.2	41.1	37.3	41.8	44.4	44.4
Poor or cachexia	5.8	1.3	3.9	5.4	12.5	0.0	1.3	8.2	3.6	5.1	0.0	4.5
Glands enlarged:												
Thyroid	0.4	0.0	1.3	0.0	1.2	0.0	0.0	0.0	0.0	0.0	1.2	0.4
Parotid	3.3	0.0	3.9	1.4	3.8	0.0	2.5	1.4	1.2	2.5	2.5	2.2
Skin, face:												
Nasolabial seborrhea	2.1	2.5	1.3	1.4	3.8	1.2	0.0	0.0	2.4	2.5	2.5	1.9
Pigmentation	28.2	30.4	28.6	17.6	21.2	22.5	27.8	24.7	20.4	30.4	24.7	25.6
Skin, general:												
Follicular keratosis	4.1	5.1	1.3	6.8	3.8	1.2	2.5	2.7	3.6	7.6	6.2	4.1
Xerosis	1.2	2.5	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
Acneform	1.7	2.5	3.9	0.0	0.0	5.0	0.0	0.0	1.2	5.1	0.0	1.8
Eyes:												
Thickened conjunctiva I	61.8	73.4	67.5	60.8	65.0	48.8	70.9	65.8	63.8	64.6	66.6	64.0
Thickened conjunctiva II	3.7	0.0	0.0	0.0	0.0	1.2	0.0	1.4	1.2	3.7	0.0	1.5
Circumcorneal injection	2.9	1.3	5.2	6.8	3.8	2.5	1.3	4.1	1.2	1.3	3.7	3.0
Conjunctival injection	0.8	0.0	2.6	0.0	1.2	0.0	1.3	2.7	1.2	0.0	1.2	0.9
Blepharitis	7.9	7.6	7.8	9.5	2.5	5.0	10.1	9.6	8.4	13.9	9.9	8.3
Lips and buccal mucosa:												
Angular fissures	16.2	14.0	10.4	4.0	11.2	10.0	7.6	9.6	8.4	11.4	7.4	11.0
Angular scars	7.5	7.6	6.5	9.5	11.2	6.2	5.1	16.4	6.0	3.8	6.2	7.7
Cheilosis	1.7	1.3	0.0	1.4	0.0	1.2	0.0	0.0	0.0	1.3	0.0	0.8
Leukoplakia	3.3	2.5	2.6	0.0	2.5	0.0	1.3	1.4	0.0	1.3	0.0	1.7
Tongue:												
Filiform papillary atrophy	0.0	1.3	0.0	0.0	0.0	1.2	1.3	1.4	1.2	0.0	1.2	0.6
Papillary hypertrophy	2.1	0.0	5.2	1.4	5.0	0.0	2.5	1.4	0.0	3.8	2.5	2.1
Magenta	0.0	1.3	0.0	0.0	0.0	3.8	2.5	2.7	1.2	1.3	0.0	1.0
Teeth:												
No caries	71.8	63.3	77.9	70.3	72.5	72.5	60.8	72.6	66.3	62.0	67.9	69.3
≧ 3 caries	10.0	15.2	5.2	8.1	7.5	5.0	10.1	9.6	13.2	6.3	11.1	9.4
1–2 caries	9.1	5.1	6.5	12.2	11.2	2.5	7.6	6.8	3.6	7.6	7.4	7.5
Worn	10.4	6.3	9.1	8.1	5.0	8.8	6.3	2.7	2.4	3.8	6.2	7.0
Malposition	6.6	3.8	9.1	8.1	5.0	5.0	5.1	8.2	6.0	7.6	7.4	6.5
Gums:												
Redness and/or swelling	17.8	14.0	16.9	10.8	18.8	15.0	15.2	23.3	28.9	19.0	13.6	17.6
Recession	7.0	8.9	7.8	4.0	7.5	3.8	2.5	8.2	7.2	3.8	3.7	6.0
Other findings	0.4	1.3	0.0	0.0	1.2	0.0	0.0	1.4	0.0	1.3	1.2	0.6
Abdomen:												
Splenomegalia	0.8	0.0	0.0	0.0	1.2	0.0	1.3	0.0	0.0	0.0	0.0	0.4
Lower extremity:												
Loss of knee jerk	1.2	1.3	1.3	1.4	1.2	0.0	2.5	2.7	0.0	0.0	3.7	1.4

This rate of obesity was slightly lower than that observed for the Navajo male.

Examination of the per cent "standard weight" of the troops in the ROK Armed Forces by various locations (table 6) revealed no difference in the main sample between the new inductee and the recruit at completion of the 16 weeks of basic training. Further scrutiny of the supplementary data (see page 22) showed that an increase in "standard weight" did occur during basic training.

Mean per cent "standard weight"

	NEW RECRUITS	FINISHED RECRUITS
Location	2	3
1545 main sample	93.5 (180) [1]	94.4 (161)
520 group supplementary	92.7 (98)	96.4 (111)

[1] Numbers within parentheses are individuals examined.

The lower weight status observed in the main sample at location 1 (mean = 91.4%) disappeared also when an adequate sample size of 162 individuals was obtained (mean = 97.8%) in the supplementary data collected. Among the line troops, the Navy and Air Force personnel, there was an increase of 2.5 to 5.4 in the average per cent "standard weight" over the recruit on induction into service.

Among the 1026 line troops of ROK Army Divisions A and B (locations 4 and 5) and the Marine Division C (location 7), there were minor variations in the per cent of "standard weight" by service components (table 8), and by length of time in service (table 9). However, no consistent pattern emerged. When the various service components of the line troops (table 8) of the main sample were individually examined, there was a significant difference among the rifle platoons in location 4 compared to those in locations 5 and 7. Examination of the supplementary data reveals that the values in location 4 more closely approached the average value for the entire Division A (mean = 96.0%) and for all

TABLE 9

Physical findings by time in service for line troops, Republic of Korea armed forces 1956

PHYSICAL FINDING	TIME IN SERVICE					
	< 1 yr.	1 yr.	2 yr.	3 yr.	≥ 4 yr.	Total
Number examined	92	257	300	271	106	1026
Per cent standard weight						
Mean	98.3	98.0	97.5	97.4	96.7	97.6
S. D.	8.6	7.6	6.2	7.1	5.5	7.0
S. E. ±	0.9	0.5	0.4	0.4	0.5	0.2
			Per cent			
History of:						
Chronic diarrhea	9.8	9.7	13.3	7.4	6.6	9.8
Malaria	6.5	3.5	9.0	7.4	10.4	7.1
General appearance:						
Good	51.1	53.7	51.3	50.9	44.3	51.1
Fair	41.3	41.6	45.0	45.8	49.1	44.4
Poor or cachexia	7.6	4.7	3.7	3.3	6.6	4.5
Glands enlarged:						
Thyroid	0.0	0.4	0.7	0.4	0.0	0.4
Parotid	3.3	2.3	0.7	3.3	2.8	2.2
Skin, face:						
Nasolabial seborrhea	4.3	1.2	2.0	1.5	1.9	1.9
Pigmentation	20.6	24.1	25.7	29.1	24.5	25.6
Skin, general:						
Follicular keratosis	5.4	4.3	5.7	1.5	4.7	4.1
Xerosis	2.2	0.8	0.0	0.4	0.9	0.6
Acneform	0.0	1.9	2.3	1.5	1.9	1.8
Eyes:						
Thickened conjunctiva I	54.3	60.3	61.3	69.7	74.5	64.0
Thickened conjunctiva II	0.0	0.4	2.3	2.2	0.9	1.5
Circumcorneal injection	2.2	2.7	3.3	3.0	3.8	3.0
Conjunctival injection	2.2	0.8	0.7	1.1	0.9	1.0
Blepharitis	3.3	5.8	10.0	8.9	12.3	8.3
Mouth:						
Angular fissures	9.8	14.8	12.3	7.7	7.5	11.0
Angular scars	10.8	8.6	6.7	6.3	9.4	7.7
Cheilosis	2.2	0.8	1.0	0.4	0.0	0.8
Leukoplakia	4.3	1.6	1.0	1.5	1.9	1.7
Tongue:						
Filiform papillary atrophy	0.0	0.8	0.7	0.4	0.9	0.6
Teeth:						
No caries	67.4	68.1	70.7	70.8	66.0	69.3
≥ 3 caries	14.1	9.3	8.7	8.9	8.5	9.4
1–2 caries	9.8	7.4	8.0	6.3	7.5	7.5
Worn	3.3	5.4	6.0	9.2	10.4	6.9
Malposition	7.6	7.4	5.7	7.0	4.7	6.5
Gums:						
Redness and/or swelling	15.2	16.7	17.3	19.9	17.0	17.6
Recession	4.3	10.5	3.7	4.8	6.6	6.0
Other	1.1	1.2	0.3	0.4	0.0	0.6
Abdomen:						
Splenomegalia	0.0	1.2	0.3	0.0	0.0	0.4
Lower extremity:						
Loss of knee jerk	3.3	1.2	1.0	1.1	1.9	1.4

the Rifle platoons (mean = 96.5%), so that the apparent activity differences disappeared with more adequate sampling.

Mean per cent standard weight

Location	4 Rifle Co.	5 Rifle Co.	7 Rifle Co.
1514 main sample	91.9 (81) [1]	100.6 (79)	97.2 (81)
520 supplementary	95.3 (53)	98.8 (96)	

[1] Numbers within parentheses are individuals examined.

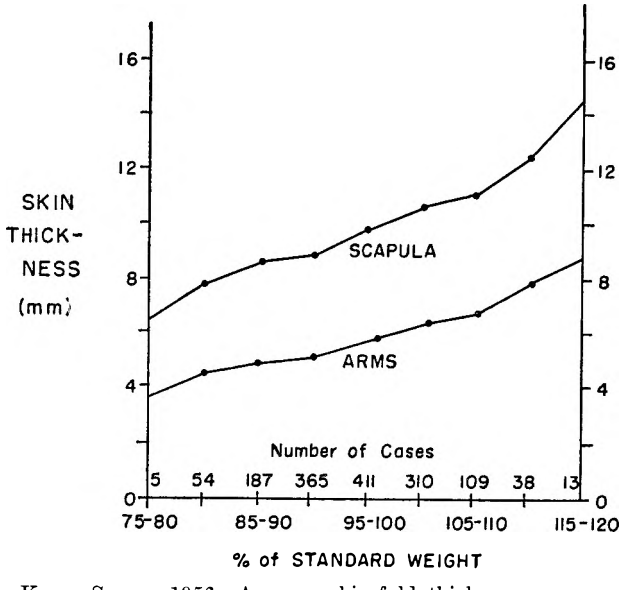

Fig. 8 Korea Survey 1956. Average skin-fold thickness vs. per cent "standard weight."

The tank troops who received an extra monetary ration allowance showed no superiority in per cent "standard weight." The small differences with length of time in military service exhibited in table 9 are explainable on the previously demonstrated age relationship as length of time in service was correlated with advancing age.

Skin-fold measurements on 1492 of the troops clinically examined, were made at two sites: (1) over the posterior

lateral aspect of the mid-upper arm and (2) over inferior angle of the scapula. The geometric mean measurement was 5.7 mm for the arm and 9.7 mm for the scapula. The relationship of the mean arm and scapula measurement to per cent standard weight is demonstrated in figure 8. The data by age groupings were as follows:

	20 yr.	20–24 yr.	25–29 yr.	30 yr.	TOTAL
Number	17	931	411	155	1514
Skin: Arm (mm)	7.3	5.9	5.5	5.2	5.7
Skin: Scapula (mm)	10.3	9.5	9.9	9.9	9.7

The mean skin-fold thickness increased for arm and scapula with increasing per cent "standard weight" of the individuals and also with increasing height. Both measurements were larger among the trained recruits than among the new inductees. This tends to confirm the change in per cent "standard weight" in the two groups shown in the supplemental height-weight data. Both skin-fold measurements were lower in Division A (location 4) also confirming the weight-status data. The arm skin thickness was low for the "tankers" while both arm and scapula measurements were low among the engineers.

Comparison of the average measurements of the Korean soldier with similar Formosan (Crowley, Ryer and Pollack, '56), Philippine (Philippine Report ICNND, '57) and American values revealed the Korean to have skin-fold thickness for the arm and scapula greater than the Formosan and less than either Filipino or American Troops (table 13).

Physical findings based on 64 items of possible nutritional significance are summarized in table 6 for the 1514 individuals who were clinically examined at the various locations. The items of physical examination which were observed in the total sample with a frequency of less than 0.5% are presented separately in table 7.

Glands. No large goiters were seen. Palpable and visual enlargement of the thyroid was observed in 12 (0.8%) individuals. In these there was no apparent evidence of hyperthyroid-

ism. Enlargement of the parotid gland was usually bilateral and soft and was recorded in 2.5% of the troops. This is in contrast to the high prevalence recorded in a similar Korean population in 1953 (Sandstead, Koehn and Sessoms, '55). Enlarged parotids were recorded more frequently among troops at location 1 (6.7%) and in individuals less than 85% of "standard weight" (6.2%).

Fig. 9 The wooden A-frame is an efficient, ingenious device for carrying incredibly heavy loads. It allows the carrier to rest his load on its legs temporarily without having to raise it all the way from the ground again. The pressure points resulting from its use were commonly encountered in the physical examination of soldiers.

Skin. Excessive pigmentation over the malar eminences of the face was the commonest (25.2%) skin change observed. Its occurrence seemed to be related to the extent to which the troops had been exposed to the elements as illustrated by its lower frequency among the new recruits as compared to that in other subgroups. Malar pigmentation was associated with an increased prevalence of thickened ocular conjunctiva. The thickened and pigmented pressure points which were observed among the new inductees over their shoulder blades and sacrum corresponded to the points of contact of the Korean "A" frame (fig. 9). Nasolabial and other seborrhea were observed

TABLE 10

Physical findings by area of origin for line troops, Republic of Korea armed forces 1956

PHYSICAL FINDING	KYONGGI-DO	CH'UNOH'ONG N.	CH'UNOH'ONG S.	KYONGSAM N.	KYONGSAM S.	CHOLLA N.	CHOLLA S.	KWANGWON-DO	SEOUL	CHEJU ISLAND	TOTAL
Number examined	152	56	122	190	166	102	154	40	30	14	1026
History of:											
Chronic diarrhea	9.9	10.7	10.7	8.4	13.9	10.8	5.8	7.5	6.7	21.4	9 8
Malaria	5.3	1.8	7.4	8.9	10.2	6.9	5.8	2.5	10.0	7.1	7 1
General appearance:											
Good	53.3	51.8	54.1	43.7	54.2	46.1	56.5	40.0	50.0	71.4	51 1
Fair	43.4	42.9	41.8	51.1	41.6	50.0	38.3	55.0	43.3	28.6	44 4
Poor or cachexia	3.3	5.4	4.1	5.3	4.2	3.9	5.2	5.0	6.7	0.0	4.5
Glands enlarged:											
Thyroid	0.7	1.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	7.1	0.4
Parotid	2.6	0.0	1.6	1.6	2.4	0.0	4.5	2.5	6.7	0.0	2.2
Skin, face:											
Nasolabial seborrhea	0.0	5.4	4.1	2.6	1.8	0.0	1.9	0.0	0.0	0.0	1.9
Pigmentation	27.6	25.0	23.8	27.9	24.7	17.6	32.5	22.5	13.3	21.4	25.6
Skin, general:											
Follicular keratosis	7.2	7.1	3.3	3.7	3.0	2.9	3.2	2.5	3.3	7.1	4.1
Xerosis	2.0	0.0	0.0	0.0	0.6	1.0	0.6	0.0	0.0	0.0	0.6
Acneform	2.0	0.0	1.6	1.6	1.8	2.9	0.6	2.5	3.3	7.1	1.8
Eyes:											
Thickened conjunctiva I	61.2	66.1	69.7	65.3	63.2	64.7	65.6	75.0	40.0	28.6	64.0
Thickened conjunctiva II	0.7	0.0	0.8	2.6	1.8	1.0	2.6	0.0	0.0	0.0	1.5
Circumcorneal injection	1.3	1.8	2.5	3.7	3.0	5.9	2.6	0.0	6.7	7.1	3.0
Conjunctival injection	0.7	1.8	0.0	0.5	0.6	1.0	0.6	2.5	6.7	7.1	1.0
Blepharitis	7.2	8.9	9.8	9.5	6.0	10.8	6.5	10.0	10.0	7.1	8.3
Lips and buccal mucosa:											
Angular fissures	11.2	17.9	13.1	13.7	6.6	14.7	9.1	7.5	0.0	7.1	11.0
Angular scars	7.2	12.5	5.7	5.8	11.4	4.9	7.1	10.0	0.0	28.6	7.7
Cheilosis	0.7	5.4	0.0	0.5	1.8	0.0	0.0	0.0	0.0	0.0	0.8
Leukoplakia	1.3	0.0	1.6	3.2	1.8	2.0	1.3	0.0	0.0	0.0	1.7
Tongue:											
Filiform papillary atrophy	0.7	0.0	0.8	0.0	0.6	1.0	1.3	0.0	0.0	0.0	0.6
Papillary hypertrophy	2.6	1.8	1.6	5.3	1.2	1.0	0.0	5.0	0.0	0.0	2.1
Magenta	0.0	0.0	0.8	2.1	1.8	0.0	0.6	2.5	0.0	0.0	1.0
Teeth:											
No caries	72.4	57.1	76.2	65.8	68.7	66.7	74.0	67.5	66.7	57.1	69.3
≧ 3 caries	10.5	10.7	9.0	9.5	12.6	3.9	7.1	10.0	10.0	14.3	9.4
1–2 caries	5.3	7.1	4.1	7.9	9.6	14.7	5.8	7.5	3.3	7.1	7.5
Worn	4.6	5.4	7.4	8.9	8.4	10.8	5.2	5.0	0.0	0.0	6.9
Malposition	7.9	5.4	6.6	8.4	4.2	10.8	3.2	7.5	6.7	0.0	6.5
Gums:											
Redness and/or swelling	15.1	17.9	14.8	17.4	21.7	18.6	19.5	15.0	16.7	7.1	17.6
Recession	5.3	7.1	5.7	8.4	4.8	4.9	5.8	7.5	6.7	0.0	6.0
Other	2.0	0.0	0.0	0.5	0.0	0.0	0.6	2.5	0.0	0.0	0.6
Abdomen:											
Splenomegalia	0.0	0.0	0.8	1.0	0.6	0.0	0.0	0.0	0.0	0.0	0.4
Lower extremity:											
Loss of knee jerk	2.0	0.0	1.6	2.6	0.0	1.0	0.6	5.0	0.0	0.0	1.4

TABLE 11

Physical findings in relation to per cent "standard weight," Republic of Korea armed forces, 1956

PHYSICAL FINDING	PER CENT OF STANDARD WEIGHT							
	< 85	85–	90–	95–	100–	105–	≥ 110	TOTAL
Number examined	64	190	373	415	312	109	51	1514
History of:								
Chronic diarrhea	12.5	11.1	10.2	10.1	9.3	8.3	3.9	9.8
Malaria	1.6	5.3	7.8	6.5	5.1	6.4	2.0	6.0
General appearance:								
Good	1.6	6.3	22.5	53.0	85.6	94.5	98.0	48.7
Fair	40.6	74.7	72.9	46.5	14.4	5.5	2.0	45.2
Poor	56.2	18.9	4.6	0.5	0.0	0.0	0.0	6.0
Cachexia	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Glands enlarged:								
Thyroid	1.6	0.5	1.3	1.2	0.0	0.0	0.0	0.8
Parotid	6.2	3.7	2.1	1.9	2.2	2.8	2.0	2.5
Skin, face:								
Nasolabial seborrhea	4.7	8.4	3.8	3.9	2.6	4.6	2.0	4.2
Pigmentation	26.6	27.9	25.7	26.3	24.4	22.0	13.7	25.2
Skin, general:								
Follicular keratosis	4.7	2.6	5.4	4.8	5.8	8.3	2.0	5.0
Xerosis	0.0	1.1	1.1	0.2	0.3	0.0	0.0	0.5
Acneform	4.7	3.7	2.4	2.9	2.6	1.8	3.9	2.8
Pigmented pressure points	6.2	4.2	2.7	1.2	1.3	0.0	2.0	2.1
Eyes:								
Thickened conjunctiva I	67.2	58.9	61.9	60.0	59.3	54.1	56.9	60.0
Thickened conjunctiva II	1.6	1.6	3.2	2.7	0.6	1.8	2.0	2.1
Circumcorneal injection	1.6	3.2	4.0	1.4	2.2	2.8	3.9	2.6
Conjunctival injection	1.6	1.6	1.1	1.2	1.0	0.9	0.0	1.1
Blepharitis	3.1	3.7	6.2	8.0	7.1	9.2	3.9	6.5
Mouth:								
Angular fissures	18.8	16.3	13.7	12.5	8.7	19.3	9.8	13.1
Angular scars	10.9	8.4	13.1	9.9	11.2	8.3	13.7	10.8
Cheilosis	3.1	4.7	2.1	1.2	0.0	1.8	2.0	1.8
Leukoplakia	1.6	0.0	0.8	2.2	1.0	1.8	0.0	1.2
Tongue:								
Filiform papillary atrophy	3.1	1.0	1.1	0.7	1.3	0.9	2.0	1.1
Papillary hypertrophy	0.0	1.6	1.6	2.2	2.2	0.0	2.0	1.7
Magenta	0.0	0.0	0.8	1.0	1.6	0.9	0.0	0.9
Teeth:								
No caries	82.8	64.7	71.6	68.7	71.1	70.6	68.6	70.1
≥ 3 caries	6.2	12.1	8.8	9.4	5.8	7.3	7.8	8.5
1–2 caries	6.2	9.5	4.8	8.2	6.7	8.3	11.8	7.3
Worn	9.4	4.7	9.1	6.0	8.0	8.3	3.9	7.3
Malposition	12.5	6.8	9.1	6.5	6.4	3.7	11.8	7.4
Gums:								
Redness and/or swelling	26.6	26.8	18.8	22.9	18.6	15.6	15.7	20.9
Recession	15.6	6.8	6.7	6.3	3.5	4.6	5.9	6.1
Other	0.0	0.5	1.1	1.0	1.3	0.9	0.0	0.9
Abdomen:								
Splenomegalia	1.6	1.0	0.0	0.5	1.3	0.9	2.0	0.7
Lower extremity:								
Loss of knee jerk	0.0	1.6	0.5	1.7	1.6	0.0	0.0	1.1
Cardiovascular:								
Mean systolic B.P.	117.9	117.8	119.5	120.5	122.3	121.0	122.6	120.3
Mean diastolic B.P.	76.4	75.4	76.8	76.2	76.6	76.8	78.7	76.5
Mean pulse rate/min.	76.0	75.6	75.6	76.0	76.2	74.8	76.6	75.8

in 4.4% of the troops with a lower prevalence among the line divisions (locations 4, 5, and 7) and an increased prevalence among those men who were less than 90% "standard weight." Individuals with nasolabial seborrhea more frequently had follicular keratosis and acneform eruptions than those without it. Follicular keratosis was recorded in 5.0% of the troops. It was only minimal in degree or extent, but was more prevalent among the men of Division A (location 4), the Navy and Air Force personnel. However, it was not correlated to the levels of vitamin A or carotene in the blood. The recorded prevalence of the other defects of both the skin and hair was low or negligible (table 7).

Eyes. Except for thickening of the ocular conjunctiva and blepharitis, other ocular lesions were not frequently observed (tables 6 and 7). Conjunctival thickening was found in 62.1% of the subjects. There was a two-fold significantly higher finding rate for this in the recruits after the 16-week period of basic training than was observed in the new inductees (table 6). In approximately 10% of those with thickening, there was also associated blepharitis (6.5%). Both of these signs were in large part the result of continued exposure to wind, sun, and dust. No correlations existed between any of the ocular lesions — even the 5 individuals observed with Bitôt's spots — and the levels of serum vitamin A or carotene.

Oral and lingual lesions. Active fissuring at the angles of the mouth was seen in 13.8% and cheilosis in 1.2% of the troops. Both signs were more frequent in the recruits at the time of induction and at the completion of basic training. Angular fissures were less common in the Navy and Air Force personnel, among the heavy mortar platoons of Divisions A, B, and C, and in those who had three or more years of service. Healed angular scars were present in an additional 10.8% of the troops; leukoplakia in 1.2%. Of the total biochemical samples, 16.3% of the individuals had urinary riboflavin levels below acceptable standards (see "Guide for Interpretation of Biochemical Findings," page 120, ICNND, '57a).

Abnormalities of the tongue were found in only 69 (4.5%) individuals (table 6). The papillary atrophy and hypertrophy were of minimal degree. Of the 13 (0.5%) men with magenta coloring of the tongue only 4 also had either active fissuring or residual scarring at the angles of the mouth. There was no correlation between the urinary riboflavin levels and magenta coloring of the tongue.

Teeth. Dental hygiene and care are somewhat restricted in this population. However, the overall dentitia of the ROK Armed Forces was excellent (tables 6 and 8). Evidence of caries, either active or treated was observed in less than 30% of the troops. There was a moderate relationship of advancing age to the frequency of caries, but even of those 30 years and over only 36% had active or treated caries. Due to the Koreans' frequent use of gold fillings and spacers for cosmetic effect, both figures are likely maximal. When caries did occur, involvement was limited frequently to the lower molars. In only a few individuals was rampant caries observed. Mottled enamel, characteristic of fluorosis, and edentia were not found. As the fluoride concentration of the water supplies was not determined, we are unable to indicate its role in the low prevalence of caries. Malposition and unusual wearing of the biting surfaces of the teeth were present in a small percentage. The recording of worn teeth increased with advancing age and among troops of rural origin.

Gums. In 27.9% of the troops some abnormality of the gingiva was noted (table 6). The vast majority of these lesions was limited to marginal redness or swelling or both. These were more prevalent in the recruit training phase and among the Quartermaster platoons. On the other hand, redness and swelling were lower in the Marine Division C and the Air Force. In 10 (0.7%) individuals bleeding or "scorbutic-type gums" were present. There was no correlation between these two lesions and the serum levels of ascorbic acid. While oral ablutions are performed routinely, they are perfunctory in type. As a result, food particles and dirty teeth were observed

frequently. Gingival lesions were present commonly in individuals with malposition of the teeth. There was no correlation between gum disorders and any of the oral or lingual abnormalities. There was a positive correlation between the increased prevalence of gingival lesions, other than scorbutic, and serum vitamin C levels below 0.4 mg per 100 ml.

Abdomen, lower extremities, neuromuscular. Enlargement of the liver and spleen was found most infrequently as were

TABLE 12

Cardiovascular status by age groups, Republic of Korea armed forces 1596

CARDIOVASCULAR MEASUREMENT	AGE				TOTAL
	< 20 yrs.	20–24 yrs.	25–29 yrs.	≥ 30 yrs.	
	NUMBER				
	17	931	411	155	1514
Mean systolic B.P.	118.8 ± 2.3	118.9 ± 0.4	121.5 ± 0.7	125.7 ± 1.2	120.3 ± 0.4
Mean diastolic B.P.	70.3 ± 2.7	75.3 ± 0.4	77.6 ± 0.6	80.8 ± 1.0	76.5 ± 0.3
Mean pulse rate	72.7 ± 2.2	76.1 ± 0.4	75.4 ± 0.5	75.1 ± 0.8	75.8 ± 0.3
	Per cent				
Blood pressure ≥ 140/90	0.0	3.9	7.6	12.9	5.8
Blood pressure ≥ 150/100	0.0	1.4	3.7	5.8	2.4
Blood pressure <100/–	0.0	3.3	2.0	1.3	2.7

bilateral edema and disorders affecting the neuromuscular system (table 7).

Cardiovascular. Elevation of blood pressure both systolic and diastolic, above 150/100 or 140/90 was encountered in 2.4 and 5.8% respectively of the troops. As would be expected the mean systolic and diastolic blood pressure, as well as the incidence of "hypertension" increased with advancing age (table 12), but not with increasing per cent "standard weight"

or arm skin-fold thickness. The mean levels of blood pressure were slightly higher in the troops of Divisions A and B than elsewhere due to an excess of values at the high extremes (table 6). Of the 87 individuals with levels of blood pressure in excess of 140/90, 77% were located in these same two divisions. In these two locations (4 and 5) there was an increased concentration of "hypertension" among the Engineer platoons. There was no correlation between "hypertension" and length of time in service, area of origin, edema, or levels of total serum protein. Comparison of the incidence of "hypertension" in the ROK Armed Forces with other population groups is hazardous as its definition and limits are not generally agreed upon (Morsell, '51). The Korean prevalence is higher than has been reported for the Navajo (Darby et al., '56) and appears somewhat higher than one might anticipate for similar male age groups encountered in an American population, but lower than reported for similar male age groups from rural villages in Japan (Takahashi et al., '57).

No significant relationship existed between pulse rates and either height-weight status, or age. The mean pulse rate was 75.8 per minute. It increased with level of systolic blood pressure.

Discussion. Among the 1514 members of the ROK Armed Forces who were clinically examined, their present nutritional status revealed limited evidence of serious deficiency disease. While the results of the dietary studies have indicated suboptimal intakes of riboflavin, vitamin A and carotene, the only physical evidence of widespread nutritional insufficiency was the relatively high frequency with which active angular lesions were recorded. Correlations between the clinical data and the dietary results in regard to vitamin A activity were entirely lacking. A few individuals presented physical defects which have been associated with deficits of other essential nutrients, but widespread evidence of insufficiency was not present. Minor variations in the frequency with which some of the physical signs were recorded were present for the var-

ious locations, activities, length of time in military service, and area of origin. However, there was not a pattern indicative of any special problem group.

Interpretation of these observations must take into account such factors as environment (exposure to sun, dust, and in locations 2 and 3 the limitation of water supply), season of the year (immediately following the spring period when food supplies are usually at their lowest), differences in energy expenditure of the troops, and possible trends developing in the examiner's criteria of the various physical signs from the time of onset to the completion of the study.

It seemed most pertinent for our present considerations to restrict discussion to data reported on comparable adult male populations having similar dietary intake patterns. Such reports on rice-eating populations have dealt in large part with civilian groups composed of women and children, and a sparsity of adult male subjects (Robinson and Suarez, '47; Salcedo et al., '48; Burgess and Musa, '50; Jolliffe and Tung, '56; Japan Ministry of Health and Welfare, '57). Large samples of adult male populations in similar occupational circumstances have been reported by Pollack ('56) and the Interdepartmental Committee on Nutrition for National Defense ('57b and c). A few selected physical measurements and findings are shown in table 13.

The anthropometric measurements of all three groups reveal obvious similarities in respect to height, and to a lesser extent, weight. When these data are compared to an American standard, the per cent of "standard weight" of the Korean is about 7% more than either the Formosan or Filipino male. All of the skin-fold measurements are lower than expected in a similar American population (Pascale, Crossman and Sloane '55). It is apparent that for the ROK Armed Forces no serious imbalance of calorie intake versus energy expenditure existed. Only 5 individuals were less than 80% of "standard weight." On the other hand, obesity was essentially non-existent (fig. 8).

The recording of physical lesions of nutritional significance indicate wide differences between the Formosan and both the Korean and Filipino data. These are most evident in lesions attributable to deficiencies of riboflavin and vitamin A activity. Obviously, variations in the examiners' criteria in the three surveys may account for some of the reported differences.

TABLE 13

Comparison of selected physical findings in rice eating populations 1955–1957

PHYSICAL FINDING	Year	1955	1956	1957
	Location	Formosa [1]	Korea	Philippines [2]
	Number	1049	1514	1333
Mean height (inches)		64.8	64.6	64.0
Mean weight (pounds)		123.2	129.5	124.2
Mean per cent "standard weight"		—	96.7	90.2
Mean skin fold thickness				
Arm, mm		4.2	5.7	6.7
Scapula, mm		7.9	9.7	12.1
			Per cent	
Skin: Nasolabial seborrhea		81	4.2	29.8
Follicular keratosis		89	5.0	3.5
Lips: Angular lesions		71	13.8	0.9
Tongue: Magenta colored		15	0.9	0.5
Gums: Any gum finding		87	27.9	13.5
Lower extremity: Calf tenderness		16	0.1	0.1

[1] Approximate means and percentages were calculated from baseline observations on the control and treated groups prior to initiation of test (Pollack, '56; Crowley, Ryer and Pollack, '56).

[2] ICNND Report: Nutritional Status Philippine Armed Forces, 1957c.

However, the dietary intake data do reveal some variations in calories and nutrients among these three rice-eating populations.

Further comparison of the present ROK Armed Forces data with that obtained in a similar survey in 1953 (Sandstead and Koehn, '53) can be made within three groups examined in the present sample (table 14): (a) recruits at induction; (b) recruits at the completion of their 16 weeks of basic

training; and (c) the troops of Division B. The new inductee of 1956 was indistinguishable in weight status from the inductee of 1953. As a result of the implementation of recommendations made at the time of the first survey and the

TABLE 14

Comparison of physical findings, Republic of Korea armed forces 1953–1956

PHYSICAL FINDING	1953 RECRUITS			1956 RECRUITS		
	0 wks	16 wks	Div. B	0 wks	16 wks	Div. B
No. examined	898	521	375	180	161	335
			Per cent			
Per cent of "standard weight":						
< 80%	0.7	3.8	15.4	0.6	0.6	0.0
80–89.9	26.6	42.2	29.7	28.3	30.4	10.4
90–109.9	71.6	53.2	52.5	70.6	66.5	83.3
110–119.9	0.8	0.8	2.5	0.6	2.5	6.0
≧ 120%	0.0	0.0	0.0	0.0	0.0	0.3
General appearance:						
Good	76.5	35.5	36.4	41.7	39.8	54.3
Fair	17.3	24.4	26.2	50.6	45.3	43.3
Poor	6.0	31.4	24.2	7.3	14.9	2.4
Cachexia	0.0	8.6	13.4	0.5	0.0	0.0
Skin:						
Follicular keratosis	3.2	12.5	34.4	5.0	3.7	3.6
Xerosis	0.6	5.2	32.0	0.6	0.6	0.0
Nasolabial seborrhea	5.5	7.7	60.5	11.1	7.5	2.4
Mouth:						
Angular lesions	25.8	44.9	77.0	18.9	28.6	11.9
Angular scars	—	—	—	14.4	20.5	5.1
Other:						
Calf tenderness	3.9	3.6	14.4	0.0	0.0	0.0
Edema	0.2	5.5	0.5	0.0	0.0	0.3
Bitôt's spots	1.2	8.4	0.0	0.6	0.0	0.3
"Scorbutic gums"	20.8	45.9	0.0	0.0	0.6	0.3

termination of active hostilities, it is apparent that definite improvement has occurred in the physical condition of the trained recruits and seasoned soldiers of the ROK Armed Forces during the intervening years.

As illustrated by the distribution of the per cent "standard weight" data, the calorie expenditure and intake have been brought into balance. This reflects both dietary improvement and decreased energy expenditure although we observed that the present training appeared to be active and well performed. It is apparent that, at present, the longer the individual has remained in service, the better is his nutritional status.

Improvement is reflected also in the reduced percentages of individuals in 1956 who exhibited clinical evidences of nutritional deficiencies. These observations are in direct contrast to the findings in 1953.

Taking the overall results of the physical examinations of the sample of the ROK Armed Forces, the Korean soldier was found to be satisfactorily nourished and in good health. No advanced cases of serious nutritional disease were observed. Only in the high frequency with which active angular lesions were recorded was there confirmatory evidence of the nutrient intake data.

Biochemical findings

The blood samples for the biochemical assessment of nutritional status were obtained at the time of the clinical examination, and the urinary collections during a 6-hour fasting period on the last night of each location. There was the inevitable loss of a few samples in transit from the field to the United States 406 Medical General Laboratory in Japan. However, these losses were small and did not follow a systematic pattern and do not affect unduly the interpretation of our results. The blood samples were obtained from 20% (303) individuals and 15% (198) had 6-hour urine specimens collected for the biochemical appraisal of various essential nutrients. The frequency of physical findings among these individuals revealed no significant variation from the prevalence of abnormalities in the total group of 1514, so that the group may be considered representative. Thus, the biochem-

TABLE 15

Biochemical determinations (blood) by location, Republic of Korea armed forces 1956

		RECRUITS		DIV. A	DIV. B	DIV. C	NAVY	AIR FORCE	TOTAL
		New	Finished						
	Location	2	3	4	5	7	8	9	
	Number of determinations	34	33	67	67	70	12	20	303
Plasma proteins gm/100 ml	Mean	7.1	7.0	6.5	6.9	7.1	7.0	6.5	6.9
	S.D.	0.39	0.42	0.55	0.53	0.34	0.37	0.82	0.55
	S.E. ±	0.07	0.07	0.07	0.06	0.04	0.11	0.19	0.03
Percentage distribution	< 6.0 gm	0.0	0.0	11.9	7.5	0.0	0.0	26.3	6.0
	6.0–6.9 gm	47.1	60.6	74.6	49.3	34.3	50.0	31.6	51.3
	≥ 7.0 gm	52.9	39.4	13.4	43.3	65.7	50.0	42.1	42.7
Hemoglobin, gm/100 ml	Mean	13.8	13.7	13.8	12.2	12.2	13.4	14.4	13.1
	S.D.	0.6	0.7	0.8	0.9	1.2	1.1	0.9	1.23
	S.E. ±	0.1	0.1	0.1	0.1	0.1	0.3	0.2	0.07
Percentage distribution	10–11.9 gm	0.0	0.0	0.0	46.3	61.4	16.7	0.0	25.2
	12.0–13.9 gm	61.8	60.6	56.7	49.3	22.9	50.0	31.6	46.4
	≥ 14.0 gm	38.2	39.4	43.3	4.5	15.7	33.3	68.4	28.5
Serum vitamin C, mg/100 ml	Mean	0.64	0.68	0.70	0.51	0.63	0.76	0.58	0.63
	S.D.	0.29	0.22	0.37	0.21	0.19	0.28	0.15	0.27
	S.E. ±	0.05	0.04	0.05	0.03	0.02	0.08	0.03	0.02
Percentage distribution	< 0.2 mg	2.9	0.0	1.5	1.5	0.0	0.0	0.0	1.0
	0.2–0.39 mg	8.8	9.1	13.6	29.9	7.1	8.3	5.0	13.9
	≥ 0.4 mg	88.2	90.9	84.9	68.7	92.9	91.7	95.0	85.1
Serum vitamin A, μg/100 ml	Mean	36.7	33.1	29.8	31.6	22.2	28.7	21.0	28.8
	S.D.	7.0	4.8	8.6	10.6	6.5	5.3	7.3	9.4
	S.E. ±	1.3	0.8	1.1	1.3	0.8	1.6	1.6	0.5
Percentage distribution	< 20 μg	0.0	0.0	12.1	10.4	40.0	0.0	45.0	17.6
	20–49.9 μg	96.4	100.0	87.9	88.1	60.0	100.0	55.0	81.7
	≥ 50 μg	3.6	0.0	0.0	1.5	0.0	0.0	0.0	0.7
Serum carotene, μg/100 ml	Mean	63	64	74	61	75	100	62	69
	S.D.	15.9	16.0	27.9	20.5	19.0	19.3	20.0	22.8
	S.E. ±	3.0	2.8	3.4	2.6	2.3	5.6	4.5	1.3
Percentage distribution	< 40.0 μg	3.6	9.1	7.6	16.4	2.9	0.0	0.0	7.4
	40.0–99.9 μg	92.9	84.8	75.8	76.1	85.7	58.3	90.0	81.1
	≥ 100.0 μg	3.6	6.1	16.6	7.5	11.4	41.7	10.0	11.5

TABLE 16

Biochemical determinations (urinary) by location, Republic of Korea armed forces 1956

		RECRUITS		DIV. A	DIV. B	DIV. C	TOTAL
		New	Finished				
	Location	2	3	4	5	7	
	Number of determinations	30	30	48	48	42	198
Thiamine excretion μg/6 hr.	Median	60	110	90	180	210	125
Percentage distribution	< 25.0 μg	16.7	0.0	6.2	0.0	4.8	5.0
	≥ 25.0 μg	83.3	100.0	93.8	100.0	95.2	95.0
Riboflavin excretion μg/6 hr.	Median	102	72	52	58	32	58
Percentage distribution	< 30.0 μg	3.4	0.0	16.7	10.4	45.0	16.3
	≥ 30.0 μg	96.6	100.0	83.3	89.6	55.0	83.7
N'-methylnicotinamide excretion mg/6 hr.	Median	6.0	8.2	6.7	7.0	4.0	6.5
Percentage distribution	< 1.0 mg	0.0	0.0	0.0	0.0	0.0	0.0
	≥ 1.0 mg	100.0	100.0	100.0	100.0	100.0	100.0

ical determinations should provide a valuable quantitative adjunct to the estimation of nutrient intake levels and to the evaluation of clinical defects of possible nutritional origin.

The results of the studies are summarized in tables 15 and 16. The distribution of the blood and serum values permitted the determination of means whereas those of the urinary levels were skewed toward the high side, necessitating the use of the medians. For all nutrients the percentage distributions which are based on the "Guide for Interpretation of Biochemical Findings" (ICNND, '57a) are also presented. All of the means and medians were in the "acceptable" range except for hemoglobin. However, from 0% (for urinary *N'*-methylnicotinamide) to 71% (for hemoglobin) of individuals were below the "acceptable" range.

The values for total plasma protein ranged from 5.0 to 8.0 gm/100 ml and are somewhat lower than those usually seen in healthy populations; there were 28% of the values below 6.5 gm/100 ml. Examination of the mean nutrient intake data and clinical findings attributable to protein lack do not indicate widespread protein deficiency. The plasma protein levels were not influenced by either activity or length of time in military service. The mean level was lower and the percentage below 6.0 gm/100 ml was greater among the troops of Division A (location 4) and the Air Force than found in the other groups. In view of the limited amount (5 gm/man/day) of animal protein ingested during the period of the mess survey at location 4 (table 1, footnote 6) one may speculate as to what relationship exists between the low dietary intake and the levels of total plasma protein. The mean value of plasma protein was 0.7 gm/100 ml lower than that found in a similar rice-eating population on Formosa and similar to the levels in the Philippines (table 17).

The average hemoglobin concentrations are on the low side — approximately 70% of the values were below the "acceptable" range — and almost 2 gm/100 ml lower than the Formosan levels (table 17). The distribution curve of the

values was bimodal in character, the lower mode being the result of levels obtained in Divisions B and C, and the upper mode reflecting the remainder of the sample. In 25% of the troops the hemoglobin levels were less than 12.0 gm/100 ml. Two per cent had values below 11.0 gm/100 ml. These "anemic" levels were concentrated almost entirely in the two locations mentioned above. Hemoglobin levels below 12.0 gm were more frequently found in the heavy mortar and artillery

TABLE 17

Comparison of biochemical data in rice eating populations 1955–1957

BIOCHEMICAL DATA	Year	1955	1956	1957
	Location	Formosa [1]	Korea	Philippines [2]
	Number	380	303	368
	Per 100 ml	*Mean*	*Mean*	*Mean*
Total plasma protein, gm		7.6	6.9	6.5
Hemoglobin, gm		15.4	13.1	14.7
Serum vitamin C, mg		0.34	0.63	0.46
Serum vitamin A, μg		26.6	28.8	49.3
Serum carotene, μg		30.5	69.0	72.6
Percentage distribution			*Per cent*	
Urinary thiamine < 25 μg/6 hr.		85	5.0	41.1
Urinary riboflavin < 30 μg/6 hr.		60	16.3	6.4
Urinary *N'*-methylnicotinamide < 1.0 mg/6 hr.		70	0.0	6.0

[1] Approximate means and percentage distribution calculated from baseline levels on the control and treated groups prior to initiation of the test (Consolazio et al.,'56).

[2] ICNND Report: Nutritional Status Phillipine Armed Forces, 1957c.

platoons. The highest levels found were among the Air Force personnel (mean = 14.4 gm/100 ml).

It is apparent from the nutrient intake data that there is not a problem of iron deficiency in the diet. Unfortunately, our data do not permit the classification of the low hemoglobin group on the basis of blood indices. There was no clinical history of blood loss among the troops. The general low levels of hemoglobin may be due to such conditioning factors as the somewhat low intakes of animal protein and the effects of enteric parasitic infestation. In this latter connection it was

worthy of note that Division C had the highest recorded rates for chronic diarrhea.

The mean serum vitamin C (ascorbic acid) level of 0.63 mg/100 ml is consistent for a healthy population. This is almost double that found in a similar rice-eating population (table 17) and for the Navajo Indian (Darby et al., '56). Only 1% of the troops had levels below "acceptable" standards. In Division B, the mean serum value was somewhat lower and there were more subjects between 0.2 and 0.4 mg/100 ml as compared to the total sample. With the adequate dietary intake of vitamin C, the satisfactory serum levels, and the paucity of physical findings attributable to deficiency of this nutrient, the status of ascorbic acid nutriture appears adequate.

The average serum vitamin A and carotene levels were, in general, satisfactory. The carotene values were almost double those obtained from the Formosans (table 17) while the vitamin A levels were similar. While 17.6% of the troops had values below "acceptable" limits for serum vitamin A and 7.4% for serum carotene, only 5 individuals were below in both. Personnel from Division C and the Air Force had lower mean values of serum vitamin A, whereas the Navy sample showed the highest mean carotene level.

Despite the severely restricted dietary sources of vitamin A available at the time of this survey, there were no extensive biochemical or clinical observations indicating widespread deprivation.

There were positive, but weak, correlations between the levels of serum carotene and the serum levels of both vitamins A and C, so that an individual whose serum carotene was "low" would tend towards low serum vitamin A and C values and vice versa. This is probably a reflection of the common food sources, in the Korean diet, for ascorbic acid and carotene and that vitamin A comes in large part from its precursor rather than as the preformed vitamin.

The median urinary thiamine and *N'*-methylnicotinamide values and their percentage distributions above and below

"acceptable" levels revealed no serious insufficiency. The median thiamine excretion of the recruit on induction was considerably lower than that of the other subgroups, with a larger proportion of "low" values. One may speculate that this is a reflection of civilian dietary patterns where polished rice is used in contrast to the 70% milled rice of the Armed Forces. Clinical evidence of either thiamine or niacin insufficiency was entirely lacking.

The median urinary riboflavin levels (table 16) revealed considerable variation with location which paralleled the dietary intake data. Of the total troops surveyed, 16.3% had excretions below "acceptable" standards. The median values were lowest in Division C (location 7) and in the infantry rifle platoons and highest among troops during their basic training (locations 2 and 3).

There was a positive correlation between the urinary excretion levels of *N'*-methylnicotinamide and riboflavin so that when either was "low" or "high," the other had corresponding low or high values.

Discussion. The mean or median levels of the nutrients in the blood and urine were all within the "acceptable" range with exception of hemoglobin. However, with each nutrient there was a variable percentage of the individuals who had values in the "low" or "deficient" range. The hemoglobin and urinary riboflavin levels indicate problem areas of nutritional import for the ROK Armed Forces. Further interpretation of these results should take into account any season influence associated with the timing of the survey.

In spite of the transportation difficulties between the field laboratory in Korea and the main laboratory in Japan, it is evident that immediate refrigeration and preservation protects the samples from significant deterioration. As with the physical examination data, major emphasis in discussion is based on reports from comparable adult male, rice-eating populations.

Unfortunately, the hematologic data did not permit the classification of the "anemia" in the 25% with low hemoglobins. The mean Korean level was lower than that of either the Formosan or Filipino adult male (table 17), and lower than the normal range for Americans, (Phillips et al., '50) but similar to values found in the Philippines, (Burch et al., '50) and Newfoundland, (Adamson et al., '45). With the very adequate dietary intake of iron among the ROK Armed Forces, consideration must be given to some source of chronic blood loss, or to another type of nutritional anemia. From the limited information available, enteric parasitism might have been universal throughout both civilian and military populations in Korea. Recent studies (ICNND, '57b and c) have suggested that only with very heavy infestation was there a demonstrable lowering of the hemoglobin level. Further clarification of this low-hemoglobin group is necessary to determine causative factors prior to undertaking any remedial measures.

While the mean Korean value for total plasma protein was lower than that found in Formosa (Consolazio et al., '56), it was similar to the Filipino levels (ICNND Philippine Survey, '57c), and in line with reports on civilian populations in the Philippines (Burch et al., '50) and Newfoundland (Adamson et al., '45). Clinical evidence of hypoproteinemia among the ROK Armed Forces was negligible, and we were unable to correlate "low" or "deficient" plasma protein values with any clinical stigmata. Scrimshaw, Guzman and Mendez de la Vega ('51) have concluded that serum protein levels cannot be used for the detection of mild to moderate degrees of protein deficiency in humans. Under conditions similar to those in location 4 (where there was a very limited amount of animal protein ingested during the period of the mess survey), Hegsted et al. ('46) found a significant decrease in total serum proteins. The overall dietary, biochemical and clinical results do not suggest that protein malnutrition is a widespread problem in the ROK Armed Forces.

There was not any correlation between the dietary intake of vitamin A and either the biochemical or clinical data. Vegetables from the military gardens and winter kimchi provide important amounts of carotene in the Korean diet. It is probable that these food sources were consumed in seasonal bursts which permitted sufficient storage of this nutrient to protect the individual from developing clinical stigmata or unsatisfactory blood levels. Vitamin A nutriture in the three rice-eating populations (tables 13 and 17) revealed both clinical and biochemical similarities between the Korean and Filipino, but major differences with these two and the Formosan data.

The status of ascorbic acid, thiamine and niacin nutrition was satisfactory in all aspects. This is in contrast to the Formosan, and to a lesser extent, the Filipino data (table 17). Although the numbers of individuals in the present study were small, a positive correlation existed between the increased prevalence of gingival disorders other than "scorbutic type" with serum vitamin C levels below 0.4 mg/100 ml.

There was a positive correlation between the dietary riboflavin intakes and the urinary riboflavin levels in the different locations. The overall clinical and biochemical findings tend to confirm the suboptimal nutrient riboflavin intake in the ROK Armed Forces. Comparatively, these results lie between the other two rice-eating populations (tables 13 and 17). Examination of the clinical and biochemical data by location (tables 6 and 16) reveals a negative correlation between the frequency of physical signs attributable to ariboflavinosis and the median urinary riboflavin level. However, there was a positive correlation between the increased prevalence of angular scars (not angular lesions or cheilosis) and with the levels of urinary riboflavin below 30 μg/6 hr.

Comparison with the 1953 Korean survey in the three segments of each sample (table 18) revealed improvement in 1956 in some of the blood levels. For the trained recruits and the divisional troops, the total plasma proteins and serum vitamin C and carotene were superior during the present study.

There was no significant difference in the serum levels of vitamin A, but there was a definite deterioration in hemoglobin values as revealed by the percentage below 12.0 gm/100 ml in the divisional troops.

The results of the biochemical assessment revealed generally adequate levels for total plasma proteins, serum vitamins A, C and carotene, and the fasting urinary excretion of thiamine

TABLE 18

Comparison of distribution of biochemical findings, Republic of Korea armed forces 1953–1956

	1953 RECRUITS			1956 RECRUITS		
	0 wks	16 wks	Div. B	0 wks	16 wks	Div. B
Total plasma protein, < 6.0 gm	0.0	10.7	12.0	0.0	0.0	7.5
Hemoglobin < 12.0 gm	3.9	4.0	9.8	0.0	0.0	46.3
No. of determinations	28	75	32	34	33	67
Serum vitamin C, < 0.2 mg	60.0	100.0	35.4	2.9	0.0	1.5
No. of determinations	25	47	23	34	33	67
Serum vitamin A, < 20 μg	0.0	17.0	1.4	0.0	0.0	10.4
Serum carotene, < 40 μg	0.0	34.0	18.6	3.6	9.1	16.4
No. of determinations	45	47	70	28	33	67

and *N'*-methylnicotinamide. One-quarter of the troops had "deficient" hemoglobin levels and one-sixth had urinary riboflavin values below the "acceptable" standard.

SIGNIFICANCE OF FINDINGS

The significance of all detailed findings have been discussed in the foregoing sections. It remains, however, to outline the significance of the picture presented by the nutritional status of the Armed Forces of Korea in relation to the recent history

of the Republic, its present economic outlook and the food pattern of Korean people compared with those of their Asian neighbors.

The destructiveness of the recent war in Korea and the economic handicap of the present division of the country into two completely separated areas without substantial economic exchange have disastrous consequences as to the present outlook. The fact that the nutritional status of the ROK troops is now relatively excellent as compared to the ROK troops in 1953 and as compared with the troops of other Asian nations, so far as these are known, is eloquent evidence of two things: (1) the excellent discipline and patriotic devotion of ROK military establishments and (2) the protective value of the Korean food pattern.

Two features of this food pattern are outstanding, first, the extensive production and nearly year-round use of generous amounts of vegetables, and second, the excellent and systematic use of undermilled rice by the ROK Armed Forces. Other factors of importance are the effective use of soybeans and of dried fish. These 4 measures, or substantial equivalents, are available in greater or less degree in all Asian countries, yet, with the possible exception of Japan, Korea surpasses all her neighbors in their practical use. The Korean example is most encouraging for the ultimate satisfactory solution of the food problems of East Asia. Many neighboring countries enjoy a much better prospect than does Korea of a major supplementation of the food supply with milk and liberal supplies of meat.

It is to be hoped that the Republic of Korea will soon find the means to extend the benefits of undermilled rice to her entire civilian population.

The value of nutritional surveys of the armed forces, such as the present one, is amply demonstrated by the great improvement in nutritional status which has been effected by the Korean Armed Forces since the survey in 1953 by Sandstead and Koehn.

SUMMARY

A survey of the nutrition of Korean military forces was conducted in June and July 1956. It included the collection of information on agriculture, food production and dietary pattern; computation of the nutrient content of rations as nominally allowed and as actually issued in 4 randomly chosen military kitchens, confirmed by biochemical analysis of composite samples of the food as served. Physical examination was performed on a statistically adequate sample of the troops and blood samples were taken from 20% of those examined clinically and 6-hour fasting specimens of urine from 14.5% and all these were analyzed biochemically.

The findings of the survey indicated that, in general, the nutritional status of the Armed Forces was good. There was a vast improvement in the nutritional health of the troops as compared to their status in 1953. This reflects a most praiseworthy accomplishment due in considerable part to the genuine efforts of the Republic of Korea and the U. S. Advisory personnel.

Among the 1514 enlisted men examined physically, there were relatively few individuals who showed evidence of poor nutrition and none exhibiting severe nutritional disease. The adequacy of the calorie intake is indicated by the observed weight-height-age relationship of the troops. Using the adjusted (to nude weight) U. S. Medico-Actuarial tables as a reference standard only 5 individuals were under 80% of "standard weight," with only 61.7% of the troops examined under 90% of "standard weight" as compared to 46% of the troops in 1953. The mean per cent of "standard weight" was approximately 97%. Great improvement in the distribution of essential nutrients to the troops is also reflected in the marked reduction in the percentage of men exhibiting clinical symptoms of nutritional disease. Indications of vitamin C deficiency were no longer present as they were in 1953 and those of protein deficiency were much less marked and indeed minor or doubtful.

Dietary studies indicated very adequate thiamine and niacin intakes but suboptimal intakes of riboflavin were noted in some of the troops. This was confirmed by the clinical findings (13.8% of the troops had angular lesions of the mouth and 16.3% excreted less than 30 μg of riboflavin per 6-hour urine specimen). Evaluation of the food issues also revealed suboptimal levels of vitamin A and carotene; however, the physical and biochemical findings of the men afforded no confirmation of this; presumably seasonal high intakes of green vegetables obtained from military gardens and elsewhere have prevented clinical deficiencies.

Messing and food distribution procedures on the whole were greatly improved, but minor weaknesses still exist in the design of menus, substitution of foods, issuing of rations and in cooking and messing facilities, especially as to sanitation. There was no evidence of food wastage in the kitchens and virtually no plate waste.

Comparisons with other surveys afford useful information on height and weight, frequency of incidence of certain symptoms of disease and biochemical values of blood and urine. Comparisons with Formosan and Filipino soldiers are of major interest because of the predominance of rice in the diets of these three East Asian peoples. The anthropometric measurements afford a preliminary basis for medico-actuarial standards more applicable to rice-eating Asians than those heretofore available. The men of the military forces of these three countries are very similar in height but the "standard weight" of the Korean is significantly above that of the Formosan or Filipino. Skin-fold measurements of Koreans combined with weight measurements show very low incidence of serious underweight and essentially no obesity.

The troops in all three countries exhibit clinical and biochemical evidence of a shortage of riboflavin. This occurs with greatest frequency among Formosans, less among Koreans and still less among Filipinos. Blood plasma protein was somewhat lower among Koreans than Formosans and similar

to that of Filipinos. Ascorbic acid level in serum was higher for Koreans than for Formosans or Filipinos. Thiamine was quite adequate as to urinary excretion in Koreans but marginal in Filipinos. Vitamin A nutriture was similar for Koreans and Filipinos but lower for Formosans. The significance of these comparisons can be fully evaluated only after the collection of further survey data.

ACKNOWLEDGMENTS

The nutrition survey team wishes to express its thanks for the excellent cooperation received from both U. S. and Korean military personnel in facilitating its work. In addition to those assigned to work with the team, (listed below), we wish to thank Lt. Col. A. A. Poindexter and Col. John H. Bosbyshell, Q.M.C., for their untiring efforts in Korea. We also wish to thank Col. J. M. Blumberg, Lt. Col. O. Felsenfeld and Lt. W. W. Evans in Japan for making arrangements and performing the biochemical analyses and for otherwise facilitating the team's work.

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Our sincere thanks are due to the above ROK Officers and men as well as U. S. personnel who participated in our day-to-day work and to Maj. Gen. Lim Boo Taek, ROKA Q.M.C., and his staff.

In addition we wish to thank Dr. Kim H. Jik, President of Hong Ik University, Seoul, Dr. Haw Kum, Director, National Chemical Laboratory, Seoul, and his staff and Col. Rak-eun Chung, Director of the Ministry of National Defense Scientific Research Laboratories, Seoul, and his staff, Mr. Henry L. Buckardt of the U. S. Embassy, Mr. Burlin B. Hamer and Mr. Stein F. Moss of the Office of Economic Coordination for their substantial help in assembling the background information for this survey. Grateful thanks are also due to officers of several colleges and universities, Korean goverment agencies and industrial food establishments which were visited.

Special recognition is due to Mr. E. B. Bridgforth of Vanderbilt University for meticulous statistical scrutiny of the dietary, physical and biochemical findings.

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