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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*

PAKISTAN

GENERAL AREAS SURVEYED
1956 NUTRITION STUDY

A NUTRITION SURVEY OF THE ARMED FORCES OF PAKISTAN[1]

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National Institutes of Health, Bethesda, Maryland

[1] Prepared by the authors at the request of and in coordination with the Interdepartmental Committee on Nutrition for National Defense. This Committee was established in 1954 to coordinate nutrition projects conducted by U. S. military and technical aid missions in foreign countries.

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I.

INTRODUCTION, ORGANIZATION, AND SELECTION OF SAMPLE

INTRODUCTION

Following preliminary investigation of the food and nutrition situation in several countries of the Middle East (Berry and Sandstead, '55), invitations were received by the Interdepartmental Committee on Nutrition for National Defense for assistance in conducting complete nutrition surveys in Iran and Pakistan. While engaged in the many preparations for these detailed studies, Dr. Harold R. Sandstead lost his life in an airline crash. It was only through the dedicated efforts of all concerned that the survey teams were promptly dispatched on January 20, 1956, under the general direction of Dr. John B. Youmans, Consultant to the Committee and Field Director for the Nutrition Surveys of Iran and Pakistan.

The principal aims of the survey were to appraise the nutritional status of the Armed Forces and to assist the Pakistanis in establishing a nutrition service. All essential laboratory equipment and supplies were furnished by the United States and upon completion of the survey were turned over to the Armed Forces of Pakistan. The time involved in completing the survey was 85 days.

The Armed Forces of Pakistan recognized the importance of nutrition in assuring the good health and performance of the soldier. At the time of the survey, however, medical personnel had not been assigned to work in this direction. The rejection percentage of recruits on medical grounds for all of Pakistan was 55% in 1951, and reached 61.5% in East Pakistan in 1953. Disabilities resulting from nutritional disease were said to account for much of this loss of man power (Berry and Sandstead, '55). The ration scales for the Armed

Forces in Pakistan (table 1) compare favorably with the Recommended Daily Dietary Allowances of the Food and Nutrition Board (U.S.A.), National Research Council, '58. For the Army it provides 3720 Cal., 110 gm of protein, and 106 gm of fat; for the Navy 4150 Cal., 135 gm of protein, and 129 gm of fat; and for the Air Force 4100 Cal., 135 gm of protein, and 126 gm of fat (Pakistan Army Training, '51). Special ration scales are in effect for the Combined Military Hospitals.

TABLE 1

Pakistan: Basic ration scale for Pakistan Army[1]

(Per man/per day or as indicated)

FOODS	OUNCES	FOODS	OUNCES
Atta (wheat)	22	Fruit, citrus	4
or		(3 × per wk.)	
(Atta	16	or	
and		(Fruit, non-citrus)	8
Rice)	6	(3 × per wk.)	
Dhal (beans)	3	Tea	⅓
Sugar	2	Salt, rock	½
Meat, fresh	3½		
Milk, fresh	9	*Supplement for Fatigue or*	
Ghee, (milk fat)	2¾	*Bad Weather Conditions:*	
(3 × per wk.)		Cocoa	1
and		or	
Ghee, (veg. oils)	2½	(tea)	½
(4 × per wk.)		Sugar	1
Potatoes	4	Milk, evap., canned	1
Other vegetables	7		
Onion	2		

[1] Pakistan Army Training, '51, Catering in the Army, Military Training Pamphlet No. 11, Code No. GSP-1036 (Section 2), 259.

The Army conducts a catering school for the training of cooks and food service personnel at Chuklala, Rawalpindi, and the Navy a school for cooks at Pakistan Navy School, Himalaya, Mindora Island, Karachi. In addition to this, the Pakistan Army Service Corps has the nucleus of a Quartermaster Food Research Group in the General Headquarters Science Laboratories, Rawalpindi, and the Medical Directorate operates the Military Food Laboratory at Lahore for

control inspection of all centrally purchased foods for the Armed Services. Since the completion of the nutrition survey, an Armed Forces Institute of Nutrition has been established at Lahore and is actively engaged in research and implementation of the survey recommendations.

ORGANIZATION

The nutritional assessment phase of the survey consisted of three parts: a dietary (food intake) study, physical examinations, and biochemical analyses of blood and urine samples. To assist in future planning of the ration, existing agricultural and food technological resources and practices were observed.

Since one very important function of the mission was to train Pakistani personnel in nutrition survey techniques, a number of Pakistani Nationals were assigned to the survey team, including: three physicians, 5 biochemists, an Army Service Corps Officer, a Quartermaster Officer, a Junior Commissioned Officer as secretary, three orderlies, and three mess specialists.

Headquarters for the survey team was established at the Military Food Laboratory, Lahore Cantonment where the biochemical laboratory equipment was permanently installed. The 4 American and 5 Pakistani biochemists comprised the laboratory group. The various analytical determinations were rotated from one person to another about every two weeks so the Pakistani biochemists became familiar with all the methods. In addition, two of them participated in the field sampling operations in order to learn the entire biochemical procedure.

Shortly after arrival of the American group, an orientation meeting was held and a detailed program for the entire nutrition survey was prepared and submitted to the Director General of Medical Services. This program included the necessary authority, list of personnel, proposed places of survey and dates at each location, procedures of the survey, requests for movement orders, transportation required, ac-

commodations needed, and a provision for implementing any necessary minor changes in the program. This program was reproduced by the Medical Directorate and when dispatched to the Navy, Air Force, and various Army Cantonments constituted a combined authority and advance notice so that local planning and preparation could be undertaken before arrival of the survey team.

SELECTION OF SAMPLE

In planning the series of nutrition surveys to provide for thorough assessment, consideration was first given to sampling: (1) all three branches of the Armed Forces; (2) troops from both East and West Pakistan; (3) troops located in the different environmental areas; (4) troops subjected to various degrees of activity; (5) special groups such as "Boys" (15 to 17-year-old junior soldiers); (6) wheat-eating compared to rice-eating troops; and (7) the Azad-Kashmir Forces.

The final selection of stations where surveys should be made included Karachi for Navy personnel, Peshawar and Karachi for the Air Force, and 8 Army Cantonments in different environmental areas. These allotments were made in relative proportion to the numbers of men in each of the three services. The selection of Army stations and the types of troops studied at each were made so as to encompass the extremes of environment, activity, and groups of special interest referred to above. The numbers of men examined at each station and in different categories were based on the populations and the time available. In no instance was the sample examined less than the square root of the number involved, and in most cases it was much larger.

Dietary intake studies were made at one complete mess for a period of 4 to 10 days at each station. As soon as a particular group had been chosen (for example an Infantry Regiment in a desert area), one representative Line Company mess was selected for the 4- to 10-day dietary study. All of the men eating in this mess were examined clinically in addition to a number of other men to make up a total number

(usually 200) which exceeded the square root of the Infantry Regimental strength. From 40 to 60 of these men were then designated for biochemical studies by selecting every third or 4th man from the company roster or nominal roll. By rigidly following this procedure it was possible to obtain random samples of sufficient size from the various segments of a "stratified" population to give adequate statistical significance.

In addition to the clinical, biochemical, and dietary phases, inspection trips were made at each station to: the station supply depot to obtain information on food service, purchase, storage, and issue procedures; the Combined Military Hospital to obtain information on food service, public health problems, and nutrition information; and to military unit gardens, military dairy farms, civilian hospitals, public health offices, university laboratories, child welfare centers, military cooks schools, and refugee camps wherever available.

A sincere interest was shown by the Army, Air, and Naval Commanders in the nutrition survey work and nontechnical lectures were presented at their request on two occasions. Medical seminars were also conducted at Quetta in West Pakistan and Comilla in East Pakistan on the subject of nutrition and nutrition surveys.

Information on agricultural economics and food technology was obtained from the pertinent offices, officials, and from field trips to the important food plants and food growing areas.

II.

BACKGROUND AND AGRICULTURAL ECONOMICS

BACKGROUND

Geography

Pakistan was established in August 1947, when the Indian Subcontinent was partitioned. It is divided into two dissimilar areas separated by 1,000 miles of India, West Pakistan, and East Pakistan. Pakistan is slightly larger than the combined area of Florida, Georgia, Alabama, Mississippi, and Arkansas, and has approximately the same latitude as this group of states.

West Pakistan has 85% of the area and only 42% of the population. It is largely an arid to semiarid country, except in the far north, and in the Indus River Valley, where it has one of the world's largest irrigation systems with an intricate network of canals.

East Pakistan is surprisingly similar to Florida in size, north latitude, and flatness. It is largely an alluvial flood plain of the Ganges and Brahmaputra rivers which join near the center and flow to the sea by a dozen or more principal branches. These broad meandering rivers quite often change their course, thus bridges are generally impractical. The waterways, along with some railroads, serve as the main arteries of travel. The vast delta is dotted by homes of bamboo built on mounds about 10 feet above the plain for protection from flood waters during the monsoon season. Owing to the annual flooding, crop production is limited largely to such crops as rice and jute which can be grown in standing water. Deepwater (or floating) Paddy rice will grow up to one foot a day for a few days and up to 25 feet in height to keep above rising waters. The rice can be submerged in water as much as a

week and yet survive provided the plants are over 6 weeks old. The dwellings usually are hidden, in part at least, by banana plants and coconut trees. The regions known as Cox's Bazaar, Chittagong, and Chittagong Hill Tracts in the southeast are hilly and have extensive subtropical forests. A "slash-and-burn" type of agriculture in some of the hill tracts results in considerable destruction of vegetation to produce one or two crops of rice. This primitive and shifting cultivation is called "Jhum" in this area whereas in Central America it is termed "Milpa."

Water and irrigation

Irrigation water is vital to the economy and existence of West Pakistan. Increased water supplies are needed for the expansion of food production to feed its rapidly growing population. Reducing the availability of irrigation water will not only retard and circumscribe economic development, but may also mean the quick resurgence of the desert over extensive areas and restriction of cultivation to flood plains along the rivers as in olden times. Consequently an equitable division of waters between India and West Pakistan involves difficult problems of grave importance.

Over half of West Pakistan gets less than 10 inches of rainfall a year and most of the rest gets less than 20 inches. This precipitation is far from adequate for agriculture, especially in summer with temperatures often rising to from 38 to 48°C. Plant and animal life, to a great extent, is dependent on the Indus River system and its numerous irrigation canals. Moreover, if the limited water is spread too thinly, or if the soil becomes waterlogged from poor drainage, the land becomes too saline for agricultural use. Cultivation has been abandoned on an extensive acreage in the Punjab owing to waterlogging and salinity. Probably 50,000 acres of tillable land goes out of production each year in the Punjab alone from these causes, with a net loss in cultivation of 15,000 to 20,000 acres annually (Knaus, '53).

Population and vital statistics

Pakistan has approximately 85,000,000 people and an annual rate of growth of at least 1.5%. Fifty-eight per cent of the people live in East Pakistan in 15% of the nation's area. The density of population there, especially in the delta region, is exceeded by few areas of the world. The average life expectancy at birth in East Pakistan apparently is less than 30 years. The population of East Pakistan is decidedly nonmigratory. In 1941, 97% were born within the district where they live (Winters, '55).

Life expectancy at birth in West Pakistan is about 33 years. The infant mortality rate (deaths under one year per 1,000 live births) is estimated at 200 to 250.

Language and literacy

The chief languages are Urdu in West Pakistan and Bengali in East Pakistan. A knowledge of English is common among government officials and businessmen and English generally is used in teaching in colleges and universities. Fourteen per cent of the population are classed as literate.

Religion

Pakistan as a whole is 86% Muslim and 13% Hindu. West Pakistan is almost entirely Muslim owing to the general exodus of Hindus who were there prior to partition. East Pakistan has 77% Muslims and 22% Hindus.

Transportation

Pakistan has nearly 7,000 miles of railroads and relatively good railway transportation between all major cities. There are 58,000 miles of roads, chiefly in West Pakistan. Macadam roads between the major cities, although somewhat narrow in places, are usually in good condition. In East Pakistan there are 2,650 miles of navigable waterways. Domestic airplane passenger service is available to various points between

Karachi and Peshawar, from Karachi to Dacca, Lahore to Dacca, and from Dacca to Comilla, Chittagong, and other points. Various airlines make international flights east and west from Karachi.

Small boats in East Pakistan, and carts of various designs drawn by bullocks, camels, and donkeys in West Pakistan are the customary means of transporting agricultural products from producers to assembly points or central markets. Motor trucks are used to some extent in transporting vegetables, oranges, and milk. Railroad services for the transport of perishable agricultural products generally are inadequate.

AGRICULTURAL ECONOMICS

The economy of Pakistan is based largely on agriculture. Approximately 70% of the national income comes from agriculture, 80% of the people are engaged in farming, and 90% of the export trade is based on agricultural products. The foreign exchange, so vital to importation of industrial products, petroleum, and some foods, is obtained largely from the export of jute, cotton, tea, wool, hides, and skins.

The area now comprising Pakistan formerly was a substantial surplus producer of food. Now, only in years of exceptionally good harvests does Pakistan produce enough food to meet domestic requirements — allowing for some international exchange in foodstuffs. The population is increasing faster than domestic food production. Crop yields per hectare, already low, have declined in recent years. Increasing agricultural production is second to none among the problems of Pakistan.

Various projects are being conducted to effect increases in areas under cultivation, yields per hectare and in total production; but the magnitude and pace of present projects are not keeping up with the increase in national food requirements. Agricultural production per capita from 1953 to 1955 averaged 8% below the level of 1935 to 1939. East Pakistan, for instance, produces approximately 7,500,000 metric tons of rice on 20,000,000 acres. Requirements were estimated by

local officials at 7,680,000 tons for the 1950 population of 42,500,000. Population is increasing about 800,000 a year whereas rice production is increasing very little. By 1960 the East Pakistan rice crop is likely to be 1,000,000 tons below requirements unless production can be increased markedly.[11]

To meet food requirements a generation hence at the present rate of population growth probably will require an increase of at least 10,000,000 acres in food crops and a 50% increase in yields. Improved farming practices, including pest and disease controls, could bring about a substantial part of the needed increase in yields per hectare, but most of it doubtless will eventually need to come from increased use of chemical fertilizers, particularly nitrogen (Pike, '55).

More fertilizer plants will be needed. The first one, with an annual capacity of 50,000 tons of ammonium sulphate is nearing completion at Daud Khel. This plant will cost about $25,000,000, of which the United States has given at least one half in dollars to finance imports needed for its construction. Although situated not far from the subsequently discovered gas fields at Sui, Baluchistan, its construction apparently does not lend itself to economical conversion to the use of natural gas.

About 83% of the cultivated land now is in food grains whereas this probably should not exceed 80% in order to leave enough land for other crops, particularly jute and cotton, which provide most of the foreign exchange. The importance of foreign exchange to Pakistan can hardly be exaggerated for it is vital to the program for industrialization. Annual capital accumulation is from 2 to 3% of the national income whereas 6 to 7% is needed for investment to provide full employment for the increasing labor force (U.S. Dept. Commerce, '54).

Three of the more conspicious needs for agricultural progress in Pakistan are land reform, improved marketing facilities and services, and rural credit for productive purposes at

[11] Based largely on discussions with Dr. A. Alim, Rice Expert, Rice Research Laboratory, Agricultural Experiment Station, Dacca, Pakistan, April, 1956.

reasonable rates of interest (Pakistan Agricultural Inquiry Committee, '52). The laws of inheritance give equal shares to each son. Centuries of subdivision have resulted in fragmentation into small and sometimes widely scattered plots, which are more costly to operate. Chain leasing of farm lands, a succession of lessees and sublessees, or intermediaries, drains off a large share of the fruits of the farmer's labor (Martin, '56). High rents and the general custom of levies or assessments on tenants for cash, produce, or free labor, operate to keep the Pakistan farmer from attaining any substantial improvement in his economic or social status (Pakistan Institute of International Affairs, '54).

Improved marketing facilities and services are needed to reduce the spread between retail prices and what the farmer receives. Some storage is being provided for grains, but not enough. Cold storage facilities would help greatly in marketing more and better meat and fish and also to prevent large losses of perishable fruits and vegetables, especially in the season of peak production. Standardization and grading of farm products, now limited largely to jute, and to eggs and ghee in some areas, would facilitate trade and the payment of premium prices for quality products. Adoption of standard weights and measures would reduce confusion. Market news on production, shipments, and prices is needed on a well organized and widespread basis.

Food: Consumption and prospects for production

The per capita consumption of food in Pakistan averages about 2124 Cal. per day, according to estimates of food balances developed by the Foreign Agricultural Service for 1954–55 (table 2). Approximately 71% of the calories were obtained from cereals, 7% each from sugar and milk, and 5% from pulses. Meat, fish, and eggs together contribute only 3%; oils and fats only 2%. Plant products contribute 90% and animal products only 10%. The production of vegetable ghee, a product similar to margarine, has increased rapidly in recent

years and some of it is now reported to be fortified with vitamins A and D. It may be that published estimates of food balances do not fully reflect the consumption of either vegetable ghee or animal ghee (butter).

TABLE 2

Pakistan: Food consumption, 1954–55 [1]

ITEM	CALORIES PER PERSON PER DAY	
	Number	*Percentages of total*
Grains	1503	70.8
Rice (milled)		45.3
Wheat		19.2
Other		6.3
Sugar	158	7.4
Pulses	104	4.9
Gram (chickpea)		3.4
Fruits and nuts	57	2.7
Oils and fats (and oilseeds)	40	1.9
Vegetables	30	1.4
Roots, tubers, and starches	21	1.0
Meat	32	1.5
Fish and eggs	33	1.5
Milk	146	6.9
Total	2124	100.0
Plant products	1910	90.0
Animal products (including mutton tallow)	214	10.0

[1] These data ". . . refer to food consumed. They are not necessarily identical with amounts of food available for consumption because not all planted food crops are harvested, nor are all foods growing wild harvested." Source — Pakistan: Food balance, '54–'55, Foreign Agricultural Service.

The chief foods are rice in East Pakistan and wheat in West Pakistan. In East Pakistan, cereals probably contribute about 80% and animal products (chiefly fish, milk, and some meat) less than 5% of the calories. In West Pakistan the per capita consumption is somewhat greater in total calories and in almost everything except rice, fish, fruit, and vegetables. Diets in West Pakistan contain a great deal more wheat and substantially more milk, sugar, meat, pulses, oils and fats than in East Pakistan.

Livestock and livestock products

Pakistan has about 24,000,000 cattle, roughly three-fifths of which are in East Pakistan. Some 5,000,000 buffaloes and 9,000,000 sheep are nearly all in West Pakistan, as are the majority of the 14,500,000 goats (Bishop, '54). West Pakistan is fortunate in having various breeds of fine cattle, particularly the Zebu. Generally, these are hardy, disease-resistant and good for draft as well as for milk production.

In East Pakistan, the cattle are malnourished and undersized. They produce very little milk or meat and are a poor source of draft power. The small size of many cattle in East Pakistan is attributed to various causes such as lack of adequate amounts of feed including calcium and trace minerals, adverse climate, and poor breeds. Many of the cattle observed between Dacca and Chittagong, although invariably thin, were normal in height, indicating that the primary lack is the quantity of adequate feed. Cattle here, as a rule, are fed either paddy (rice) straw or green grass, or both if available. No concentrates are fed, except for an occasional feeding of rice bran or husks of pulses. On the basis of Morrison's standards, cattle in all areas in East Pakistan often consume less than that required for maintenance at rest (Animal Nutrition Survey in East Pakistan, '47).

Cows in East Pakistan usually give from 3 to 15 pounds of milk a day compared with 50 or more pounds a day on military dairy farms in West Pakistan. Improved practices in selection, breeding, and feeding, however, may bring substantial increases in milk production in the next generation of East Pakistan cows.

Housing also is needed to protect animals from rain and floods. Goats and sheep live by browsing around the homestead. With the great pressure of population on food supplies which exists in East Pakistan and so little land for expanding food production, livestock are the residual claimant; they get what is left of nature's bounty.

The chief needs of livestock producers are for adequate feed at a price they can afford, and some means of reducing the high rate of calf mortality. Although retail prices of meat are relatively high the marketing costs are such as to keep prices to cattle producers low in relation to production costs. The influx of people into urban centers in recent years increased the demand for meat so much that the Government imposed meatless days; first one, then two, and finally three meatless days a week.

The most outstanding feature in animal husbandry in West Pakistan is the production of high-grade buffaloes and cows, and quality dairy products at the 17 large military dairy farms. One of these, at Okara, covers over 40 square miles. Approximately 2,500 buffalo were being milked there early in 1956. In addition to fluid milk for local use, this farm has two factories, one producing ghee (butter oil) and another producing canned milk. This buffalo milk is pasteurized, homogenized, and evaporated to 9% butterfat. It is diluted with two and one-half parts of water when served to troops.

Eleven miles from Okara, the Government maintains a huge buffalo breeding farm, with outstanding breeding animals. Young breeding stock is distributed from this farm at a nominal price to various local government installations.

Poultry

Data from the last census indicate that East Pakistan in 1954 and 16,500,000 chickens and 5,000,000 ducks compared with 6,000,000 chickens and ducks in West Pakistan. Thus, there is only about one fowl for every two people in Pakistan. Eggs make up a small part of the diet. Some interest is being shown in the production of broilers. The Agricultural Experiment Station in Dacca is doing a creditable job in producing and disseminating improved breeds of poultry of various types. Increased production and consumption of poultry and eggs among the millions of farm families would enable a substantial improvement in diets.

Fisheries

A large potential food supply from fish is generally recognized. The Government has a "Five-Year Plan for Fishery Development" and a large new fish harbor is being built in Karachi. East Pakistan has many fish ponds or "fish tanks" as they are termed, which provide considerable food.

Pakistan has 850 miles of coastline, 550 on the Arabian Sea and 300 on the Bay of Bengal. Although these waters have an abundance of warm-water fish, probably only 5% of the marine resources have been exploited. Modern methods of fishing have made little headway and fishing is confined to nearby coastal waters. Diesel motors for fishing boats, nylon for gill nets and refrigerated transportation are greatly needed.

The Director of Fisheries in East Pakistan is well aware of the potential food supply from fish, and has done a commendable job in publishing information on the fish situation. There are outlined 22 proposals for a solution to fishery problems and the fuller utilization of fish resources in ponds, paddy fields, and the Bay of Bengal (Ahmad, '55). Sharks, skates, rays, and sardines are prevalent along the coast of West Pakistan. The shark-liver oil is used to treat and tighten fishing boats. Indications are that investment in plant and equipment to make vitamin A from shark livers in Pakistan will not be undertaken owing to the competitive position of synthetic vitamin A. There is no canning of fish in Pakistan except for a little shrimp, in Karachi. Yet there are abundant sardine resources and some other firm-fleshed fish with a strong taste, such as mackerel and tuna, which probably would be readily marketable if canned properly.

Fruits and vegetables

Many fruits and vegetables are available in the large city produce markets, but the production and consumption of fruits and vegetables among the large rural population is relatively small. The Boulton and Empress markets in Karachi in March 1956 had oranges, grapefruit, guavas, papayas, (man-

goes from India), ground cherries, custard apples, ber (small wild apple), melons, and tomatoes. The more common vegetables were potatoes, sweet potatoes, onions, carrots, turnips, cauliflower, green beans, radishes (long white), cabbage, eggplant, cucumbers, rutabagas, red peppers, and garlic. Grams (chick peas) are a common market item and to a lesser extent dry beans and lentils. Oranges of good quality are fairly plentiful in West Pakistan in season at three annas (about 4 cents) each, but in East Pakistan oranges are inferior and relatively scarce at three times that price.

In East Pakistan the chief fruits are bananas, mangoes, melons, papayas, pomelos (grapefruit), and pineapple. Other fruits include blackberries, gooseberries, guavas, jackfruit, lemons, limes, a few oranges, plums, and pomegranates. Potatoes, the commonest vegetable, as a rule are so small as to defy peeling; seldom more than about an inch in diameter. Other vegetables available in season include beans, beets, cabbage, carrots, cauliflower, chilies (peppers), cucumbers, gourds, lettuce, onions, peas, radishes, spinach, and tomatoes. Coconuts (dry or green) and such pulses as gram, masur, matar, and mung are available throughout the year (Khaton et al., '55).

Fats and oils

A considerable increase in production of fats and oils in Pakistan seems desirable. There is little likelihood of any appreciable increase in animal fat production. Pakistan normally imports considerable vegetable oil for food use, such as mustard, peanut, and coconut oils. In recent years, however, there has been a marked increase in production of hydrogenated cottonseed oil in West Pakistan. East Pakistan produces only about one half of its edible oil requirements, chiefly from mustard and rapeseed. Coconuts are available throughout the year in East Pakistan. The possibility of producing coconut oil from fresh coconut meat has been explored to some extent, but apparently with no positive results as yet. Sesame oil also is produced in Pakistan, primarily for use in cooking.

Estimates vary considerably as to the percentage of cottonseed crushed, but it is evident that the percentage has been increasing rather rapidly in the last few years. After allowing for seed for planting, loss and waste in handling and shipping, probably about 90% of the cottonseed crop is crushed and processed into oil, soap and cake, with the balance, chiefly of the 4-F type, fed as seed to livestock. More oil for food could be obtained by the use of improved crushing machinery.

III.

FOOD HABITS AND TECHNOLOGY

The main goal of the survey of food technology was to obtain firsthand information on the potentiality of the country to supply any deficiency that might be turned up in the nutritional survey. It was recognized that sound recommendations for nutritional improvement must be based on background information covering: food preferences and habits of the native population; availability of manufacturing facilities and know-how; previous nutritional programs that have been undertaken or proposed; and men and institutions qualified to make a continuing contribution to nutritional problems.

The importance of getting firsthand information rather than relying on published statistics was evident in the discrepancy between the available statistics on fruit and vegetable processors and the observed actual state of development of this industry.

PREPARED FOODS

The chief source of calories in West Pakistan is wheat and in East Pakistan, rice. Wheat is eaten largely in the form of unleavened bread (Chapatti), when fried in butter fat (Paratha) (Poori), in doughnuts (Balushahi), in pancakes soaked in syrup (Jalebi), and as patties filled with spiced vegetables (Samosa), and in sweetened puddings from semolina (Halwa); vermicelli (Suvayan). Rice is eaten most commonly as plain boiled rice (Khushka) boiled in excess water, and the cooking water thrown away. A variety of sweetened rice dishes are commonly prepared (Zarda, Kheer, Firni).

Peas, beans, and lentils are used largely in mixed foods. The dried peas and small beans are called grams and when split and polished, are called dhals. Gram flour is fried in oil as a kind of pancake (Missi roti) and as a sort of mush (Pakora).

Meat dishes are regarded as desirable in the descending order: chicken (Murghi), fish (Machli), goat and sheep (Kebab — barbecued, Keema — minced, Kofta — meat balls, and Korma — curried). Dishes are made from the feet (Pae), heads (Siri), and brains (Bheja — Magaz) of domestic animals.

Vegetables are eaten after frying in butter fat (Bhujia) and after boiling as in corn-on-the-cob (Bhutta). A pudding is made of carrots (Halwagajar). Boiled vegetables are made into a salad (Raita). Fruits in season are always eaten raw. Pickles (Achar) and chutney are made from fruits and vegetables. Milk products and eggs are used in Khoa, Barfi, Halwa Anda, Rasgula, and Oulab jaman.

Combinations of meat, rice, vegetables, and pulses are made into an infinite variety of main dishes, for the most part, highly seasoned and colored with saffron. These are classified as pulaos and biryanis when made with rice. Other mixtures are rice and dhals (Khichris), vegetables and dhals (Bhajias), and wheat flour, vegetables and dhals (Samosas).

There is a very large number of curried dishes largely containing meat. Curries include meats cooked with onion and spices (Korma) and meats cooked with onion plus additional vegetables (Salan).

Most prepared dishes in Pakistan are highly seasoned with curries perhaps because the staple foods are cereals and very bland in flavor. The nutritional significance of curries has not been established. They sometimes contain appreciable amounts of vitamins C and A.

The widespread chewing of betel nut (Area catechu) with lime and pan leaves (piper betel) may have some nutritional significance, although how much of the red juice gets swallowed is uncertain. The production of betel nut and pan leaf combined exceeds that of tobacco, chilies, tea, onions, and garlic, or coconuts.

The most common beverage is hot tea, always served with boiled milk and sugar.

A few miscellaneous additional notes may be of interest. Butter fat is the preferred cooking oil. The use of vegetable oil for frying is limited to fish, gram flour, and a few other

foods. Animal fat is rarely used in cooking. The vegetables that are eaten raw are radishes, carrots, and cucumbers. Seafoods are not popular except for prawns which are eaten in the south and also shrimps, but to a lesser extent. Biscuits, cakes, pastries, sandwiches, and soups are popular in the cities and towns, but are not representative Pakistani foods.

In general, the diet in Pakistan is characterized by a reliance on wheat (or rice) as a staple and by an extensive use of curries.

FOOD MANUFACTURING

In spite of the fact that Pakistan has an economy that is essentially agricultural, the development of a food processing industry is embryonic. Out of a total of 120 registered plants, only 11 plants (for canning fruits and vegetables) employ as many as 20 people.

There is good potential for the development of food processing, and a nucleus of such plants has been established. Mitchell's Fruit Farms, Ltd. at Montgomery cans premium products for sale to the upper and middle classes in the cities, and also for export, chiefly to Great Britain. The army has some 17 dairies and milk pasteurizing plants. An evaporated milk plant and a ghee plant, owned and operated by the army, are located at Okara. A considerable number of dehydration plants (of the tunnel drier type) were established during the war, but these are not operating now. The biggest of these is the Government Dehydration Factory at Peshawar. There is a Premier Sugar Mill at Mardan with a capacity of 50,000 tons a year, but most of the sugar is produced in primitive units beside the cane fields. The product is crude brown sugar (Gur), and the yield is low.

A considerable quantity of edible oil is obtained from crushing cottonseed. Cottonseed oil (Vanaspati) is used as a substitute for ghee on two days a week by the army.

A can factory is located in Karachi which makes cans out of imported tin plate. Several factories exist for the manufacture of glass bottles, although corks, caps, and labels must be imported. In addition to these items, preservatives, es-

sences, and coloring agents are imported. Also, a number of other ingredients, even though grown in East Pakistan, are imported from India, since it is not economical to transport perishable products from East Pakistan to West Pakistan.

The Pakistan Fruit and Vegetable Preserver's Association has been organized with headquarters in Lahore. There are a number of experiment stations with laboratories and pilot plants.

The Fruit Products Control Order of 1951 defines the required conditions of sanitation and quality. Even among the larger plants, the majority do not begin to fulfill the requirements of the order.

EDUCATION, RESEARCH, AND DEVELOPMENT PROJECTS

Training in food technology is provided by the Punjab Agricultural College at Lyallpur, which is the site of the principal experiment station. Others are located at Tandojam in the Sind, at Quetta in Baluchistan, and at Peshawar in the North West Frontier Provinces (Tarnab Farms). As yet no real investigations are being carried on in food technology in these institutions. Some of these stations are being assisted by American institutions under contract, namely, New Mexico University at Tandojam, Washington State College at Lyallpur, and Texas Agricultural and Mechanical College at Dacca.

The Pakistan Council of Scientific and Industrial Research is organizing and building a number of central research laboratories. The Lahore laboratory will also include a food section.

The present military Food and Nutrition Laboratory in Rawalpindi is small but well equipped. Research projects are being conducted in the following subjects: Transport and storage of atta (wheat); preservation of vitamins in cooking; soil-less farming; cold weather feeding of troops; and pack rations. A multi-building General Science Laboratory is being constructed by the military at Rawalpindi. One building is planned for food and nutrition. The new food laboratory will have 5 major divisions: dietetics, microbiology, technology, chemistry, and biology.

IV.

DIETARY STUDIES

Dietary studies were conducted in 7 Army messes, one Navy mess, and one Air Force mess in 9 geographical locations in East and West Pakistan. In each case the procedure was similar to that outlined in the ICNND Manual for Nutrition Surveys ('57). The duration of each dietary study varied from 4 to 10 days. Only normal messing procedures were permitted and all of the personnel eating in each unit mess were included in the clinical and biochemical phases of the nutrition surveys.

METHODS

At the beginning of the mess survey, two team quartermaster officers and three noncommissioned mess specialists made a complete inventory of all food items in the mess hall. These items were kept locked in a storeroom and were again weighed and issued whenever requested by the cooks. All foods coming into the mess, including the daily issues of perishable foods and weekly issues of nonperishable items were weighed and recorded before being placed in the storeroom. Another complete food inventory was made after the last meal of the survey. Subtracting the final inventory amounts from the initial inventory plus the daily issues, gave the gross quantities of food used for the period of days studied. To this was added food consumed in canteens, bazaars, etc. From these amounts were subtracted all foods not consumed after conversion to equivalent weights of food "as issued." The average per man per day consumption of each food item was then computed by dividing the total weight of each food item consumed by the product of the number of days involved and the average number of men fed per day. The latter figure was obtained by making an accurate count of all men eating the

food, either in or outside the mess, including regulars, casuals, cooks, and servants or dependents.

Several determinations were made of the small quantity of fat drippings and fat in plate washings. This value was used in all subsequent computations. Nonedible kitchen waste, such as vegetable peelings, bones, cores, and pits from fruit, etc., were weighed and notes were made when these contained portions of potentially edible food. During the hours of mess

TABLE 3

Pakistan: Conservative vitamin losses on cooking [1]

FOOD CLASS	THIAMINE	RIBOFLAVIN	NIACIN	VITAMIN C
	%	%	%	%
Meats	35	20	25	—
Cereals	10	—	10	—
Legumes	20	—	—	—
Leafy green vegetables	35	20	25	60
Vegetables, other	35	20	25	60
Tomatoes	—	—	—	15
Potatoes	40	20	25	60

[1] References: U.S. Department of the Army TM 8-501, Nutrition, p. 19, September, '49, and Pakistan Army data from Major M. Iqbal, P.A.S.C., GHQ Science Laboratory, Chuklala. Pakistan losses, especially of vitamins A and C, would be expected to exceed these in cases of prolonged cooking and the use of copper vessels.

operation, one or more members of the survey team was always present to record recipes, methods of preparation, cooking times, temperatures, amounts of water used, seasoning, etc., as well as the weights of all issue foods utilized by the cooks as a check on the inventory account.

The average food consumption per man per day was converted to nutrient consumption by use of tables of food composition applicable to these foods. The United States Department of Agriculture Handbooks No. 8 ('50) and No. 34 ('52) and FAO Bulletin ('54) were found most useful. In addition to these tables, values for foods not listed were obtained from the regional scientific literature. An estimate of the vitamin losses during cooking was calculated, based on the values given in table 3.

RESULTS AND DISCUSSION

The average nutrient intake data for all three branches of the Armed Forces are presented in table 4. Composition of the ration as consumed by the various units surveyed is given in table 5.

Caloric intakes agreed rather well with the estimated activity of the various units. Troops at Bahawalpur consumed significantly more than any other unit except for the "Boys" at Lahore who needed the extra amount to satisfy the increased requirement of growth and activity for boys between the ages of 15 and 17 years. A comparison of the three branches of the Armed Forces indicated essentially similar caloric consumption despite the greater ration issues to the Navy and Air Force. These differences were reflected in the greater edible food waste in the Navy and Air Force messes as shown in table 6.

Protein and fat consumption ranging around 100 gm each per man per day were satisfactory in all three branches of the service.

Calicum intakes averaged about 500 to 600 mg for all groups except the "Boys" who received double this amount as a result of milk allowance. This amount of calcium intake is considered in the "acceptable" range to meet the calcium requirement for men in this age group (ICNND, '57).

The vitamin A consumption in Lahore and Comilla Army units was lower than desirable. The Navy and Air Force ration supplements raised the vitamin A to very acceptable levels of 4000 to 5000 International Units in each case.

Thiamine and niacin intakes were satisfactory in all instances, but riboflavin intake was low in the rice-eating groups and borderline in most of the other units.

Vitamin C intake levels were low in the Lahore and Muzaffarabad troops at the particular time of the surveys, but very acceptable in Bahawalpur and in the Navy and Air Force due to oranges (Malta) and guava issues (table 5).

All of the salt used by the Armed Forces was mined in the northern area of West Pakistan. Average daily consumption

of salt, in addition to that naturally contained in foods, was rather low in the Air Force (5 gm) compared to the other services. Consumption was somewhat higher in the warmer regions, and it was noted that the Navy vegetarians consumed the most (27 gm per man per day).

Edible food wastage (table 6) was found to be very low (4.8%) in all Army units except Bahawalpur (7.6%); however, this was still below the 10% levels found in the Navy and Air Force. In general, the lower figures in the Army reflect both greater skill of the cooks and economy necessitated by a smaller ration issue.

Kitchen preparation refuse (table 7) was quite variable in the different messes studied. The low value indicates little or no loss of edible raw food issues, and in contrast the higher values indicate considerable wastage or poor quality food supplied by the contractors. For example, potato peelings in the "Boys" mess at Lahore constituted only 5.9% refuse as contrasted to 34.4% in Muzaffarabad. Other vegetable losses varied in a similar manner according to the training and capabilities of cooks and mess personnel.

Chemical analyses of a few selected Pakistan dried raw foods and of spices commonly used are presented in tables 8 and 9.

SUMMARY

In general, the dietary intake of the Pakistan Armed Forces was found to be good. The ration supplies sufficient protein, iron, thiamine, and niacin. Calorie intake was consistent with the trim, well conditioned appearance of the troops and agreed rather well with their estimated activity levels. The dietary intake of riboflavin of the rice-eating troops in East Pakistan was slightly lower than that of the wheat-eating troops in the same area. During the time of the nutrition surveys some of the units were receiving suboptimal amounts of vitamin C and vitamin A or carotene due to variation in distribution and seasonal availability of fresh fruits and vegetables. Edible food wastage was found to be very low (about 4%) in most Army units and somewhat greater (about 10%) in the Navy and Air Force.

TABLE 4

Pakistan: Average nutrient intake (per man per day)
Corrected for conservative vitamin losses in cooking [1]

UNIT	AVERAGE NO. MEN IN MESS	CALORIES	PROTEIN	FAT	CALCIUM	IRON	VIT. A	THIAMINE	RIBOFLAVIN	NIACIN	VIT. C	SALT
			gm	*gm*	*mg*	*mg*	*I.U.*	*mg*	*mg*	*mg*	*mg*	*gm*
I. Army												
Lahore, Med.[2]	178	3278	85	93	543	18	659	2.78	1.26	26	16	10.4
Lahore, Inf.[2]	85	3466	87	117	626	24	763	3.80	1.20	27	39	9.6
Quetta [2]	50	3208	78	90	604	21	5294	2.80	1.17	26	47	12.0
Bahawalpur [2]	50	3911	94	153	634	24	2629	3.83	1.36	29	126	19.9
Muzaffarabad [2]	143	3358	86	89	604	23	2768	2.87	1.20	26	14	7.2
Comilla, E. Bengal [3]	73	3649	90	102	423	19	1744	2.39	0.99	22	50	16.0
Army average	97	3478	87	107	572	22	1904	3.08	1.20	26	49	12.5
Lahore boys	124	3718	109	111	1163	22	2753	3.50	2.25	29	50	11.6
II. Navy, PNS Jhelum												
Wheat-eaters	122	3451	99	102	558	21	4188	2.49	1.26	24	263	11.6
Rice-eaters	28	3675	91	99	483	17	4188	1.59	1.08	17	263	14.7
Vegetarian [2]	6	3989	99	138	1251	19	5304	3.00	1.96	21	340	24.3
Vegetarian [3]	10	4213	91	135	1176	15	5304	2.10	1.78	14	340	26.7
Navy average	166	3555	97	104	609	19	4298	2.34	1.28	22	270	13.5
III. Air Force												
Peshawar [2]	356	3300	89	98	490	21	5218	2.55	1.14	25	69	4.9

[1] See table 3.
[2] Wheat-eaters.
[3] Rice-eaters.

TABLE 5

Pakistan: Average daily food consumed [1]

(Grams per man per day)

FOOD	LAHORE MEDICAL CORPS	LAHORE INFANTRY	QUETTA	BAHAWALPUR	MUZAFFARABAD	COMILLA RICE DIET	LAHORE BOYS	KARACHI		NAVY VEGETARIANS [2]		PESHAWAR
								Wheat	Rice	Wheat	Rice	AIR FORCE
Cereal												
Atta (wholewheat meal)	493	540	507	564	466	336	607	226	14	226	14	311
Rice	82	35	25	27	64	288	12	—	427	—	427	87
Flour, wheat	—	—	—	—	—	—	—	269	105	269	105	104
Biscuit	—	—	—	—	38	—	—	—	—	—	—	—
Corn meal	—	—	—	—	—	—	—	—	—	—	—	2
Legume												
Dhal, "gram" [3]	—	—	—	—	—	—	—	25	25	25	25	38
Dhal, chana [3]	16	26	31	—	—	—	—	—	—	—	—	—
Dhal, mung	15	—	—	—	15	54	45	—	—	—	—	—
Dhal, masur	—	24	—	51	39	—	—	—	—	—	—	24
Lentils, dry	—	—	—	—	—	—	—	22	22	22	22	—
Gram, atta [3]	—	—	—	9	—	—	—	—	—	—	—	—
Meat												
Mutton, goat	117	55	54	95	34	43	52	125	125	—	—	119
Beef	—	24	30	—	43	—	23	—	—	—	—	—
Fish	—	—	—	—	—	80	29	—	—	—	—	16
Chicken	—	—	—	—	—	—	—	40	40	—	—	38
Eggs	—	—	—	—	—	—	—	32	32	—	—	2
Milk												
Milk, fresh	253	244	247	243	80	—	724	—	—	585	585	155
Milk, canned [4]	—	—	—	—	90	77	—	58	58	—	—	—
Sugar												
Sugar	59	48	57	52	54	34	58	61	61	61	61	71
Gur, sugar	16	—	15	9	30	—	—	—	—	—	—	—

Fat												
Ghee, milk	11	19	28	95	19	—	26	20	20	36	36	42
Ghee, veg.	55	54	65	31	44	83	43	52	52	71	71	29
Butter	—	—	—	—	—	—	—	1	1	1	1	3
Vegetables, leafy, green, and yellow												
Carrots	—	—	43	34	19	—	—	—	—	—	—	33
Peas, fresh	—	27	—	37	19	—	28	24	24	53	53	—
Cabbage	—	75	20	38	—	—	—	16	16	212	212	45
Spinach	—	—	—	—	—	—	29	5	5	12	12	13
Coriander, green	1	—	—	—	—	—	—	—	—	—	—	1
Karela, green	—	—	—	—	—	52	—	—	—	—	—	—
Vegetables, other												
Potato	51	113	119	104	48	129	127	99	99	199	199	92
Onion, dry	39	—	43	—	—	46	—	53	53	130	130	—
Onion, green	15	69	—	64	35	—	81	—	—	—	—	33
Turnip	—	45	15	42	—	—	26	24	24	221	221	—
Cauliflower	52	—	37	—	—	—	29	—	—	—	—	—
Veg. marrow	—	—	—	—	—	28	—	—	—	—	—	—
Eggplant	—	—	—	—	—	31	—	—	—	—	—	—
Fruit												
Tomato, fresh	—	—	—	—	—	34	—	6	6	27	27	11
Tomato, canned	—	—	—	—	18	—	—	—	—	—	—	—
Orange, Malta	17	17	57	—	9	—	42	511	511	511	511	132
Guava	—	—	—	40	—	—	—	—	—	—	—	—
Papaya	—	—	—	—	—	—	—	170	170	170	170	—
Banana	—	—	—	—	—	83	—	—	—	—	—	—
Tamarind	—	—	—	—	—	—	—	—	—	—	—	1
Raisins	—	—	—	—	1	—	—	—	—	—	—	—
Miscellaneous												
Garlic	2	7	—	7	—	—	1	5	5	1	1	3
Chilies, dry	3	3	3	8	—	6	2	4	4	1	1	4
Spices mix	4	4	—	—	4	4	3	5	5	—	—	5
Tea, dry	5	5	6	7	5	6	7	6	6	7	7	6
Salt	10	9	12	20	7	16	12	15	15	24	27	5

[1] Includes food purchased in canteens, bazaars, etc., which usually included tea with milk and sugar or Gur and amounted to 50 to 100 Cal. per man per day.
[2] Vegetarians include vegetarian-wheat and vegetarian-rice diets.
[3] Local term for dried beans is dhal and for chickpeas, gram.
[4] Milk, canned, should be multiplied by 2.25 to convert to fresh basis.

TABLE 7

Pakistan: Kitchen preparation refuse

LOCATION	MEAT	FISH	POTATO	ONION [1]	TURNIP	CARROT	PEAS	CABBAGE	CAULIFLOWER	SPINACH	FRUIT [2]
	%	%	%	%	%	%	%	%	%	%	%
I. Army											
Lahore Med.[3]	22.0	—	26.3	24.8	—	—	—	—	—	—	—
Lahore Inf.[3]	33.6	—	26.0	34.4	28.6	—	44.1	18.8	—	—	—
Quetta [3]	21.0	—	16.8	18.0	15.4	19.1	—	22.2	18.1	—	33.4
Bahawalpur [3]	19.7	—	18.6	35.0	39.6	8.8	65.2	16.4	—	—	4.0
Muzaffarabad [3]	27.6	—	34.4	68.4	—	31.7	50.5	—	—	—	—
Comilla, E. Bengal [4]	—	—	—	—	—	—	—	—	—	—	Estim.
Army average	22.6	—	22.3	35.6	27.9	19.9	53.3	19.1	18.1	—	—
Lahore Army Boys	23.1	13.4	5.9	35.1	24.7	—	61.4	—	19.8	28.8	30.2
II. Navy											
PNS Jhelum	19.9	—	18.9	21.0	25.7	—	41.6	10.4	—	11.6	13.3
III. Air Force											
Peshawar [3]	21.9	37.6	27.1	34.0	—	19.5	—	20.4	—	17.5	42.7

[1] Larger per cent refuse with winter loose-type onion.
[2] Varies from 4% for guava to 42.7% for tamarind.
[3] Wheat-eaters.
[4] Rice-eaters.

TABLE 6

Pakistan: Edible food waste (grams per man per day)

LOCATION	ATTA	RICE	SUGAR	MILK	GHEE	MEAT	DHAL	MIXED VEGETABLES	EDIBLE WASTE TOTAL	EDIBLE FOOD TOTAL	EDIBLE WASTE
											%
I. Army											
Lahore Med.[1]	7.3	1.4	1.8	8.6	2.7	10.0	1.4	24.0	57.4	1444	3.9
Lahore Inf.[1]	10.0	0.9	0.9	2.7	1.4	10.0	3.2	20.9	53.1	1317	4.0
Quetta [1]	14.1	0.9	1.4	5.0	2.3	14.5	1.4	21.8	61.4	1262	4.9
Bahawalpur [1]	41.4	1.8	4.5	21.0	6.4	4.5	7.8	24.5	114.0	1476	7.6
Muzaffarabad [1]	10.9	—	1.8	3.6	0.5	5.9	1.8	5.9	30.4	999	3.0
Comilla, E. Bengal	—	—	—	—	—	—	—	—	Estim.	Estim.	3.9
Army average	17.3	1.4	1.8	8.2	2.7	8.6	3.2	19.5	62.6	1298	4.8
Lahore Army Boys	11.8	—	1.4	8.2	2.7	9.1	4.5	27.7	65.5	1843	3.5
II. Navy											
PNS Jhelum	51.7	17.8	3.2	3.2	3.2	13.6	6.8	45.4	145.0	1412	10.3
III. Air force											
Peshawar [1]	43.1	13.6	2.7	4.5	4.1	22.2	13.6	26.8	131.0	1320	9.9

[1] Wheat-eaters.

TABLE 8

Pakistan: Analysis of dried raw foods[1]

NAME	PROTEIN	FAT	MOISTURE	ASH	CARBOHYDRATE	CALCIUM	THIAMINE	RIBOFLAVIN
	%	%	%	%	%	*mg/100 gm*	*mg/100 gm*	*mg/100 gm*
Italian millet	10.97	2.63	5.63	2.28	78.49	30	0.35	0.31
Dhal, mung	22.27	0.37	5.85	3.86	67.65	109	0.78	0.25
Dhal, masur split	26.19	0.34	5.26	2.22	65.99	61	0.35	0.53
Gram, split	15.73	1.17	5.69	3.19	74.22	80	0.51	0.29
Gram, whole	25.91	4.04	5.09	4.55	60.41	—	—	—
White gram	22.95	2.30	6.98	3.68	64.09	—	—	—
Ginger	10.20	1.93	7.12	13.65	67.10	—	—	—
Green gram	24.14	0.53	6.30	3.71	65.32	176	—	—
Dried chilies (peppers)	[2]	14.50	2.29	7.83	—	—	—	—
Moth (moth bean)	22.68	0.58	3.24	4.98	68.52	311	0.44	—
Bullrush millet	11.39	3.59	2.58	7.62	74.82	214	0.56	0.26
Dhal urd split	21.80	0.04	3.53	3.86	70.77	153	0.62	0.21
Cardamon	22.24	5.21	—	—	72.55	—	—	—
Arum (taro)	31.90	0.16	64.85	2.82	0.27	99	0.09	0.32
Imlok	40.42	1.00	0.37	2.59	55.62	253	—	—
Tamarind	11.27	0.43	2.31	10.62	75.37	—	—	—
Atta	11.58	0.93	0.36	2.32	84.81	45	0.70	0.17
Black gram	[2]	0.37	6.24	3.70	—	—	—	—
Betel nut	[2]	—	0.42	1.66	—	108	0.04	—
French bean	[2]	3.50	—	—	—	—	—	—

[1] Analyses by the U. S. Army Medical Research and Nutrition Laboratory, Denver.
[2] Not enough sample for analysis.

TABLE 9

Pakistan: Nutritional evaluation of spices[1]
(Per 100 gm)

SPICES		CALORIES	PROTEIN	CARBOHYDRATE	FAT	CALCIUM	IRON	VIT. A
			gm	*gm*	*gm*	*mg*	*mg*	*I.U.*
Cumin		356	18.7	36.6	15.0	108	31.0	870
Coriander seed		288	14.1	21.6	16.1	63	17.9	1570
Turmeric		349	6.3	69.4	5.1	15	18.6	50
Composition in usual proportion of all three								
Cumin	20%	71	3.6	7.2	3.0	21.6	6.2	174
Coriander seed	40%	115	5.6	8.6	6.4	25.2	7.2	628
Turmeric	40%	139	2.6	27.7	2.0	6.0	7.2	20
Total	100%	325	11.8	43.5	11.4	11.4	52.8	822

[1] Pakistan Army Data from Major M. Iqbal, P.A.S.C., GHQ Science Laboratory, Chuklala. The nutritional value of the mixed spices has been based on their individual values in the above proportion. The various spices used in dishes varied from unit to unit in number as well as quantity of each spice.

V.

PHYSICAL EXAMINATIONS

The Armed Forces of Pakistan are composed of men whose features, languages, and customs denote their varied racial heritage, geographic origins, and cultural backgrounds. Pakistani soldiers, sailors, and airmen are in addition the products of three other general influences; first, the influence of Islam; second, the influence of British control of the Indian subcontinent for the century and a half preceding 1947; third, the climate which, while not uniform throughout the nation, may be quite extreme in any given area. In the clinical appraisal of nutriture or medical status, these many factors are apparent. An appreciation of their existence is an essential complement to scientific evaluation if reasonable interpretations of the findings are to be made.

PROCEDURES

The selection of stations and the types of personnel studied at each are described in Part I. During the entire survey physical examinations were carried out on 2,019 enlisted and noncommissioned personnel of the Pakistan Armed Forces distributed among 22 units at 9 geographical locations in East and West Pakistan. Each physical examination was performed in its entirety by a single physician. The American physician reviewed the examinations carried out by Pakistani physicians to maintain uniformity and to aid in training Pakistani personnel in the techniques of the examination.

Historical data and vital statistics were recorded for each man by bilingual orderlies after direct questioning and reference to the individual's pay book. Nude weights and shoeless heights were taken twice by orderlies for each examinee and any discrepancies between duplicate measures reconciled be-

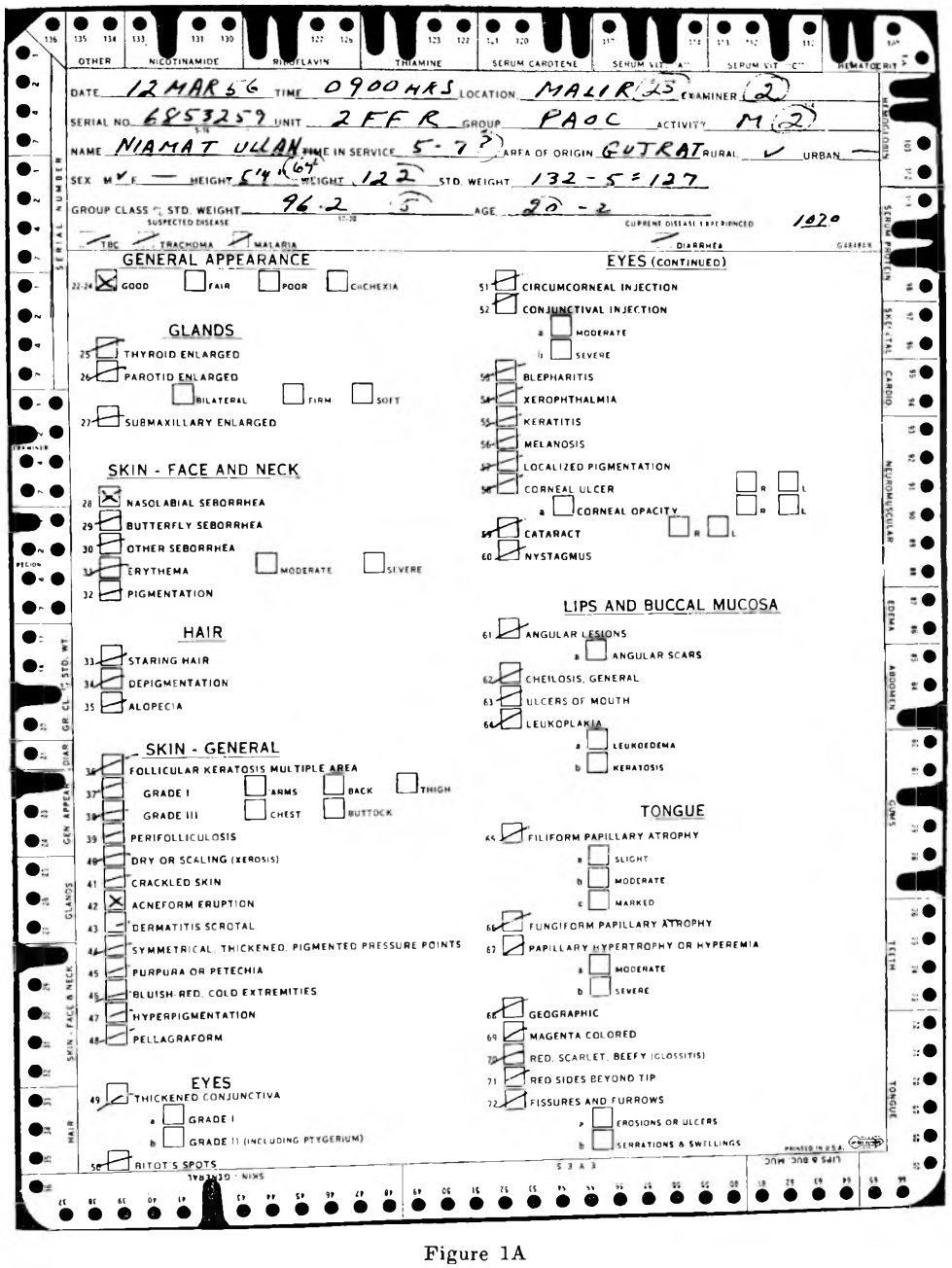

Figure 1A

Fig. 1 Card used for recording of vital statistics, physical signs, and biochemical data marked and punched for a fictitious but typical Pakistani service man. A, front of card; B, back of card.

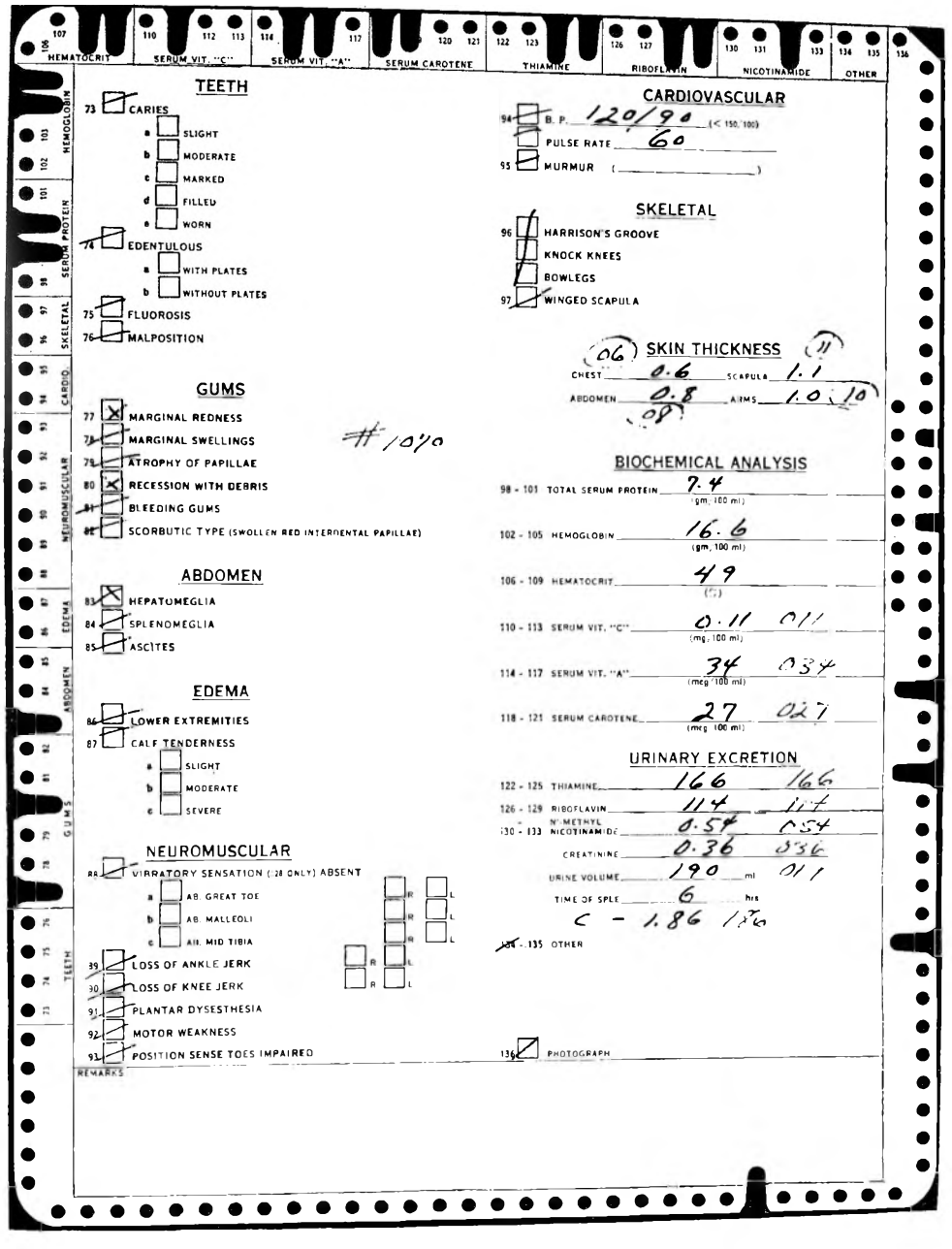
HEMATOCRIT
SERUM VIT. "C"
SERUM VIT. "A"
SERUM CAROTENE
THIAMINE
RIBOFLAVIN
NICOTINAMIDE
OTHER
TEETH
73 CARIES
a SLIGHT
b MODERATE
c MARKED
d FILLED
e WORN
74 EDENTULOUS
a WITH PLATES
b WITHOUT PLATES
75 FLUOROSIS
76 MALPOSITION
GUMS
77 MARGINAL REDNESS
78 MARGINAL SWELLINGS
79 ATROPHY OF PAPILLAE
80 RECESSION WITH DEBRIS
81 BLEEDING GUMS
82 SCORBUTIC TYPE (SWOLLEN RED INTERDENTAL PAPILLAE)
#10%
ABDOMEN
83 HEPATOMEGLIA
84 SPLENOMEGLIA
85 ASCITES
EDEMA
86 LOWER EXTREMITIES
87 CALF TENDERNESS
a SLIGHT
b MODERATE
c SEVERE
NEUROMUSCULAR
88 VIBRATORY SENSATION (-128 ONLY) ABSENT
a AB. GREAT TOE
b AB. MALLEOLI
c AB. MID TIBIA
89 LOSS OF ANKLE JERK
90 LOSS OF KNEE JERK
91 PLANTAR DYSESTHESIA
92 MOTOR WEAKNESS
93 POSITION SENSE TOES IMPAIRED
REMARKS
CARDIOVASCULAR
94 B. P. 120/90 (< 150, 100)
PULSE RATE 60
95 MURMUR (_____)
SKELETAL
96 HARRISON'S GROOVE
KNOCK KNEES
BOWLEGS
97 WINGED SCAPULA
(06) SKIN THICKNESS (11)
CHEST 0.6 SCAPULA 1.1
ABDOMEN 0.8 ARMS 1.0, 10
08
BIOCHEMICAL ANALYSIS
98 - 101 TOTAL SERUM PROTEIN 7.4 (gm, 100 ml)
102 - 105 HEMOGLOBIN 16.6 (gm, 100 ml)
106 - 109 HEMATOCRIT 49 (%)
110 - 113 SERUM VIT. "C" 0.11 011 (mg, 100 ml)
114 - 117 SERUM VIT. "A" 34 034 (mcg, 100 ml)
118 - 121 SERUM CAROTENE 27 027 (mcg, 100 ml)
URINARY EXCRETION
122 - 125 THIAMINE 166 166
126 - 129 RIBOFLAVIN 114 114
130 - 133 N' METHYL NICOTINAMIDE 0.54 054
CREATININE 0.36 036
URINE VOLUME 190 ml 011
TIME OF SPLE 6 hrs
C - 1.86 176
134 - 135 OTHER
136 PHOTOGRAPH

Figure 1B

fore final recording. "Standard weights" for height and age (ICNND, '57) were determined by referring to the American "standard" ("standard" refers to U.S. averages) and the per cent of "standard weight" computed by a physician.

Classification of general appearance was based on the subjective impression of the examiner. Examinations of the glands, face, neck, hair, skin, eyes, lips, and buccal mucosa, tongue, teeth, gums, and skeletal system were conducted in the best available light with the subject standing. Determination of pulse and blood pressure in the right arm, auscultation of the chest, palpation of the abdomen, inspection for edema, and the neurological examination were carried out with the subject supine on a bed or examining table. Skin thickness was measured at 4 sites by a single examiner and recorded to the nearest millimeter.

Findings were recorded by the examiners directly on McBee punch cards, a sample of which appears in figure 1. In general the practice in recording physical signs and lesions possibly related to nutritional deficiencies was to record as positive any definite finding which conformed to the descriptions provided in the "ICNND Manual for Nutrition Surveys" without regard to severity and irrespective of whether the examining physician believed the subject to be suffering from a nutritional deficiency. Ultimately the data from the McBee punch cards were transferred to I.B.M. punch cards. Coefficients of correlations of physical signs with biochemical findings, with dietary intakes, with activity, length of time in service, and area of origin were derived from the original data where indicated.

RESULTS

The age distribution of the 2,017 Pakistani soldiers, naval personnel, and airmen (to be referred to hereafter collectively as troops) is shown by the histogram in figure 2. The mean age was 25.6 years; the median age was 25.0 years.

The percentage of troops in each location, in each length of service group, and in each activity level falling in each per

cent of "standard weight" category appear in table 10. Almost 80% of all troops examined fell within the 80 to 99% category, less than 8% below the 80% category, and 13% above the 99% category.

The percentage of troops in any given location demonstrating any particular clinical finding appears in table 11. From a clinical standpoint, the nutrition and health of the men were generally good. The overwhelming majority of troops

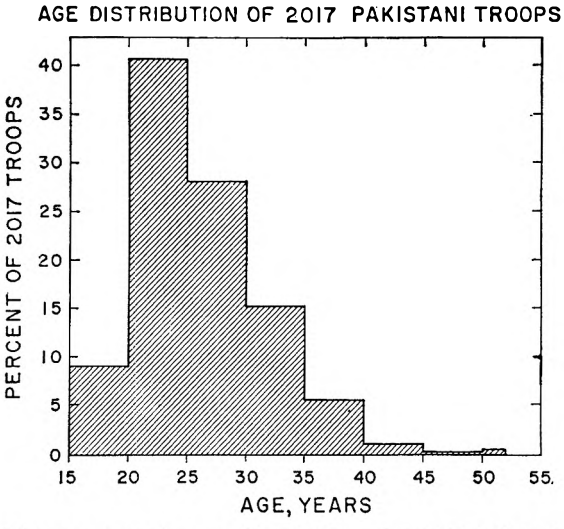

Fig. 2 Histogram of the age distribution of 2,017 Pakistani troops.

(98.1%) were categorized as having a good general appearance. There were no examples of extreme malnutrition. Nasolabial seborrhea, follicular keratosis, acneform eruption, papillary hypertrophy, caries, gum recession and debris, and marginal swellings were the most frequent findings. A skin infection, tinea versicolor, caused by the organism, *Malassezia furfur,* was the most common finding of general medical interest noted under remarks.

Nasolabial seborrhea was observed in 18.1% of the troops. The incidence of this condition was roughly the same throughout the various units examined. Follicular keratosis, generally

TABLE 10

Per cent of "standard weight"[1]

"STANDARD WEIGHT"	< 60%	60–69%	70–79%	80–89%	90–99%	100–109%	110–119%	120–129%	130+%	NO. EXAM.
				Per cent of troops						
				By location						
Bahawalpur	0	0	6.5	36.5	44.8	10.4	1.7	0	0	230
Comilla, E. Bengal	0	0	6.0	56.0	33.0	5.0	0	0	0	100
Comilla, Frontier Force	0	1.0	2.0	27.0	50.0	18.0	2.0	0	0	100
Dacca	0	0	0	52.0	34.0	12.0	2.0	0	0	50
Hyderabad, S.	0	0	10.0	43.0	41.0	6.0	0	0	0	100
Karachi, Navy	0	0.6	10.4	33.5	38.2	14.5	1.7	1.2	0	173
Karachi, Air Force	0	0	14.0	37.0	35.0	10.0	3.0	1.0	0	100
Karachi, Artillery	0	1.0	12.9	31.7	39.6	12.9	2.0	0	0	101
Lahore Med. Corps	0	0	6.2	35.4	48.3	9.0	1.1	0	0	178
Lahore, Boys	0	0	3.6	29.8	47.6	19.0	0	0	0	84
Lahore, Infantry[2]	0	0.5	8.0	44.8	37.3	8.9	0.5	0	0	201
Muzaffarabad	0	0	2.0	32.0	48.0	16.5	1.0	0.5	0	200
Peshawar Air Force	0	0.5	11.5	46.0	32.0	8.0	2.0	0	0	200
Quetta	0	0	9.0	37.0	40.5	12.5	1.0	0	0	200
Totals	0	0.2	7.6	38.2	41.0	11.5	1.3	0.2	0	2017
				By time in service						
Under 7 years service	0	0.1	5.3	35.0	45.6	12.9	0.9	0.2	0	1219
7 or more years	0	0.5	11.2	42.9	33.9	9.4	1.9	0.3	0	788
Totals	0	0.2	7.6	38.1	41.0	11.5	1.3	0.2	0	2007
				By activity						
Sedentary	0	0.5	12.9	33.0	36.6	13.9	2.1	1.0	0	194
Moderate	0	0.3	9.1	35.9	41.0	11.7	1.9	0.1	0	746
Active	0	0.2	5.4	40.1	42.5	11.0	0.8	0.1	0	1048
Totals	0	0.3	8.5	37.8	41.3	11.5	1.3	0.2	0	1988

[1] Based on U.S. Age-Height-Weight Averages.

[2] Of 40 Lahore Frontier Troops examined 10% were in the 70 to 79% group, 62.5% in the 80 to 89% group, and 27.5% in the 90 to 99% group of "standard weight."

quite mild, was observed in 28.9% of all troops examined with the highest incidence occurring among the "boys company" in Lahore and the Air Force in Peshawar.

Acneform eruption was observed in 67.4% of all troop personnel. Papillary hypertrophy of the tongue was noted in 26.3% of the total with the highest incidence occurring in East Pakistan and Muzaffarabad. Dental caries was noted in 30.8%

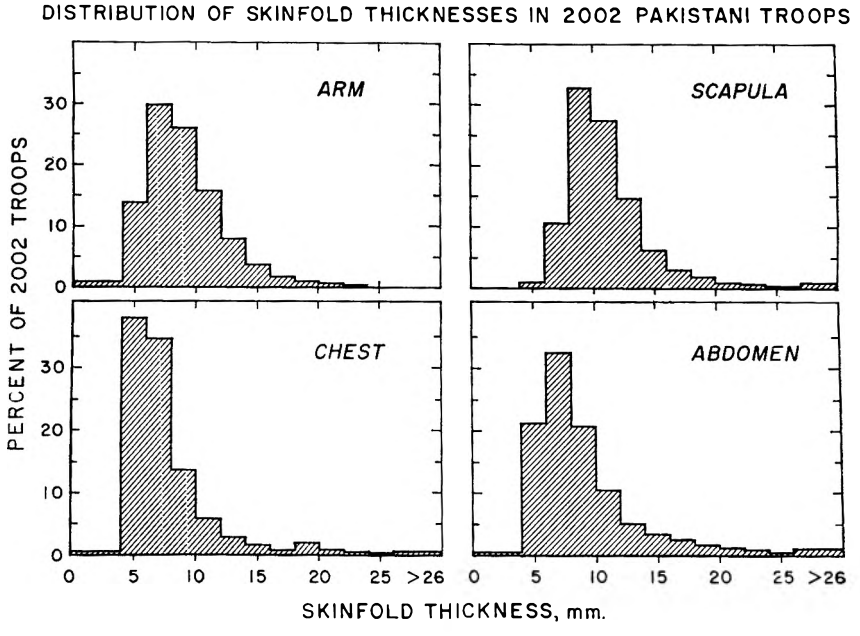

Fig. 3 Histograms giving distribution of skinfold thicknesses at the 4 sites where measurements were taken in 2,002 Pakistani troops.

and gum recession with debris in 65.3% of the total. Marginal swellings of the gums occurred in 26.9% of the men examined. Hepatomegalia was observed in 5.1% of the total, but in 12.5% of those examined in the Peshawar area. Thyroid enlargement was noted in 6.8% of the total but in 31.0% of the men examined in Muzaffarabad.

Histograms giving the distribution of skinfold thicknesses at the 4 sites measured are presented in figure 3. Statistically significant correlations were found between the skinfold thick-

TABLE 11

Summary of physical findings by location

LOCATION	BAHAWALPUR [1]	COMILLA (RICE DIET)	COMILLA (WHEAT DIET)	DACCA	HYDERABAD	KARACHI NAVY
NUMBER EXAMINED	231	100	100	50	100	173
	%	%	%	%	%	%
Appearance						
Good	97.3	100.0	99.0	100.0	98.0	97.7
Fair	2.2	0	1.0	0	2.0	2.3
Poor	0.4	0	0	0	0	0
Cachexic	0	0	0	0	0	0
Skin						
Nasolabial sebhorrhea	11.3	27.0	24.0	10.0	12.0	16.8
Follicular keratosis	23.8	8.0	2.0	4.0	20.0	16.2
Perifolliculosis	0	0	1.0	0	0	1.2
Acneform eruption	69.3	87.0	80.0	88.0	62.0	60.7
Bluish cold extremities	0	0	0	0	0	0
Xerosis	16.5	1.0	0	0	4.0	2.3
Eyes						
Thickened conjunctivae	0	5.0	0	2.0	0	0.6
Conjunctival injection	6.5	7.0	10.0	24.0	3.0	4.6
Blepharitis	0.9	1.0	0	2.0	1.0	0.6
Mouth						
Angular lesions	0.9	1.0	0	0	0	0
Angular scars	0	2.0	0	0	0	0
Angular scars and lesions	0	1.0	2.0	0	0	0
Cheilosis	0	1.0	0	0	0	0
Tongue						
Filiform atrophy (Slight excluded)	0.9	1.0	5.0	4.0	0	0
Fungiform papillary atrophy	0	1.0	0	0	0	0
Papillary hypertrophy	22.9	47.0	61.0	58.0	25.0	24.9
Geographic tongue	2.2	7.0	5.0	6.0	0	1.2
Fissures and furrows	0	1.0	0	0	0	0
Teeth						
Caries	41.1	13.0	28.0	16.0	37.0	38.7
Worn teeth	19.5	7.0	6.0	4.0	9.0	13.3
Fluorosis	13.9	3.0	24.0	6.0	7.0	14.5
Gums						
Recession	73.6	75.0	84.0	76.0	63.0	59.0
Bleeding	8.7	1.0	3.0	0	9.0	4.6
"Scorbutic type"	0	0	0	0	0	0
Marginal redness	6.5	3.0	10.0	2.0	4.0	7.5
Marginal swelling	26.0	31.0	42.0	42.0	39.0	24.9
Atrophy of papillae	9.1	5.0	8.0	0	8.0	4.6
Other						
Hepatomegalia	4.3	7.0	6.0	0	4.0	2.3
Splenomegalia	2.2	0	3.0	2.0	3.0	0
Edema of legs	0	0	0	0	0	0
Thyroid enlargement	1.3	5.0	7.0	12.0	4.0	6.9
Loss of ankle jerks	0	0	0	2.0	0	0

[1] Several similar units grouped together.

TABLE 11 (Continued)

Summary of physical findings by location

KARACHI AIR FORCE	KARACHI ARTILLERY	LAHORE MED. CORPS	LAHORE BOYS	LAHORE INF.[1]	MUZAF-FARABAD[1]	PESHAWAR	QUETTA[1]	TOTAL
100	101	178	84	201	200	200	201	2019
%	%	%	%	%	%	%	%	%
99.0	94.0	97.8	96.4	97.0	99.0	98.5	98.0	98.1
1.0	6.0	2.2	3.6	1.5	1.0	1.5	1.0	1.8
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1.0	0.1
19.0	16.8	1.7	0	26.9	16.0	24.0	24.8	18.1
23.0	14.0	20.8	57.1	23.9	36.5	61.5	51.2	28.9
0	0	0	0	0	1.5	0	0.5	0.3
63.0	56.4	52.2	76.2	69.7	62.0	64.0	76.1	67.4
0	0	0	0	0	0.5	0	0	0
5.0	2.0	6.2	20.2	3.5	10.5	10.5	12.9	7.8
0	0	0	0	0	4.0	0	0	0.7
8.0	5.0	3.9	1.2	7.5	7.0	1.0	7.5	6.1
0	1.0	0.6	0	0	0.5	0	0	0.4
0	0	1.7	3.6	0.5	0	0	1.5	0.6
0	0	0	0	0.5	0	0	0	0.1
0	0	0	0	0	1.0	0	0	0.2
0	0	0	0	0	1.5	0	0	0.2
0	1.0	0	0	0.5	0.5	0	0	0.6
0	0	0	0	0.5	0	1.0	0	0.2
25.0	20.8	2.8	4.8	23.9	49.0	15.5	20.4	26.3
1.0	0	0.6	0	2.5	2.0	2.0	2.5	2.1
0	1.0	0.6	0	0	1.0	0.5	1.5	0.4
20.0	29.7	36.0	27.4	25.9	38.0	16.5	37.8	30.8
5.0	5.9	11.2	0	12.4	11.0	0.5	12.4	9.7
5.0	3.0	1.1	1.2	10.0	3.0	5.5	5.5	7.5
42.0	64.4	58.4	56.0	68.2	58.0	57.5	75.6	65.3
2.0	3.0	14.6	10.7	5.0	1.5	4.0	9.0	5.9
0	0	0	0	0	0	0	0	0
2.0	8.9	1.7	4.8	10.0	5.5	3.5	14.4	6.5
15.0	29.7	14.0	14.3	34.8	32.0	8.5	36.8	26.9
3.0	2.0	0	0	12.9	5.0	4.0	11.4	6.0
5.0	6.9	3.4	3.6	4.5	1.0	12.5	7.0	5.1
3.0	7.9	1.1	2.4	2.0	3.0	2.0	5.0	2.3
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
8.0	5.9	0	0	5.5	31.0	1.5	5.0	6.8

nesses and general appearances and skinfold thicknesses and per cent of "standard weights."

Neither length of time in service, degree of activity, or area of origin influenced the clinical findings in any consistent fashion.

DISCUSSION

Clinical signs of improper nutrition are the reflection of long standing dietary habits. Inspection of the incidence of such physical signs in the Pakistan Armed Forces suggests that traditional dietary deficiency patterns are either totally absent or present in minimal degree.

The age distribution in Pakistani troops (high percentage of men in the 25 to 35 year bracket) reflects the fact that the Armed Forces are composed of career personnel recruited on a volunteer basis. Aside from the higher incidence of dental and gum disease among older personnel, age *per se* was not a factor correlated with nutriture or general health. Certain factors tended to limit the accuracy of the stated ages. Since a military career is a desirable way of life, age limits on recruitment are rigidly enforced and retirement is compulsory after 15 years service, certain recruits tend to underestimate their true age on entering the service. Absence of birth records and local variations in the custom of computing age also contribute to the lack of absolute accuracy in the data.

The per cent "standard weight" data recorded in table 10 indicate that the distribution by the American "standard" is skewed to the left, i.e., that the Pakistani troops do not on the average weigh as much for given age and height as did American males prior to World War I. In consideration of the factors mentioned in the introduction, a comparison even with pre-World War I Americans is not entirely fair. In figure 4, therefore, is presented a comparison of the Pakistani "standard weight" distribution curve with curves from troops in the Philippines, Iran, Libya, Korea, and Turkey. The histogram characteristic of Pakistani troops is skewed slightly to the left of the histogram for Iranian and Libyan troops and

considerably to the left of the histogram for Korean and Turkish troops, but slightly to the right of the histogram for Philippine troops. It seems reasonable to assume, therefore, that Pakistani troops in general are somewhat underweight when compared to Americans prior to World War I and to the present day troops of 4 other Near, Middle, and Far Eastern nations, but approximately the same weight as troops of the Philippines.

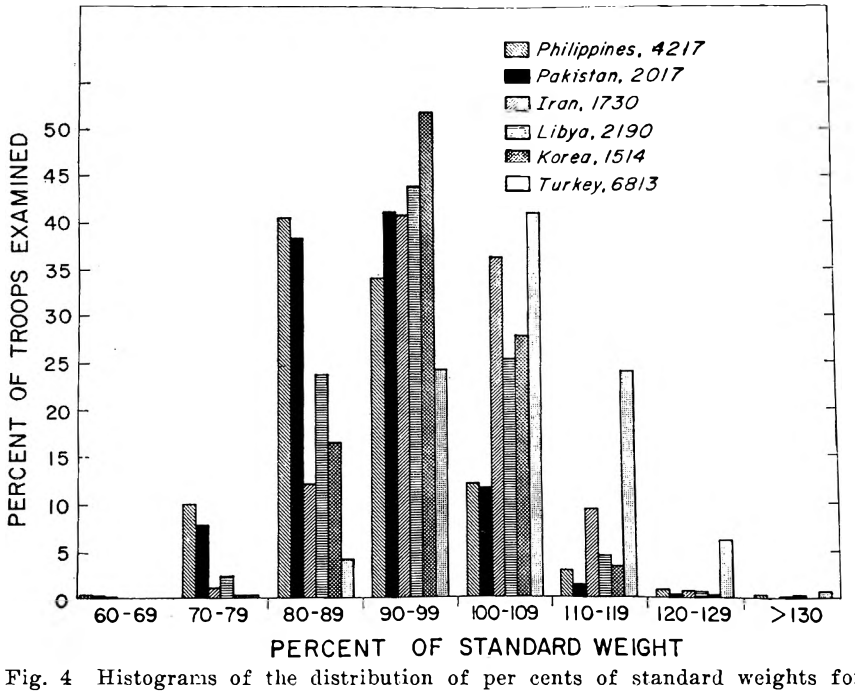

Fig. 4 Histograms of the distribution of per cents of standard weights for Philippine, Pakistani, Iranian, Libyan, Korean, and Turkish troops.

No specific etiology can be attributed to the relatively high incidence of nasolabial seborrhea. Faulty personal hygiene and climatic factors as well as riboflavin deficiencies must be considered. The failure to observe a correlation between the dietary riboflavin or the urinary excretion of riboflavin and the incidence of nasolabial seborrhea suggests either a non-nutritional origin of the condition or that the condition re-

flects nutritional deficiencies suffered months to years in the past.

The high incidence of follicular keratosis in troops at Peshawar, Quetta, Muzaffarabad, and among the "boys company" in Lahore, as contrasted to East Pakistan, again suggests that the lesion is aggravated by exposure to sun, wind, or dust rather than representing a deficiency of vitamin A or carotene alone. This is borne out also by failure to find a statistically significant correlation between plasma levels of vitamin A and the clinical finding of follicular hyperkeratosis. It is perhaps worth noting that the "boys company" in Lahore had been recruited more recently than any group examined and hence came closest to representing conditions prevalent in the civilian population.

The high incidence of acneform eruption almost certainly is based on the combination of inadequate cleansing of the skin and the age category into which most of the men fell.

A major problem among the Pakistani troops is the condition of the teeth and gums, examples of which appear in figure 5. Caries and recession with debris are conditions which eventually lead to inefficient mastication, loss of teeth, and hence to secondary nutritional problems. Inadequate oral hygiene is the most important factor contributing to the high incidence of these conditions. Preventive educational measures and prophylactic and corrective dentistry were quantitatively inadequate at all stations included in the survey.

Papillary hypertrophy of the tongue was observed in many men in association with a so-called fissured, furrowed, or scrotal tongue, an hereditary variant of the normal. No correlation with dietary riboflavin intake or urinary riboflavin excretion could be established.

Hepatomegalia was not recorded as such unless the liver edge extended 4 cm below the costal margin in the midclavicular line in normal inspiration. The cause of the 5.1% incidence is not known. However, infectious hepatitis is endemic in Pakistan as is intestinal parasitism. No purely nutritional etiology could be identified.

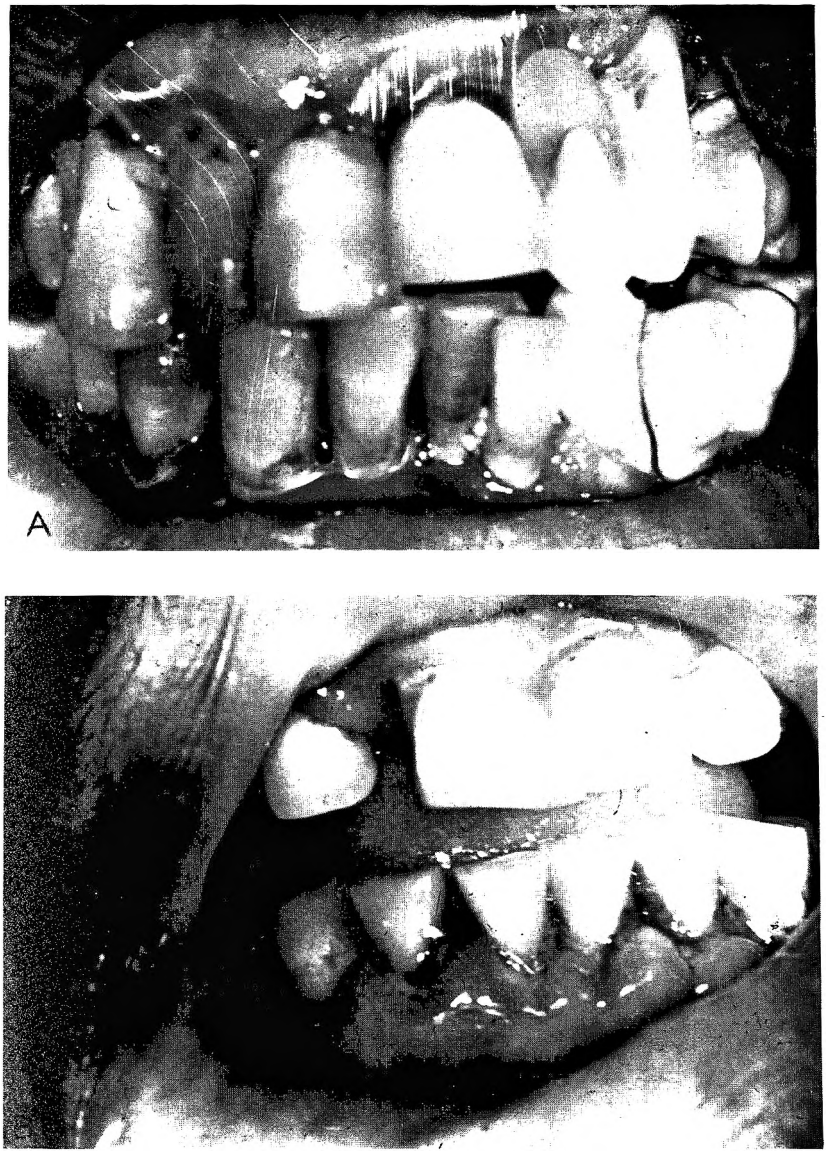

Fig. 5 A, teeth and gums of a Pakistani service man. Note gum recession with debris, papillary atrophy, misalignment and false tooth replacing 2nd left upper incisor. B, teeth and gums of a Pakistani service man. Note marginal swelling of the gums.

Fig. 6 A, thyroid enlargement in a Pakistani service man. B, stigmata of cretinism in an Azad Kashmir service man. Note body configuration, facial expression and features, hands and feet.

One of the most significant findings was the high incidence of thyroid enlargement (an example of which appears in figure 6) in the Muzaffarabad area. The Himalaya range has long been listed among the world's goiter belts (McCarrison, '17). The only salt available in the area is mined salt containing trace amounts of iodine, (1.5 p.p.m. or less of inorganic iodine with approximately 15 p.p.m. of iodine found in organic form). The conditions favorable to the development of endemic goiter are thus present. The discovery among the troops surveyed in Azad Kashmir of a cretin, (whose photograph appears in figure 6B), is further evidence suggesting the presence of endemic goiter. The desirability of a comprehensive study of the goiter problem including further surveys of the civilian as well as military populations and therapeutic trials in adolescents to ascertain the iodine sensitivity of these goiters is obvious.

The positive correlation between skinfold thickness and per cent of "standard weight" suggests that Pakistani troops in general have thinner skinfold thicknesses than their American counterparts. This suggestion is confirmed when the Pakistani data are compared with data reported from a study of 88 healthy American soldiers studied by Pascale, Grossman and Sloane ('55). The data from the two studies are recorded in table 12.

TABLE 12

Means and standard errors of the ages, weights, heights, and skinfold thicknesses of Pakistani and American troop personnel

	NO.	PAKISTANI	NO.	AMERICAN [1]
Age yr.	2017	25.61 ± 0.12	88	22.01 ± 0.21
Weight, kg	2019	58.61 ± 0.17	88	68.28 ± 0.12
Height, cm	2016	170.02 ± 0.12	88	172.43 ± 0.14
% "standard weight" of average man		89		101
Skinfolds, mm				
Arm	2002	8.53 ± 0.19	88	12.10 ± 0.49
Scapula	2002	10.55 ± 0.24	88	12.17 ± 0.53
Chest	2002	6.95 ± 0.16	88	10.39 ± 0.94
Abdomen	2002	8.32 ± 0.19	88	16.45 ± 0.65

[1] Pascale et al. ('55).

A group of 1,049 Chinese Nationalist soldiers, Crowley et al. ('56) have been compared to the same group of 88 American soldiers. The average age was 26.8 years (range 20 to 30 years); the average weight, 55.7 kg (range 40 to 78.5 kg); the average height, 164.5 cm (range 147 to 182 cm); the per cent "standard weight" of the average man, 89; the average skinfold thickness midpoint, back of arm, 4.2 mm (range 1 to 14 mm); and the average skinfold thickness at the tip of the scapula, 7.9 mm (range 1 to 21 mm). While the Nationalist Chinese soldiers were similar in age and identical in per cent "standard weight" to Pakistani troops, they were lighter in weight, shorter, and had thinner skinfolds as far as the two measurements made are concerned (Crowley et al., '56).

Skinfold thickness is inversely related to body density as reported by Pascale et al. ('56). In general, it is also directly related to adequacy of nutriture as indicated by the positive correlation between skinfold thicknesses and general appearances noted above. The pitfalls encountered in applying these generalizations to an individual serviceman are demonstrated in figure 7. The first soldier (7A) was one of the best physical specimens observed. He was of 93% "standard weight" and had skinfold thicknesses as noted in the legend which compared favorably with his American counterparts. The second soldier (7B) was among the poorest physical specimens observed. He was 70% of "standard weight" and had skinfold thicknesses which placed him in the 10th percentile by the American comparative standard. The third soldier (7C) was 98% of "standard weight" and by common agreement among all the examining physicians was the finest physical specimen examined. His skinfold thickness, however, fell in the 10th percentile along with the previously described man at the opposite extreme. Hence, in evaluating skinfold thickness data, the general appearance and the per cent of "standard weight" must be considered simultaneously.

During this survey, the physicians performing the clinical examinations agreed on the desirability and practicality of performing on each examinee as complete a physical examina-

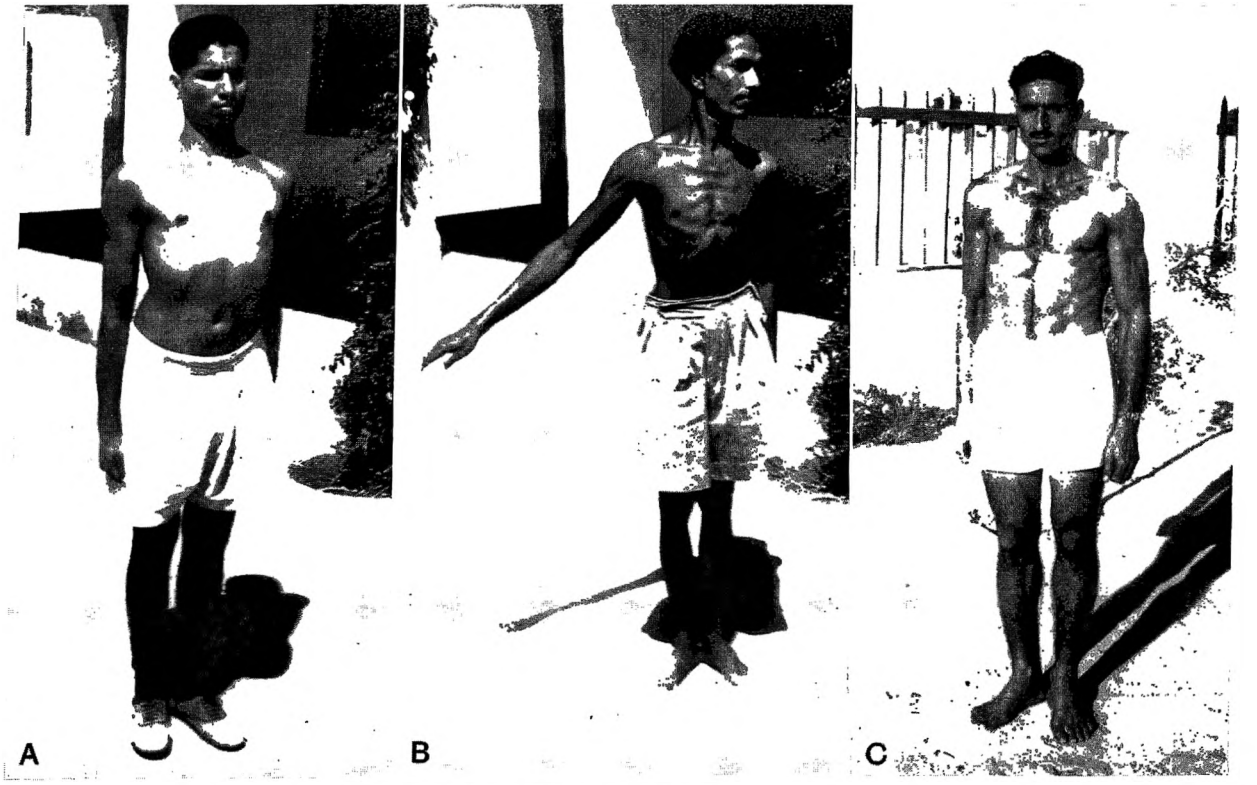

Fig. 7 A, Pakistani service man: age 20, height 168 cm, weight 57.4 kg; 93% "standard weight"; general appearance good. Skinfold thicknesses: arm 7 mm; scapula, 8 mm; abdomen, 9 mm; chest, 6 mm. B, Pakistani service man: age 27, height 165 cm, weight 43.6 kg. 70% of "standard weight"; general appearance, fair. Skinfold thicknesses: arm, 4 mm; scapula, 8 mm; abdomen, 4 mm; chest, 4 mm. C, Pakistani service man: age 33, height 183 cm, weight 78.2 kg; 98% of "standard weight"; general appearance, good. Skinfold thicknesses: arm, 4 mm; scapula, 8 mm; abdomen, 4 mm; chest, 4 mm.

tion as could be done in the approximately 5-minute interval allotted each man. An effort was made to uncover medical diseases of a nonnutritional as well as nutritional nature. By far the most common of these was tinea versicolor. This affliction is known the world over but occurred with a greater frequency among Pakistani troops than is found among American troops. Again, the lack of soap and water is unquestionably a factor in the spread of the disease. The possibility that it may be a nutritionally conditioned ailment cannot be ruled out.

The incidence of recognizable veneral disease among the Pakistani troops was remarkably low. Only two penile lesions were observed, both among Azad Kashmir troops. One aortic diastolic murmur was discovered in an asymptomatic, otherwise apparently healthy rifleman. The universal practices of circumcision and shaving of the pubic area completely eliminated phimosis and *Phthirus pubis* infestation.

Acute diarrheal disease, although a major cause of hospitalization, was not evident among examinees, probably because they were excused from duty when afflicted.

Trachoma in varying degrees of chronicity was diagnosable very frequently. However, almost all troops serving in hot, dry, and dusty climates had conjunctival injection, making the clinical diagnosis of trachoma difficult in borderline cases.

Hypertension was infrequent. Other cardiac conditions diagnosable at physical examination were rare.

Pakistani service men, in the opinion of the American clinician, appeared to be older than their stated age. The process of aging seemed to be especially accelerated in men over 30, as judged by American standards.

The average educational level of the Armed Forces varied with the branch of service. Because of the necessity of their having technical skills, naval personnel and airmen were better educated than soldiers. The Army was conducting an educational program designed to eliminate illiteracy among troops. In addition, progress in education throughout the nation as a whole, promises to improve the general educational level.

Numerous problems with a bearing on nutrition are not strictly nutritional in origin. Personal hygiene, preventive medicine, sanitation, public health measures, military medicine and surgery, and food processing and preparation are intimately involved in the nutrition of the Pakistan Armed Forces. The recognition of nutrition as a problem area by the Ministry of Defense is a long step toward the ultimate improvement of the general health as well as nutriture of the military establishment.

SUMMARY

As part of a nutrition survey of the Pakistan Armed Forces, physical examinations were performed on 2,019 soldiers, sailors, and airmen.

Serious nutritional deficiency states were not found. The highest incidences of lesions traditionally associated with nutritional deficiencies were the following: nasolabial seborrhea, follicular keratosis, acneform eruption, papillary hypertrophy, caries, gum recession with debris, and marginal gum swelling. None of these signs could be unequivocally related to nutritional deficiencies to the exclusion of the effects of personal hygiene and climate. Thyroid enlargement noted in one third of the Azad Kashmir Forces examined suggests the possibility of an iodine deficiency.

Improved education, preventive medicine, and public health measures are important in the progress of nutrition in the Pakistan Armed Forces from its present satisfactory to a more ideal level.

VI.

BIOCHEMICAL STUDIES

Biochemical data provide valuable quantitative evidences of nutrient intake level and assist in defining subclinical to borderline deficiencies. Samples of blood and urine were obtained from approximately one fourth of the total men examined clinically.

METHODS

The general procedures were those described in the ICNND Manual for Nutrition Surveys and by Consolazio et al. ('56). Fasting 6-hour urine specimens were collected from midnight to 6 A.M. Blood samples were taken in a fasting state before breakfast. Part of the blood was heparinized for the determination of hemoglobin and hematocrit by the copper sulfate specific gravity method of Phillips et al. ('50); Van Slyke, Hiller et al. ('50); Van Slyke, Phillips et al. ('50). Serum from the remainder of the blood was divided into two portions, one being stabilized with metaphosphoric acid for the determination of ascorbic acid and the other being reserved for serum protein, vitamin A, and carotene determinations.

Analyses performed on the urine included thiamine, riboflavin, and *N'*-methylnicotinamide; those performed on blood consisted of hemoglobin, hematocrit, total serum protein, ascorbic acid, vitamin A, and carotene. Ascorbic acid was determined photocolorimetrically by the decolorization of 2,6-dichlorophenolindophenol (Association of Vitamin Chemists, '51). Thiamine was determined by the thiochrome-fluorometric method as described by Perlzweig et al. ('45).

Whole blood specific gravity was the only determination performed in the field. The remainder of the blood and an aliquot of the urine were iced in an insulated container and shipped to the base laboratory by rail or plane. With one

exception, no more than 12 hours elapsed between the collection of samples and their arrival at the laboratory.

Samples were obtained from 12 different units, the number of men at each location varying from 20 to 60. In addition to the routine analyses listed above, blood samples from a group of naval personnel were analyzed for total lipid, cholesterol, phospholipid, total serum protein, and albumin, and globulin. These samples were packed in ice and flown to the U.S. Naval Medical Research Unit 3, Cairo, Egypt, and analyzed under the supervision of Dr. Martin Hanke.

RESULTS AND DISCUSSION

The data from 496 individuals are summarized in table 13. In addition to the average values for each constituent, the percentage of values falling below generally recognized normal minimum levels (Lowry, '52; Bessey, '54; Unglaub and Goldsmith, '54) is also given. With one or two exceptions, noted below, the average values are similar to those reported for normal adults in the United States and they substantiate

TABLE 13

Biochemical evaluations of Pakistan Armed Forces

ANALYSIS	AVERAGE VALUE	TROOPS WITH "LOW" VALUES	
		VALUES LESS THAN	% OF TROOPS
Serum protein, gm/100 ml	7.8	6.5	0.4
Hemoglobin, gm/100 ml	16.5	14.0	2.7
Hematocrit, %	49.0	42.0	2.9
Serum vitamin C, mg/100 ml	0.33	0.2	43.1 [1]
Serum vitamin A, μg/100 ml	43.0	20.0	0.6
Serum carotene, μg/100 ml	59.3	40.0	11.2
Urine thiamine, μg/6 hrs.	178.0	25.0	5.9 [2]
Urine riboflavin, μg/6 hrs.	91.0	30.0	2.5 [3]
Urine N'-methylnicotinamide, mg/6 hrs.	1.67	0.6	4.8

[1] The Muzaffarabad group had 98% in the low range. The Navy and Air Force units at Karachi had only 14.3% and 15.8% of the troops in the low range.

[2] The Comilla (E. Bengal), Karachi Air Force, and Peshawar Air Force groups had 13.8%, 15.0%, and 10% respectively of the troops in the low range.

[3] The Comilla (E. Bengal) group had 6.6% of the troops in the low range.

the observed generally satisfactory physical condition of the men. Total serum protein, hemoglobin, and hematocrit were normal in essentially all men examined.

Although the serum carotene levels were lower than those found in the United States in healthy adults, the adequate concentration of vitamin A in over 99% of the men indicates that this vitamin is obtained primarily as preformed vitamin A, probably from the butter fat (ghee).

A detailed presentation of the results from each detachment of men, for each constituent studied, is shown in table 14. The values for each constituent are divided into 4 ranges which may be considered as "high," "satisfactory," "low," and "deficient." (ICNND, '57.)

Serum ascorbic acid levels in most of the units were definitely suboptimal in a large percentage of the men (43% having serum levels of less than 0.2 mg/100 ml). The relatively high percentage of troops with serum ascorbic acid values greater than 0.4 mg/100 ml in the Army units at Bahawalpur and the Navy correlated well with the dietary intake data (table 4). In contrast, at the remote mountain post at Muzaffarabad where the daily ration contained an average of 14 mg ascorbic acid, 96% of the men were in the group below 0.1 mg/100 ml. It is significant that with so many values below 0.1 mg/100 ml very few cases of gingival involvement attributable to ascorbic acid deficiency were found.

The excretion of thiamine was satisfactory in all groups, which is in agreement with the observed high dietary intake of this vitamin. The average value is considerably higher than that reported by Ullah and Ahmed ('54) for 15 male Pakistani University students (average of 34.1 μg/6 hr; range of 25 to 55, calculated from 24-hour urine excretions). It is of interest that the military unit with the lowest percentage of high values was that at Comilla in which the staple grain was exclusively rice. This same unit also had very few men in the high range for riboflavin excretion. In general, the urinary excretion data for riboflavin and *N'*-methylnicotina-

TABLE 14

Pakistan: Serum and urine constituents of Pakistan Military Forces according to location of units[1]

LOCATION	NO. OF TROOPS	SERUM PROTEIN, GM/100 *ml*				NO. OF TROOPS	HEMOGLOBIN, GM/100 *ml*			
		0–6.0	6.1–6.5	6.6–7.0	7.1+		0–11.9	12.0–13.9	14.0–14.9	15+
		Per cent of troops					*Per cent of troops*			
Bahawalpur	39				100.0	40	2.5	5.0	5.0	87.5
Comilla, (rice diet)	30				100.0	30			3.3	96.7
Comilla, (wheat diet)	30				100.0	30			10.0	90.0
Karachi, Navy	57				100.0	57		7.0	17.5	75.5
Karachi, Air Force	20				100.0	20			10.0	90.0
Karachi, Artillery	20				100.0	20			10.0	90.0
Lahore, Med. Corps	20			10	90.0	20		5.0	5.0	90.0
Lahore, Boys	39		2.6		97.4	39		5.1	20.5	74.4
Lahore, Infantry	60			1.7	98.3	60		1.7	5.0	93.3
Muzaffarabad	48			4.2	95.8	48		2.1	6.3	91.6
Peshawar, Air Force	50				100.0	50		2.0		98.0
Quetta	60		1.7	3.3	95.0	60				100.0
Total	473	0	0.4	1.3	98.3	474	0.2	2.5	7.4	89.9

TABLE 14 (*Continued*)

Pakistan: Serum and urine constituents of Pakistan Military Forces according to location of units[1]

LOCATION	NO. OF TROOPS	HEMATOCRIT, %				NO. OF TROOPS	SERUM ASCORBIC ACID, MG/100 ML			
		0–36	37–41	42–45	46+		0–0.1	0.11–0.19	0.20–0.40	0.41+
		Per cent of troops					*Per cent of troops*			
Bahawalpur	40	2.5	5.0	10.0	82.5	40	25.0		12.5	62.5
Comilla (rice diet)	30			3.3	96.7	0				
Comilla (wheat diet)	30		3.3	23.3	73.4	0				
Karachi, Navy	58		1.7	13.8	84.5	56	10.7	3.6	10.7	75.0
Karachi, Air Force	20		10.0	15.0	75.0	19	5.3	10.5	36.8	47.4
Karachi, Artillery	20	5.0	5.0	5.0	85.0	20	40.0	15.0	25.0	20.0
Lahore, Med. Corps	20			5.0	95.0	0				
Lahore, Boys	39		7.7	28.2	64.1	39	23.1		64.1	12.8
Lahore, Infantry	60	1.7		15.0	83.3	59	13.6	18.6	55.9	11.9
Muzaffarabad	50			14.0	86.0	50	96.0	2.0	2.0	
Peshawar, Air Force	51		2.0	2.0	96.0	51	33.3	11.8	35.3	19.6
Quetta	60				100.0	58	43.1	20.7	22.4	13.8
Total	478	0.6	2.3	11.1	86.0	392	33.7	9.4	28.8	28.1

LOCATION	NO. OF TROOPS	SERUM VITAMIN A, µG/100 ML				NO. OF TROOPS	SERUM CAROTENE, µG/100 ML			
		0–10	11–19	20–49	50+		0–19	20–39	40–99	100+
		Per cent of troops					*Per cent of troops*			
Bahawalpur	38			71.1	28.9	40		5.0	95.0	
Comilla (rice diet)	30		3.3	90.0	6.7	30		10.0	90.0	
Comilla (wheat diet)	30			86.7	13.3	30		13.3	86.7	
Karachi, Navy	54			92.6	7.4	55		3.6	85.5	10.9
Karachi, Air Force	17			100.0		18		11.1	77.8	11.1
Karachi, Artillery	20	5.0		65.0	30.0	20		40.0	60.0	
Lahore, Med. Corps	20			45.0	55.0	20			100.0	
Lahore, Boys	29			65.5	34.5	34		11.8	85.3	2.9
Lahore, Infantry	57			96.5	3.5	60		11.7	88.3	
Muzaffarabad	46			56.5	43.5	48		25.0	75.0	
Peshawar, Air Force	43		2.3	88.4	9.3	52			88.0	12.0
Quetta	59			61.0	39.0	60	1.7	11.7	86.7	
Total	443	0.2	0.4	77.4	21.9	465	0.2	11.0	85.6	3.2

TABLE 14 (*Continued*)

Pakistan: Serum and urine constituents of Pakistan Military Forces according to location of units[1]

LOCATION	NO. OF TROOPS	URINE THIAMINE, μG/6 HRS.				NO. OF TROOPS	URINE RIBOFLAVIN, μG/6 HRS.			
		0–9	10–24	25–49	50+		0–9	10–29	30–99	100+
		Per cent of troops					*Per cent of troops*			
Bahawalpur	39			2.6	97.4	40		2.5	40.0	57.5
Comilla (rice diet)	29		13.8	48.3	37.9	30		6.6	90.0	3.3
Comilla (wheat diet)	30		3.3	13.3	83.3	30		3.3	76.7	20.0
Karachi, Navy	59	1.7	8.5	16.9	72.9	59		1.7	79.7	18.6
Karachi, Air Force	20		15.0	15.0	70.0	20			40.0	60.0
Karachi, Artillery	19		10.5	10.5	79.0	20		5.0	35.0	60.0
Lahore, Med. Corps	17			11.5	89.5	19	5.3		57.9	36.8
Lahore, Boys	38	2.6			97.4	39			17.9	82.1
Lahore, Infantry	60		3.3	10.0	86.7	60			78.3	21.7
Muzaffarabad	47		4.3	10.6	85.1	49			77.6	22.4
Peshawar, Air Force	55		10.9	25.5	63.6	55		3.6	80.0	16.4
Quetta	53			13.2	86.8	60		5.0	66.7	28.3
Total	466	0.4	5.4	14.6	79.6	481	0.2	2.3	65.5	32.0

		URINE N′-METHYLNICOTINAMIDE, MG/6 HRS.			
		0–0.19	0.20–0.59	0.6–1.59	1.6+
		per cent of troops			
Bahawalpur	0				
Comilla (rice diet)	29			27.6	72.4
Comilla (wheat diet)	30		3.3	30.0	66.7
Karachi, Navy	58		6.9	55.2	37.9
Karachi, Air Force	20	5.0	10.0	35.0	50.0
Karachi, Artillery	20		15.0	60.0	25.0
Lahore, Med. Corps	0				
Lahore, Boys	0				
Lahore, Infantry	59		1.7	67.8	30.5
Muzaffarabad	49		6.1	40.8	53.1
Peshawar, Air Force	55		1.8	30.9	67.3
Quetta	60		3.3	66.7	30.0
Total	380	0.3	4.5	48.7	46.6

[1] Values in table indicate percentage of values at each location falling within the designated range.

mide indicate adequate dietary intakes of riboflavin and niacin.

Examination of the data with the view of attempting to relate the length of time in service, or the degree of physical activity, with the biochemical findings did not reveal any consistent relationships.

The results of analyses of blood lipids and proteins from 44 naval personnel are given in table 15. The mean values are similar to those reported for healthy adult males. The cholesterol levels resemble those of American males, and probably reflect the high fat consumption (24 to 31% of the calories), most of which is animal fat or hydrogenated vegetable oil.

TABLE 15

Serum protein and lipid fractions[1] *obtained from 44 Navy personnel*

	MEAN	RANGE
Age in years	26	19–45
Total lipid, mg/100 ml	682	400–1155
Cholesterol, mg/100 ml	221	128–351
Phospholipid, mg/100 ml	170	101–271
Albumin, gm/100 ml	4.32	3.72–4.88
Globulin, gm/100 ml	2.91	2.00–3.66
Total serum protein, gm/100 ml	7.24	6.10–8.25
A/G ratio	1.52	1.02–2.45

[1] Analyses by U. S. Naval Medical Research Unit 3, Cairo, Egypt.

SUMMARY

Biochemical studies of blood and urine from 496 Pakistani Army, Navy, and Air Force enlisted personnel verify the generally satisfactory physical condition observed clinically. The hemoglobin, hematocrit, serum protein, and serum vitamin A levels were satisfactory. The serum carotene levels were considerably lower than those usually found in adult males in Western countries. Serum ascorbic acid levels were critically low, especially in the Muzaffarabad area, in a high percentage of the men. In general the value for urinary excretion of thiamine, riboflavin, and *N'*-methylnicotinamide were within the range associated with good nutriture.

Analysis of 44 blood serums from the Navy personnel for total lipids, cholesterol, phospholipid, albumin, globulin, and total protein gave values similar to those reported for normal young adult American males.

VII.

SIGNIFICANCE OF FINDINGS

The general objectives of the nutrition survey were to assess the nutritional status of the troops and to evaluate this in terms of the nation's food production and food technology. In interpretation of the dietary data it must be realized that it represents only the situation at a given, limited time and that seasonal foods and other dietary variations might alter significantly the nutritional status of the individual.

In interpreting the significance of the physical findings, there are several factors which must be kept in mind when dealing with relatively mild deficiency states. Almost any population group, even a well-nourished one, will show a low incidence of most of the physical signs listed. Even though the average intake of a nutrient may be adequate, there will be individuals with higher requirements, or individuals who consume less than average amounts and thus are deficient or borderline with respect to the nutrient. Furthermore, few, if any, of these physical signs in mild form are "specific" or "diagnostic" of a particular nutrient deficiency since they can be produced by nonnutritional factors or by any one of a group of nutrient deficiencies. Certain of the physical signs listed in figure 1, Part V, and in table 11 are included not because they have specific importance in predicting nutrient deficiency, but because they have some relationship to general health status, with possible secondary nutritional implications. Furthermore, it is known that physical signs of nutrient deficiencies come and go, often unpredictably, in mild deficiency states. In spite of these limitations, it is well established that the incidence and severity of these physical signs *in population groups* have diagnostic significance as to the average nutritional state of the group, especially when considered collectively with dietary and biochemical data.

In general, the dietary, biochemical, and physical examination data indicate adequate nutrition with regard to calories, protein, iron, thiamine, and niacin. Calcium intakes were slightly low when compared to the usual recommended allowances, although no clinical signs of calcium deficiency were seen. Studies in other countries have shown adult populations with lower intakes of calcium without physical signs of deficiency. Such low intakes may be significant for children and pregnant women.

A study of the "standard weight" distribution revealed that most of the Army troops were around the 80 to 99% class, as might be expected with the observed caloric intake and activity levels (table 4 and table 10).

Intakes of vitamin A were quite variable in Army units, being below optimum levels in Lahore and Comilla at the time of the survey. In Quetta and the Navy and Air Force, issues of carrots raised the intakes to "acceptable" levels. However, biochemical indices of vitamin A nutrition did not confirm the existence of a prior or long-continued low intake. Perishable fruit and vegetable issues varied considerably with the seasons in the different areas. This fact, coupled with body storage of vitamin A and carotene, is sufficient to explain the apparent variation in findings. The fact that these troops had a fat intake considerably higher than in many countries in the Middle East, which may have contributed to efficient utilization of the vitamin A and carotene in their food, may also help to explain this variation. The high incidence of follicular keratosis and xerosis in troops at Peshawar, Quetta, Muzaffarabad, Bahawalpur, and in the "Boys" at Lahore, as contrasted to the findings in East Pakistan, was possibly related to exposure to sun, wind, and dust.

The units with very "low" vitamin C intakes also had "low" serum blood levels. Most of the Army units had troops with serum vitamin C levels in the very low range (0–0.1 mg/100 ml of serum), indicating a need for more of this vitamin. It should be emphasized that the vitamin C dietary intake may be considerably lower than calculated, due to possible

severe losses as a result of the use of copper cooking vessels and long-time cooking procedures. The Navy unit which had a "high" vitamin C dietary intake also had the greatest percentage of troops with "high" serum levels. In this same connection, the Bahawalpur group had "high" intakes and a low percentage of "low" serum vitamin C cases, whereas in the Muzaffarabad location a "low" intake was reflected by the lowest serum levels recorded.

Urinary riboflavin excretion was slightly higher than might be expected on the basis of the borderline dietary intake levels in some of the units. Few physical signs indicative of riboflavin deficiency were noted, with the possible exception of nasolabial seborrhea and papillary hypertrophy. The highest incidence of papillary hypertrophy was found in the troops in Comilla, Dacca, and Muzaffarabad, while the Comilla, Lahore (Infantry), and Quetta troops had the greatest incidence of nasolabial seborrhea. Whether these physical signs may be directly related to personal hygiene, environmental effects, such as humidity and exposure to sunlight, or to actual deficiency of vitamin A, is debatable. There was no apparent correlation of these physical signs (nasolabial seborrhea and papillary hypertrophy) with dietary intake levels. The generous ration of atta (whole wheat meal) in all branches of the service seems to be vital in maintaining the riboflavin level at its present value. Where polished rice was substituted, as in the Navy, Air Force, and Comilla (East Bengal Regiment), it would appear advisable to increase the milk or dhal legume issues to prevent inadequate intakes of this vitamin.

One of the most significant findings of the survey was the high incidence of thyroid enlargement in the Muzaffarabad area. It was noted that the troops in this area used less salt in comparison to most other areas. Mined salt is used throughout the country and is preferred to crude sea salt. Iodine analysis of a sample of both types of salt indicates that 99% of the iodine is present in the organic form. The stability and the physiological availability of this organic form of iodine are not known and need to be determined. Troops in the other

areas have additional food sources of iodine which are not available to the troops in the Muzaffarabad area. A comprehensive study of the goiter problem, including a study of the civilian population, is under way. A therapeutic trial with adolescents should determine whether the goiter is iodine-sensitive.

The coefficients of correlation of physical signs with biochemical data, dietary intake, activity, length of time in service, and area of origin are too low to be of practical significance. This is an important piece of evidence supporting the thesis that Pakistani troops do not suffer from present dietary deficiencies of long standing.

Numerous problems, in addition to those mentioned previously, require further study: (1) losses of vitamin C during cooking and ways to minimize them; (2) planning and instituting methods of increasing the amount and seasonal constancy of vitamin C in the diet, perhaps through better distribution and substitution of seasonal crops such as Malta oranges, karela, cabbage, guava, papaya, etc.; (3) ways and means to insure slightly increased levels of riboflavin in the diet; (4) nutrient analyses before and after cooking of many native vegetables for which there are few reliable data in the scientific literature; (5) studies in troops showing a higher than average incidence of clinical signs, such as follicular keratosis, xerosis, nasolabial seborrhea, papillary hypertrophy, and gum changes, before and after appropriate therapy or ration improvements.

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