# DIETS OF A GROUP OF AIRCRAFT WORKERS IN SOUTHERN CALIFORNIA[1]

DOROTHY G. WIEHL

THE importance of developing measures to improve the diets of industrial workers has been discussed in a previous report (1) from the Committee on Nutrition in Industry of the National Research Council. A general survey of plant facilities for meals, of food habits of workers, and of evidence on dietary deficiencies among industrial employes led the Committee to the conclusions that more detailed investigations of the problem were greatly needed and that the present situation requires prompt, remedial measures to promote better dietary practices. There is much evidence from research on nutrition that workers who are well fed and have neither hunger nor "hidden hunger" may be expected to have better health, greater efficiency, and higher morale.

In order to obtain more definite data on the dietary deficiencies of industrial workers and their relation to health and absenteeism, an intensive study was planned and sponsored by the Committee on Nutrition in Industry. This investigation was begun at the Lockheed Aircraft Corporation, Burbank, California, in November, 1941, and included: (1) the collection of dietary histories; (2) medical examinations to determine the prevalence of various specific nutritional diseases; (3) a follow-up study of absences and accidents over a period of one year. The investigation is still in progress and the present report relates only to an analysis of the diet histories.

[1] This survey of diets is part of an investigation of the nutritional status of employes in a war industry. The study is sponsored jointly by the Los Angeles County Committee on Nutrition in Industry and the Committee on Nutrition in Industry of the National Research Council. The County of Los Angeles, the California Institute of Technology, and the Lockheed Aircraft Corporation cooperated in the study and assistance has been afforded by the California Fruit Growers Association.

The investigation is being directed by Dr. H. Borsook, California Institute of Technology. The collection of the data on diets was organized by the author of this report, and the analysis was carried out by the Milbank Memorial Fund. Views expressed in this report are solely those of the author.

Family diets and those of children have been studied extensively, but little attention has been given to the diets of individual workers. In general, it may be inferred that if the family diet is poor it is unlikely that some members of the family will have a completely adequate diet. However, there is evidence from data on family diets and on food consumption of individual members of the family collected in several Canadian studies (2) that the wage earner may consume more than a proportionate share of at least some of the available foods. Thus, in satisfying his natural desire for calories, the worker may obtain a more adequate supply of some essential nutrients than is obtained by women and children in the family. But in the Canadian studies, the diets of the men were more often deficient in vitamin A and vitamin C than those of the children, although they were less likely to be deficient in protein, iron, and vitamin $B_1$. Many studies of diets of wage-earners' families in the United States have shown that only a small percentage of families has a food supply which furnishes amounts of the principal essential food elements which are equal to the safe allowances recommended by nutrition authorities.

This study of the diets of about 1,100 aircraft workers was designed to fill in some of the gaps in our knowledge of what are the principal dietary deficiencies of industrial workers, and to describe the food choices and food failures which lead to these deficiencies. Such information can serve as an important guide in planning measures to improve dietary conditions. As the study was made in the winter months, the diets may have been somewhat worse than they would have been in late spring or summer. However, consumption of the right foods is necessary at all seasons. The diets of workers in California probably are not typical in all respects of those of workers in other regions. Dietary differences from region to region affect chiefly the relative prevalence of deficiencies of the various nutrients. In the study of diets of families by Stiebeling and Phipard (3), 14 per cent of the diets of families in the Pacific coast

states, chiefly California, were graded as good, and for three other regions the percentages ranged from 11 to 21. However, the percentage of poor diets was lowest for Pacific coast families, 40 per cent as against 46 to 60 per cent in other sections of the country; and the percentage of fair diets was highest for Pacific coast families, 46 per cent compared with 28 to 33 per cent. Thus, this family study found the diets to be slightly better in California, but the majority was definitely in need of improvement.

## The Sample

The men from whom diet histories were obtained had volunteered to participate in the special study of nutritional status. Diet records from office and clerical personnel have not been included. All were on the evening or "swing" shift at the time the record was taken, with the exception of about fifty men whose employment began after the record was taken.

Ages of the men in the Study are shown in Table 1. The majority was young with nearly three-fourths of the group under 30 years of age, and 46 per cent under 25 years of age. Only nine of the

Table 1. Age distribution of aircraft workers in nutrition study in California, November 1941-February 1942.

| Age Group | Number of Men | Per Cent of Total | Cumulated Per Cent |
|---|---|---|---|
| Total, Age Known | 1,080 | 100.0 | |
| Under 20 Years | 79 | 7.3 | 7.3 |
| 20–24 Years | 415 | 38.4 | 45.7 |
| 25–29 Years | 299 | 27.7 | 73.4 |
| 30–34 Years | 156 | 14.4 | 87.9 |
| 35–39 Years | 64 | 5.9 | 93.8 |
| 40–44 Years | 38 | 3.5 | 97.3 |
| 45–49 Years | 20 | 1.9 | 99.2 |
| 50–54 Years | 8 | 0.7 | 99.9 |
| 55–59 Years | 1 | 0.1 | 100.0 |
| Unknown Age | 23 | | |

| Period of Time | Time in California | | Duration of Employment | |
|---|---|---|---|---|
| | Number of Men | Per Cent of Total | Number of Men | Per Cent of Total |
| Total Known Period | 1,073 | 100.0 | 1,100 | 100.0 |
| Pre-employment | — | — | 49 | 4.5 |
| Less Than 3 Months | 38 | 3.5 | 33 | 3.0 |
| 3 to 11 Months | 302 | 28.1 | 595 | 54.1 |
| 1 Year, Less Than 2 Years | 139 | 13.0 | 285 | 25.9 |
| 2 Years, Less Than 3 Years | 65 | 6.1 | 66 | 6.0 |
| 3 Years, Less Than 5 | 88 | 8.2 | 59 | 5.4 |
| 5 Years, Less Than 10 | 116 | 10.8 | 13 | 1.2 |
| 10 Years or Longer | 325 | 30.3 | — | — |

Table 2. Duration of residence in California and of employment at this aircraft plant of employes in nutrition study, November 1941-February 1942.

1,080 men were between 50 and 60 years of age, and twenty were from 45 to 49 years old.

The period of employment at this factory had been less than one year for 62 per cent of the group; but only 7.5 per cent had been employed less than three months. About one in eight of the men had been employed two years or longer.

Nearly one-third of the men had lived in California less than one year, and 45 per cent had been in California less than two years. On the other hand, 30 per cent had lived in California ten years or longer. More detailed distributions of the duration of employment and time lived in California are shown in Table 2.

Slightly less than one-half, 44 per cent, of these men were single, 54 per cent were married, and 1.5 per cent had been married but were widowed or divorced.

Inquiry was made as to whether meals were eaten in a restaurant, a boarding house, or "at home." About three-fourths of the men ate meals "at home," 15 per cent ate in restaurants most of the time, and 10 per cent ate at a boarding house. The "at home" group includes those who lived with families, whether or not related, and also includes a few men who joined together and "kept house" for themselves.

## Description of Diet Histories

Information concerning diets of the employes was obtained by interview and was of two types. One record was a quantitative estimate by the informant of all food consumed during the two days preceding the interview; the other record was for the remaining five days of a one-week period and required, for the most part, only the listing of foods in selected categories which had been included in the diet.

The two-day quantitative diet history furnished a complete description of all food consumed at each meal and between meals. Quantities were stated, when possible, in ordinary units, such as, a glass of milk, two slices of bread, one pat of butter, one medium-sized potato, two chops, etc. For many foods, estimates of the size of the serving had to be made and to assist the informant in describing the servings, models of measured quantities of several foods were displayed on the interviewer's desk, and glasses of three different sizes were also at hand. These were used as standards of reference and the employe was asked to estimate the amounts of different foods consumed in relation to some one of the sample portions. Although the quantitative values for each food obtained by this method are only approximate, it is believed that the estimate of total food intake is reasonably accurate and provides a satisfactory basis for classifying diets into several broad groups according to consumption levels.

The five-day report on the use of selected foods was designed to describe qualitative food choices or food habits over a longer period than two days. For each day, the subject was asked to give information on the use of specific foods, as follows:

(1) Number of glasses of milk;
(2) Number of eggs;
(3) Number of slices of whole wheat, or rye bread;
(4) Type of cereal, if any;

(5) Potatoes;
(6) Kinds of vegetables;
(7) Citrus fruits (approximate amounts of juices), and kinds of other fruits;
(8) Kinds of meat.

It is admittedly difficult to remember what one has eaten for a whole week. However, the use of the above food items, in general, represents rather basic food habits, and the errors in reporting seldom would affect a classification of diets with respect to general type or quality.

*Method of Analysis.* For the two-day quantitative records, estimates were made of the nutritive values of all foods in calories, protein, calcium, iron, vitamin A, thiamin, riboflavin, ascorbic acid, and niacin. For this purpose, extensive tables were prepared[2] from recent publications on food content (4). Vitamin values determined for cooked foods have been used whenever available, and estimates of loss in cooking were made for other cooked foods. Because of the large amount of work and time required for processing the quantitative records, estimates of nutritive values are available at present for only 250 of the dietary histories.

From the five-day qualitative record plus the two-day quantitative record, tabulations of the use during one week of specific foods or types of foods listed above have been made for the entire group. Some explanation of the classification used in making a total count for one week for different food groups is needed. A description of each food group follows:

*Milk.* A total of the number of glasses of milk reported was

[2] The food value tables were prepared by Mrs. Emily K. Stamm, and her painstaking work is gratefully acknowledged. The nutritive values for several hundred cooked dishes have been calculated from recipes. Allowances made for loss of vitamins in cooking, when assay values on cooked foods were not found, were as follows: ascorbic acid 50 per cent loss; thiamin 40 per cent loss in vegetables and various percentages for meats depending on method of cooking; and riboflavin, various percentages for meats depending on method of cooking, but no estimates of loss in other foods. *See* references 4, a-k. It was assumed that white bread was "enriched," and that rolls, buns, and biscuits were not made from enriched flour.

made; and to this total was added one-half glass of milk for each day on which a breakfast cereal was eaten.

*Vegetables.* The number of different vegetables reported for any day was the total for that day, as no attempt was made to obtain information as to the number of servings. Vegetables were classified as green or yellow and "other" vegetables. A weekly total was made for each of these two groups of vegetables. Vegetables were classed as green or yellow only when the edible part is colored and vitamin-A content is relatively high. Sweet potatoes were counted as a yellow vegetable, but they were reported very infrequently; and cabbage and lettuce were counted as "other" vegetables. A separate total for tomatoes was made, so that they could be accounted for in a general consideration of the use of vegetables, but also could be combined with citrus fruits. One tomato or a serving of canned tomatoes was counted as one, the tomato in a salad including tomato was counted as one-half; four ounces, or a small glass of tomato juice, was counted as one, and a large glass as two.

*Fruit.* The number of different fruits eaten each day provided the total for one day and these were summed for the seven days to obtain a total count for fruit for one week. A separate count was made for citrus fruits and "other" fruits. In the citrus fruit count, one orange or one-half grapefruit was one; one tangerine was one-half; and four ounces or a small glass of orange or grapefruit juice counted as one. Fruit salad and fruit pie were counted as one serving of "other" fruit. For raw fruits, as bananas or apples, the number eaten usually was reported and this number was used in the total count for one week.

*Eggs.* The number of eggs usually was reported and a total count for one week was made. When the number was not stated, but eggs were eaten in some form at any meal, a count of one was used.

*Meat, Poultry, Fish.* The total count for meat is approximately the number of meals at which a lean meat or fish was eaten. In a

few instances, when the same type of meat was eaten at two meals on the same day, this fact probably was not reported.

*Whole Grain Foods.* The total number of slices of whole wheat or rye bread eaten in one week was obtained from the number reported for each day. All "dark" bread was counted, although the whole grain content of some of it was limited. Whole grain breakfast cereals were counted as the number of days in the week on which such a cereal was eaten. With a few exceptions, prepared breakfast foods, such as corn flakes and puffed wheat, were not counted.

### A. Quality of Diets for One Week

The total use of selected foods or food groups during one week affords a basis for comparing the diets of these employes with the dietary pattern recommended by the National Research Council, Committee on Food and Nutrition (5), for obtaining a safe allowance of protein, minerals, and vitamins.

Before the data on use of different foods are discussed, it will be helpful to consider the significance of the recommended foods with reference to their contribution to a balanced diet with adequate amounts of various essential nutrients. Although some of the essential nutrients are distributed in nature in many different foods, several are present in appreciable amounts in only a few foods. An important example of the latter is ascorbic acid. Citrus fruits and tomatoes are very good sources of this vitamin, and, although a few other foods also are good sources if fresh and raw when eaten, most diets will contain insufficient amounts of ascorbic acid unless a citrus fruit or tomato is included regularly in the diet. The vitamin A allowance of 5,000 International units daily can be obtained from various combinations of foods, nevertheless, a green or yellow vegetable of high vitamin A content is almost a *sine qua non* because it can be replaced satisfactorily only by an exceptionally large consumption of dairy products. The pint of milk daily which

is recommended not only is needed to assure a good source of calcium and to supplement the vitamin A from vegetables, but also is almost indispensable for obtaining the amount of riboflavin which is considered necessary. Meat is the next best source of riboflavin, but some methods of cooking destroy a large percentage of the riboflavin (4k), and only those who eat exceptionally large quantities of meat daily are likely to have an adequate amount of riboflavin unless milk is included in the diet. Niacin (nicotinic acid) must be obtained largely from meat. Thiamin is rather widely distributed in foods, but not in concentrated amounts. Milk, meat, and some vegetables are fairly good sources of thiamin, but there may be considerable loss from cooking; therefore, enriched or whole grain bread, or a whole grain cereal, preferably both, is needed to assure an adequate supply of this vitamin. Eggs are not the most important source of any of the nutrients, but they are a good source of several vitamins as well as of iron and protein. The regular consumption of eggs, therefore, is desirable as a supplement to other foods. Thus, it is apparent that a regular and adequate supply of the principal vitamins and minerals under most circumstances can be obtained best by the consumption each day of a green or yellow vegetable, a citrus fruit or tomato, two glasses of milk or equivalent, an egg, a serving of lean meat, and a whole grain cereal food or enriched bread. Other food combinations can be used to obtain complete nutritional protection, but as a rule, only very specially planned diets furnish all the necessary nutrients when these varieties of foods are not included. The total diet should include some foods not discussed, especially butter or fortified oleomargarine, and potatoes, and an amount of food sufficient to furnish the required energy value.

### CONSUMPTION OF SPECIFIC FOODS

The reported frequency within a one-week period with which each of several types of foods was included among the foods chosen,

Table 3. Vegetables and fruits eaten during one week by employes of an aircraft factory in California, November 1941-February 1942.

| Number of Times in Week | Vegetables | | | Fruits | | Citrus Fruit and Tomatoes |
|---|---|---|---|---|---|---|
| | Any Kind | Yellow or Green | Tomatoes | Any Kind | Citrus | |
| | Per Cent of Total | | | | | |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 0 | 0.7 | 3.9 | 48.1 | 3.4 | 22.6 | 11.2 |
| 1 | 1.2 | 6.5 | 29.4 | 2.4 | 6.5 | 9.6 |
| 2 | 2.3 | 13.3 | 11.0 | 3.2 | 10.8 | 9.4 |
| 3 | 3.3 | 18.9 | 5.0 | 4.0 | 11.1 | 10.2 |
| 4 | 5.3 | 21.7 | 2.3 | 4.3 | 7.4 | 8.6 |
| 5 | 8.2 | 14.8 | 1.3 | 4.1 | 8.0 | 7.1 |
| 6 | 12.6 | 10.0 | 1.2 | 5.9 | 7.3 | 7.9 |
| 7 | 15.4 | 5.7 | 0.5 | 8.7 | 11.3 | 11.2 |
| 8 | 12.7 | 2.8 | 0.6 | 7.3 | 3.8 | 7.3 |
| 9 | 11.2 | 1.1 | 0.2 | 6.5 | 2.7 | 4.7 |
| 10 | 8.0 | 0.5 | 0.3 | 6.5 | 1.5 | 2.4 |
| 11 | 6.3 | 0.3 | 0.1 | 6.0 | 1.4 | 3.0 |
| 12 | 3.8 | 0.3 | 0 | 7.2 | 1.1 | 1.1 |
| 13 | 3.2 | 0 | 0.1 | 5.3 | 0.6 | 1.1 |
| 14 | 0.8 | 0 | 0 | 5.5 | 1.4 | 0.8 |
| 15 or More | 5.3 | 0.2 | 0.2 | 19.8 | 2.5 | 4.5 |
| | Number of Persons Reporting | | | | | |
| Total | 1,103 | 1,103 | 1,103 | 1,103 | 1,103 | 1,103 |
| 0 | 8 | 43 | 530 | 37 | 249 | 123 |
| 1 | 13 | 72 | 324 | 27 | 72 | 106 |
| 2 | 25 | 147 | 121 | 35 | 119 | 104 |
| 3 | 36 | 209 | 55 | 44 | 122 | 112 |
| 4 | 58 | 239 | 25 | 47 | 82 | 95 |
| 5 | 90 | 163 | 14 | 45 | 88 | 78 |
| 6 | 139 | 110 | 13 | 65 | 81 | 87 |
| 7 | 170 | 63 | 5 | 96 | 125 | 124 |
| 8 | 140 | 31 | 7 | 80 | 42 | 80 |
| 9 | 123 | 12 | 2 | 72 | 30 | 52 |
| 10 | 88 | 6 | 3 | 72 | 16 | 27 |
| 11 | 69 | 3 | 1 | 66 | 15 | 33 |
| 12 | 42 | 3 | 0 | 79 | 12 | 12 |
| 13 | 35 | 0 | 1 | 59 | 7 | 12 |
| 14 | 9 | 0 | 0 | 61 | 15 | 8 |
| 15 or More | 58 | 2 | 2 | 218 | 28 | 50 |

Table 4. Milk, meat, eggs, and whole grain cereal foods eaten during one week by aircraft employes in California, November 1941-February 1942.

| Number Per Week[1] | Milk (Glasses) | Meat | | Eggs (Number) | Cereal Products | |
|---|---|---|---|---|---|---|
| | | Any Kind | Glandular | | "Dark" Bread | Whole Grain Breakfast Food |
| | | Per Cent of Total | | | | |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 0 | 11.3 | 0.5 | 78.3 | 18.3 | 32.9 | 51.6 |
| 1 | 3.4 | 0.1 | 15.4 | 4.6 | 20.1 | 11.0 |
| 2 | 5.7 | 0.5 | 4.5 | 11.2 | 16.0 | 7.6 |
| 3 | 5.2 | 1.2 | 1.3 | 6.8 | 9.5 | 8.2 |
| 4 | 3.7 | 2.5 | 0.2 | 9.2 | 6.6 | 4.0 |
| 5 | 4.2 | 5.5 | 0.1 | 6.7 | 3.7 | 5.6 |
| 6 | 3.9 | 8.5 | 0.1 | 7.6 | 4.3 | 4.9 |
| 7 | 3.9 | 16.8 | 0 | 9.2 | 3.4 | 7.2 |
| 8 | 3.5 | 24.4 | 0.1 | 6.1 | 1.8 | |
| 9 | 4.4 | 25.9 | 0 | 2.8 | 0.8 | |
| 10 | 3.6 | 9.8 | | 2.8 | 0.5 | |
| 11 | 2.4 | 2.7 | | 1.5 | 0.2 | |
| 12 | 3.7 | 0.8 | | 4.0 | 0.1 | |
| 13 | 3.8 | 0.5 | | 1.1 | | |
| 14 | 4.5 | 0.2 | | 5.8 | | |
| 15+ | 32.7 | 0.1 | | 2.3 | | |
| | | Number of Persons Reporting | | | | |
| Total | 1,103 | 1,103 | 1,103 | 1,103 | 1,103 | 1,103 |
| 0 | 125 | 5 | 864 | 203 | 363 | 569 |
| 1 | 37 | 1 | 170 | 52 | 222 | 121 |
| 2 | 63 | 5 | 50 | 124 | 177 | 84 |
| 3 | 57 | 13 | 14 | 75 | 105 | 90 |
| 4 | 41 | 28 | 2 | 102 | 73 | 44 |
| 5 | 46 | 61 | 1 | 74 | 41 | 62 |
| 6 | 43 | 94 | 1 | 84 | 47 | 54 |
| 7 | 43 | 185 | 0 | 101 | 38 | 79 |
| 8 | 39 | 269 | 1 | 66 | 20 | |
| 9 | 49 | 286 | | 31 | 9 | |
| 10 | 40 | 108 | | 31 | 5 | |
| 11 | 26 | 30 | | 16 | 2 | |
| 12 | 41 | 9 | | 44 | 1 | |
| 13 | 42 | 6 | | 12 | | |
| 14 | 50 | 2 | | 63 | | |
| 15+ | 361 | 1 | | 25 | | |

[1] Except for "dark" bread, which is the average number of slices per day, as "one or less," "two or more than one," etc.

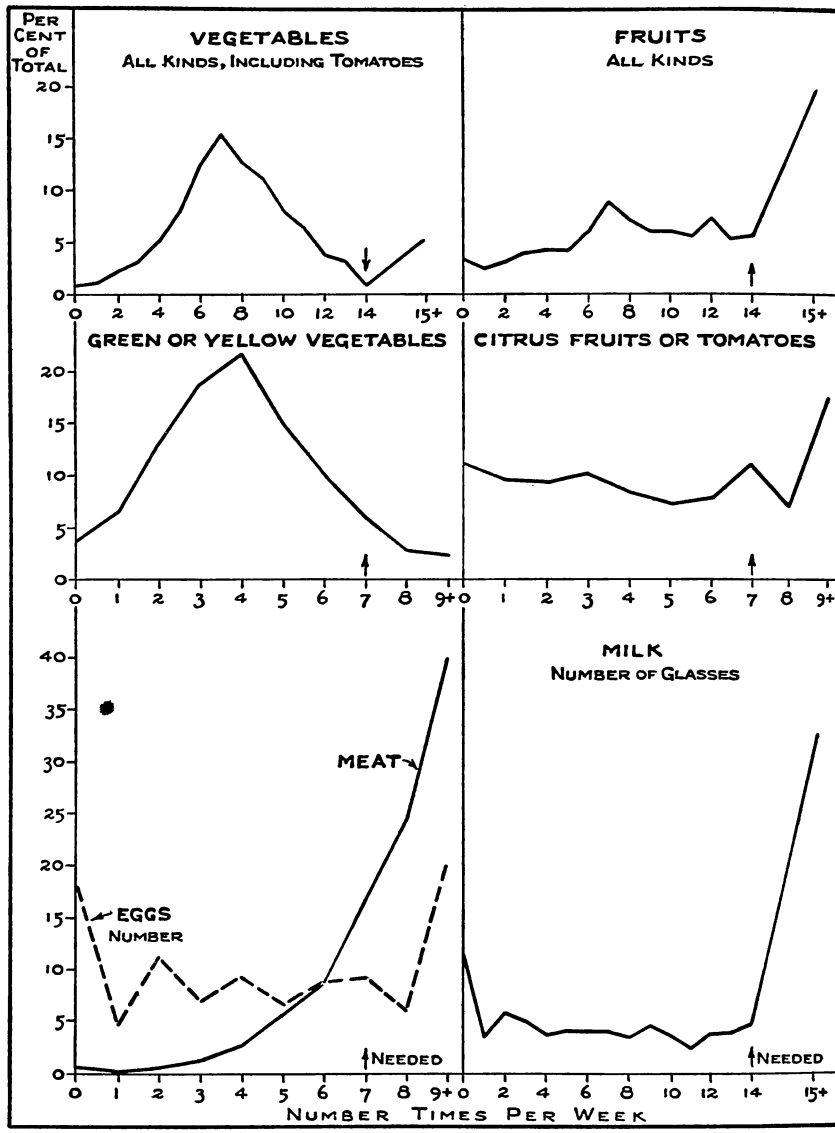


Fig. 1. Percentage distribution of 1,103 diet records for aircraft workers in Southern California according to the reported use of specific foods or food groups during one week.

is shown in Tables 3 and 4, and in Figure 1. The food habits of these employes are shown to differ greatly from the recommended dietary pattern and indicate no appreciation or application of the

principles for obtaining a good diet. A brief comment on the consumption of specific foods follows.

*Vegetables.* Only 6 per cent of these industrial workers reported that vegetables of any type, including tomatoes, but not Irish potatoes, were eaten as many as fourteen or more times in a week, or an average of at least two per day. One-third of the group had eaten vegetables less than seven times during the week or, on the average, less than one a day.

The choice of green or yellow vegetables was relatively infrequent. Only 11 per cent of the men had had green or yellow vegetables seven or more times during a week, although two-thirds of them had reported seven or more vegetables of some type. A total of three or four green or yellow vegetables occurred most often and 40 per cent of the men reported either three or four. Nearly one-fourth of the men, 24 per cent, had eaten green or yellow vegetables less than three times within the week.

Tomatoes or tomato juice were seldom reported. Nearly one-half of the men reported none during an entire week, and about 30 per cent had had one serving of tomatoes. Although tomatoes are a moderately good source of vitamin A, they are especially significant as a substitute for citrus fruits to furnish ascorbic acid.

*Fruits.* It is indeed surprising to find that this group in California used very little citrus fruit. About 23 per cent had had none during an entire week, and 17 per cent had had only one or two servings. Only 26 per cent of the men had seven or more servings during a week. If tomato servings during the week are added to those of citrus fruits, only an additional 10 per cent (or a total of 36 per cent) were found to have reported seven or more servings of citrus fruit or tomatoes during the week.

Other fruits were eaten more regularly than the citrus fruits and 73 per cent of the men had had some kind of fruit, including citrus, at least an average of once a day, and about one-fourth of them had had an average of two or more per day.

*Milk.* The consumption of milk was better than that for either green and yellow vegetables or citrus fruits. Nevertheless, nearly two-thirds of the men (63 per cent) reported less than an average of two glasses per day. About 37 per cent had less than one glass of milk per day, on the average, and 11 per cent had drunk no milk. Somewhat unusual is the finding that 11 per cent of the men drank a quart of milk or more per day.

*Eggs.* Eggs were not eaten regularly by the majority of the men. Only 35 per cent of them averaged one a day, or seven per week or more, and 34 per cent of the men had two or less eggs within the week.

*Meat.* Lean meat, fish, or poultry was eaten at least once a day by most of the men. Only 5 per cent of the group had meat less than five times during the week, and four-fifths had meat seven or more times.

Liver and other glandular meat products were reported by only 22 per cent of the men. Fifteen per cent had had one serving within the week, and 5 per cent had had two servings.

*Whole Grain Cereal Foods.* With the introduction of enriched flour as a substitute for whole wheat breads, consumption of breads or cereals made from the whole grain is more an index of food habits than it is of the probable level of thiamin intake. Most bakeries in this area in California were using enriched flour, but no attempt was made to determine whether the men were eating enriched bread.

One-third of these men ate no whole wheat, rye, or "dark" bread during a week; 20 per cent of them had on the average about one slice per day; and about 20 per cent had four or more slices per day.

Slightly over one-half of the group (52 per cent) used no whole grain breakfast cereal, either prepared or cooked, in a week, and only 7 per cent ate a whole grain cereal every day.

On the charts in Figure 1, an arrow indicates the amount of each food or food group which would correspond to that in the recom-

mended dietary pattern. If the diets had conformed approximately to this pattern, each curve would reach a peak at a point above the arrow. Only the curve for meat consumption is of this type; for other foods, the areas under the curves and to the left of the arrows show that large percentages of the diets were low in their content of yellow or green vegetables, of citrus fruits or tomatoes, of eggs, and of milk. With these dietary deficiencies, the nutritional content would be unsatisfactory in vitamin A, ascorbic acid, riboflavin, thiamin, or calcium, and multiple deficiencies would be expected to occur very frequently.

### QUALITATIVE CLASSIFICATION OF DIETS

It is convenient for further discussion of these diets and for summarizing the pattern of individual diets to classify the use of selected foods in a few categories based on the extent of the deviation from amounts recommended in the dietary pattern prepared by the Committee on Food and Nutrition. For five types of food, namely, citrus fruits or tomatoes, green or yellow vegetables, eggs, milk, and meat, the total reported consumption during one week was classified in one of three categories. These categories are described in detail in Appendix I, where the amounts in the recommended dietary pattern used as a standard are also given. Use of each type of food approximately equal to or slightly less than that recommended is termed "satisfactory," amounts moderately below standard are termed "marginal," and more than moderate deviation below standard is called "unsatisfactory." The limits selected for the three categories were arbitrarily chosen and were determined in large part on the basis of availability of or ease of making substitutions for a specific type of food. Any dietary pattern may be modified to some extent without producing a dietary failure, but in the average American diet, the use of less than the recommended amounts of any of these principal food groups produces a need for careful substitutions or increases in amounts of some other foods in order to obtain the recommended allowances for essential nutri-

ents. Marginal and unsatisfactory ratings indicate a need to improve the use of the specific food or make carefully chosen substitutions.

These qualitative classifications of the use during one week of selected types of foods, for which information on consumption was mostly nonquantitative, afford a good index, it is believed, of dietary habits and indicate fairly well the likelihood of certain dietary deficiencies. It should be emphasized that they do not give precise information on the prevalence of any deficiency. A diet with satisfactory ratings may be deficient in one or more nutrients because the amounts consumed were less than average portions, and a diet with a rating of unsatisfactory for some foods may be adequate because of an unusually high consumption of some alternative foods. Either type of diet probably is not very frequent. In spite of these limitations, the qualitative groupings define the nature of the prevailing dietary pattern and suggest the changes in food habits which are most commonly needed in order to obtain the safe, balanced diet recommended by the Committee on Food and Nutrition.

The frequency of diets which were equal to or slightly below the recommended amounts per week for the five different foods or types of food (satisfactory rating) was as follows:

| | *Per Cent* |
|---|---|
| Green or yellow vegetables, 6 or more | 21 |
| Citrus fruit or tomatoes, 7 or more | 36 |
| Milk, 10 or more glasses | 51 |
| Eggs, 4 or more | 59 |
| Lean meat, etc., 5 or more times | 95 |

Unsatisfactory ratings for amounts per week of specific foods were given to the following percentages of the diets:

| | *Per Cent* |
|---|---|
| Green or yellow vegetables, 3 or less, or less than 7 vegetables of which 4 or 5 were green or yellow[3] | 56 |

[3] There was 13 per cent of the diets which had 4 or 5 green or yellow vegetables but less than 7 vegetables of all types during one week.

| | |
|---|---|
| Citrus fruits or tomatoes, 4 or less | 49 |
| Milk, 5 glasses or less | 33 |
| Eggs, 1 or none | 23 |
| Lean meat, 2 times or less | 1 |

It is apparent from the above data, and Figure 2, that vegetables and citrus fruits were the outstanding food deficiencies.

*Summary Classification of Individual Diets.* It is of interest to know whether persons with good diets in respect to some food groups chose well in other foods or whether the majority had some food deficiency which would impair the dietary adequacy. Therefore, a general or composite qualitative rating of each diet history for one week was made on the basis of ratings for the five foods. As has been discussed, in the usual American dietary, failure to include regularly any one of these food groups among the foods consumed is likely to bring the intake of one or more vitamins or minerals below the allowance recommended. Therefore, the total diet rating is no better than the lowest rating given to any one of the specific food groups. A general rating of unsatisfactory was given if any one of the groups was classified as unsatisfactory; the total diet was rated marginal if any food group was considered marginal but all five were marginal or better; and a diet was classified as satisfactory only if all five food groups were rated satisfactory.

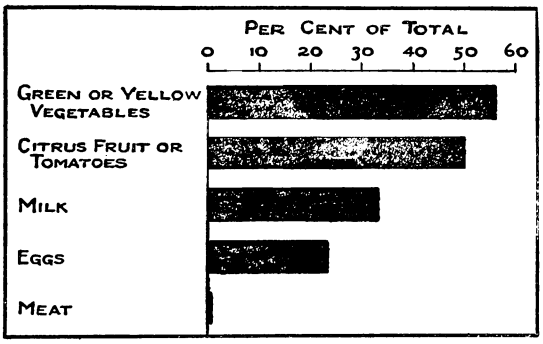


Fig. 2. Percentage of 1,103 diet records for one week in which reported amounts of five different types of food were classified as unsatisfactory.

Among this group of 1,103 industrial workers, only four men reported diets which included approximately the recommended amounts of all five types of food, and nineteen others reported diets which were rated satisfactory. Thus, only 2

per cent of the men had diets which were close to the recommended dietary pattern and furnished regularly dependable food sources for obtaining the recommended allowances of mineral and vitamin elements. The percentage distribution of diets according to their general qualitative ratings is shown in Table 5. Furthermore, only 11 per cent of the men reported marginal diets, and 87 per cent had diets which were unsatisfactory for one or more food groups. Thus, most of the men who had a satisfactory intake of some of the essential foods failed to obtain a balanced diet.

Slightly more than half (55 per cent) of the marginal diets were in this class because of only one food group, and 34 per cent of them were marginal in two food groups. The distributions of marginal diets and unsatisfactory diets according to the number of

Table 5. Distribution of weekly diets according to lowest qualitative rating[1] for any of five food groups and number of food groups in individual diets with the specified lowest rating for 1,103 dietary histories reported by aircraft workers in California, November 1941-February 1942.

| General Rating[2] and Number of Food Groups With Same Rating | Number of Diet Records | Per Cent of Total Records in Each Category | Percentage Distribution by Number of Food Groups for Diets With Specified General Rating |
|---|---|---|---|
| Total Records | 1,103 | 100.0 | |
| *Satisfactory* | | | |
| Total | 23 | 2.1 | |
| *Marginal* | | | |
| Total | 126 | 11.4 | 100.0 |
| 1 Food Group | 69 | 6.3 | 54.8 |
| 2 Food Groups | 43 | 3.9 | 34.1 |
| 3 Food Groups | 9 | 0.8 | 7.1 |
| 4 Food Groups | 5 | 0.5 | 4.0 |
| *Unsatisfactory* | | | |
| Total | 954 | 86.5 | 100.0 |
| 1 Food Group | 356 | 32.3 | 37.3 |
| 2 Food Groups | 395 | 35.8 | 41.4 |
| 3 Food Groups | 172 | 15.6 | 18.0 |
| 4 Food Groups | 31 | 2.8 | 3.2 |

[1] *See* Appendix I for description of qualitative classifications for each of the five food groups.

[2] The general rating is the lowest qualitative rating for one or more of the five food groups.

types of food rated marginal or unsatisfactory, respectively, are shown in Table 5 and Figure 3. The sixty-nine diets, or 6 per cent of the 1,103 histories, which were satisfactory with the exception of a marginal rating for one group, were borderline good diets and needed only slight modification.

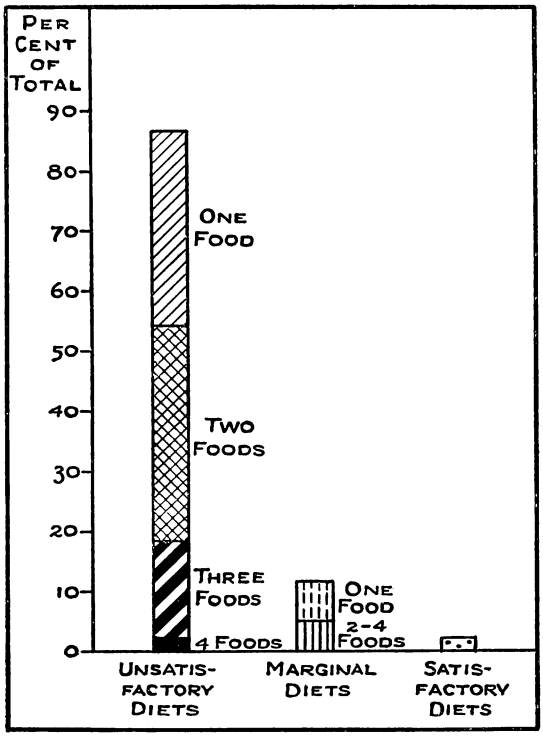


Fig. 3. Percentage of 1,103 diets for one week classified as satisfactory for use of five types of food, as marginal for one or more of five foods, and as unsatisfactory for one or more of five foods.

Included in the unsatisfactory classification were 109 diets, or 10 per cent of all diet histories, which were satisfactory for four of the five foods, but unsatisfactory in one type of food. Nearly two-thirds of these 109 diets, 64 per cent, were unsatisfactory because of too few green or yellow vegetables; 21 per cent because of too little citrus fruits or tomatoes; and 6 per cent because of low milk consumption.

The total number of diets in which the use of four of the five foods during one week was nearly equal to that recommended was 178, or 16 per cent of the total, compared with 2.3 per cent of the total satisfactory for all five foods. Since the one food failure was vegetables, citrus fruits, or milk in nearly all of these diets, they fell below the recommended diet in foods of special importance as sources of essential nutrients.

In all, 32 per cent of the diets were classified as unsatisfactory be-

cause of only one food group; but 22 per cent also had marginal ratings for one or more food groups. More than one-half of the men (54 per cent) reported diets rated as unsatisfactory in the amounts of two or more types of food. It is apparent that a majority of the men needed to increase their consumption of at least two types of food in order to approximate the recommended dietary pattern.

Since eggs are less essential for obtaining a balanced diet than the other foods, a composite rating based on vegetables, citrus fruit or tomatoes, milk, and meat also was applied to the diets. The omission of eggs changed only slightly the percentages of diets in the different categories. An increase in the number of satisfactory diets from 23 to 43 is of most interest, but on the basis of these four foods, only 3.9 per cent of the men had satisfactory diets. The percentage of marginal diets became 12.6 instead of 11.4, and the percentage of unsatisfactory diets was reduced from 86.5 to 83.3.

## FACTORS RELATED TO FOOD HABITS

An analysis of the diet histories was made to determine whether the use of specific types of foods differed for men of various ages and of different durations of residence in California; and the possible relation of type of eating place to the quality of the diet also was considered.

*Time in California.* For men who had resided in California for five years or longer, the proportions of diets which were classified as satisfactory, marginal, and unsatisfactory were the same as for those who had been in California less than one year. There were slight differences in the percentages of men with unsatisfactory use of specific foods, as is shown in Table 6. Thus, the diets of men in California less than one year were somewhat more frequently low in the amount of green or yellow vegetables and in the number of eggs, but were slightly less frequently unsatisfactory in the amount of milk and of citrus fruits than the diets of men in California a

| Classification of Diet[1] | Per Cent of Diets of Employes in California for Specified Time | | | Number of Diets of Employes in California for Specified Time | | |
|---|---|---|---|---|---|---|
| | Less Than 1 Year | 1 to 4 Years | 5 Years or Longer | Less Than 1 Year | 1 to 4 Years | 5 Years or Longer |
| Total Records | 100.0 | 100.0 | 100.0 | 340 | 292 | 441 |
| *General Rating* | | | | | | |
| Satisfactory | 2.4 | 2.1 | 2.0 | 8 | 6 | 9 |
| Marginal | 11.2 | 10.3 | 11.3 | 38 | 30 | 50 |
| Unsatisfactory | 86.5 | 87.7 | 86.6 | 294 | 256 | 382 |
| *Unsatisfactory* | | | | | | |
| One Food Group | 31.8 | 32.2 | 32.2 | 108 | 94 | 142 |
| Two Food Groups | 35.3 | 37.0 | 36.1 | 120 | 108 | 159 |
| Three Food Groups | 15.6 | 16.4 | 15.4 | 53 | 48 | 68 |
| Four Food Groups | 3.8 | 2.1 | 2.9 | 13 | 6 | 13 |
| *Specific Foods Unsatisfactory* | | | | | | |
| Green or Yellow Vegetables | 62.9 | 53.8 | 51.5 | 214 | 157 | 227 |
| Citrus Fruit or Tomatoes | 44.1 | 51.7 | 52.2 | 150 | 151 | 230 |
| Milk | 30.9 | 33.6 | 36.1 | 105 | 98 | 159 |
| Eggs | 26.2 | 24.0 | 21.5 | 89 | 70 | 95 |
| Meat | 0.3 | 0.7 | 1.1 | 1 | 2 | 5 |

[1] *See* Appendix I.

Table 6. Duration of residence in California in relation to quality of total diet and frequency of unsatisfactory ratings for use of specific foods among weekly dietary histories reported by aircraft workers, November 1941-February 1942.

longer time. None of these differences was large, but it is of interest that men who had most recently arrived in California ate the most citrus fruit.

*Age in Years.* Dietary differences by age group were greater than according to time in California. Young men under 25 years of age had diets classified as unsatisfactory for one or more foods about as frequently as the older men; but as age increased, there was an increase in the number of types of food used in insufficient amounts. This is shown in Table 7 and in Figure 4. Thus, about 39 per cent of the diets of men under 25 years of age were unsatisfactory because one food was neglected, 29 per cent of diets of men aged 25 to 34 years, and 21 per cent for men 35 years of age or older. On the other

| Classification of Diet[1] | Per Cent of Diets of Employes of Specified Age | | | Number of Diets of Employes of Specified Age | | |
|---|---|---|---|---|---|---|
| | Under 25 Years | 25–34 Years | 35 Years or Older | Under 25 Years | 25–34 Years | 35 Years or Older |
| Total Records | 100.0 | 100.0 | 100.0 | 449 | 421 | 124 |
| *General Rating* | | | | | | |
| Satisfactory | 2.0 | 1.9 | 3.2 | 9 | 8 | 4 |
| Marginal | 13.4 | 10.2 | 8.1 | 60 | 43 | 10 |
| Unsatisfactory | 84.6 | 87.9 | 88.7 | 380 | 370 | 110 |
| *Unsatisfactory* | | | | | | |
| One Food Group | 38.5 | 29.5 | 21.0 | 173 | 124 | 26 |
| Two Food Groups | 32.5 | 36.3 | 41.1 | 146 | 153 | 51 |
| Three Food Groups | 10.9 | 18.5 | 23.4 | 49 | 78 | 29 |
| Four Food Groups | 2.7 | 3.6 | 3.2 | 12 | 15 | 4 |
| *Specific Foods Unsatisfactory* | | | | | | |
| Green or Yellow Vegetables | 54.3 | 57.2 | 54.0 | 244 | 241 | 67 |
| Citrus Fruit or Tomatoes | 44.1 | 50.4 | 54.8 | 198 | 212 | 68 |
| Milk | 23.2 | 39.9 | 51.6 | 104 | 168 | 64 |
| Eggs | 24.7 | 23.8 | 24.2 | 111 | 100 | 30 |
| Meat | 0.7 | 0.7 | 1.6 | 3 | 3 | 2 |

[1] *See* Appendix I.

Table 7. Age of employe in relation to quality of total diet and frequency of unsatisfactory use of specific foods from dietary histories for aircraft workers in California, November 1941-February 1942.

hand, about 14 per cent of the diets of men under 25 years of age were unsatisfactory for three or four food groups compared with 22 per cent and 27 per cent in the older age groups respectively.

The specific foods in which the diets of older men were more often unsatisfactory were milk and citrus fruits or tomatoes.

*Eating Place and Age.* Since more of the younger men ate at restaurants or boarded, a comparison was made of the consumption of different foods according to eating place as well as by age. The percentages of diets classified as unsatisfactory for each type of food are shown in Table 8 and in Figure 5. There were only 15 men over 35 years of age who ate in a restaurant or boarded, and these have been omitted.

The use of green or yellow vegetables was similar for all groups,

and from 50 to 58 per cent of diets were unsatisfactory in this food group.

Men under 25 years of age who ate at home had the best consumption of citrus fruits or tomatoes, but 40 per cent of them had diets classified as unsatisfactory for this type of food. In the same age group, 52 per cent of the diets were unsatisfactory for citrus fruits when the men ate in a restaurant or boarded, and 50 to 55 per cent of the diets of older men were unsatisfactory for citrus fruit if they ate at home or in a restaurant.

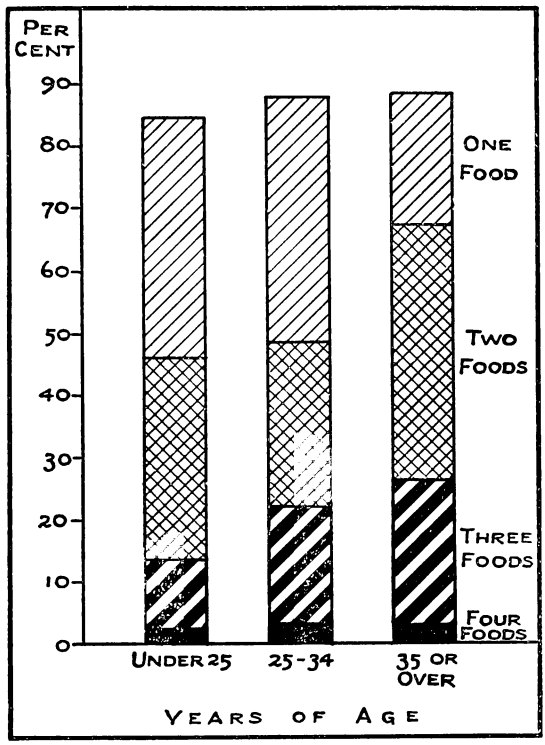


Fig. 4. Age of employe and the percentages of diets for one week classified as unsatisfactory because of insufficient amounts of one or more of five important food groups.

Milk consumption was considered unsatisfactory for only 22 per cent of men under 25 years of age who ate at home and for 25 per cent of those eating in restaurants or boarding houses, compared with 51 per cent of diets of men 35 years of age or older who ate at home. Diets were unsatisfactory in milk for 41 per cent and 33 per cent of men aged 25 to 34 years who ate at home and boarded, respectively. The consumption of milk differed more by age of the employe than consumption of any of the other types of food.

### B. Nutritive Content of Two-Day Diets

The consumption level for calories and eight essential nutrients

| Classification of Diet[1] | Per Cent of Diets of Employes in Specified Category | | | | | |
|---|---|---|---|---|---|---|
| | Meals at Home | | | Restaurant or Boarding House | | |
| | Under 25 Years | 25–34 Years | 35 Years or Older | Under 25 Years | 25–34 Years | 35 Years or Older |
| Total Records | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | |
| *General Rating* | | | | | | |
| Satisfactory | 2.1 | 1.7 | 2.8 | 1.9 | 3.3 | |
| Marginal | 11.5 | 10.0 | 7.3 | 16.7 | 11.7 | |
| Unsatisfactory | 86.4 | 88.4 | 89.9 | 81.5 | 85.0 | |
| *Specific Foods Unsatisfactory* | | | | | | |
| Green or Yellow Vegetables | 56.8 | 58.2 | 55.0 | 50.0 | 51.7 | |
| Citrus Fruit or Tomatoes | 39.7 | 49.6 | 55.0 | 51.9 | 55.0 | |
| Milk | 22.0 | 41.0 | 50.5 | 25.3 | 33.3 | |
| Eggs | 21.3 | 23.5 | 24.8 | 30.9 | 25.0 | |
| Meat | 1.0 | 0.6 | 1.8 | 0 | 1.7 | |
| Number of Diet Histories | 287 | 361 | 109 | 162 | 60 | 15 |

[1] *See* Appendix I.

Table 8. Age and eating place of employe in relation to quality of total diet and frequency of unsatisfactory use of specific foods from dietary histories for aircraft workers in California, November 1941-February 1942.

by these employes is revealed by the estimates of the average daily amounts of different nutrients furnished by the food reported in the two-day quantitative record. The accuracy of these estimates of nutritive content of foods consumed can be described as fairly good approximations. Both the errors in reporting the quantity of each food eaten and the errors in average values for nutrient content of each food tend to be compensating, and the total nutrient value calculated for a complete two-day diet usually will have a smaller error than the errors in reported quantity and in nutrient values for individual food items. For a few diets, the error of the total value probably was significantly large due to omission of some food or general underestimation or overestimation of portions. In general, the calculated nutritive content is believed to afford a sufficiently accurate index of the consumption level of the various nutrients for

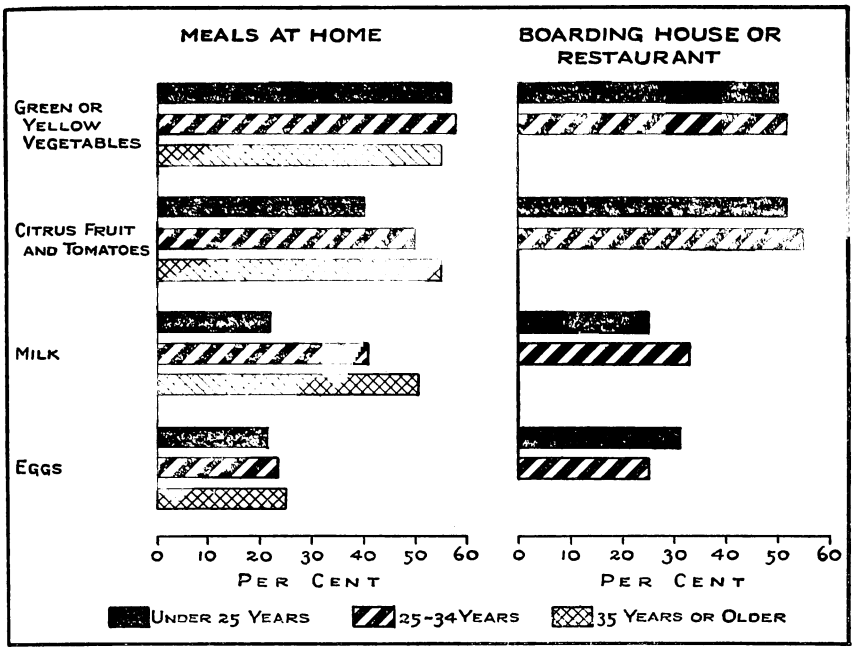


Fig. 5. Age of employe and eating place in relation to percentages of diets for one week classified as unsatisfactory for amounts of specific types of food.

several broad classifications of individual diets which will disclose the approximate frequency of deficiencies of different nutrients as judged by recommended allowances.

The average daily nutritive content of a two-day diet will not always disclose dietary deficiencies that would be revealed in a longer period. In the previous discussion of quality of food habits, it was emphasized that certain types of food should be eaten regularly, and daily consumption of some foods was the standard for a good diet. In the two-day diet, inadequate amounts of any nutrients give evidence that the reported diet fell below the recommended allowances on one or both days; but adequate amounts for two days do not necessarily indicate that the person was obtaining a good diet regularly. Thus, the frequency of deficient diets will tend to be somewhat lower for a two-day period than for an entire week.

The 250 two-day diets for which the content of specific nutrients

is presented were selected to represent the three-month period from November 15 to February 15. Records included were taken in the last week of November, and the first half of December, of January, and of February. The diet reports used always were for two days on which the employe had been at work. In addition, no record was used if the informant stated that there was anything "unusual" about the reported diet in response to a specific question to determine whether or not it was a typical diet.

### DAILY INTAKE OF SPECIFIC NUTRIENTS

The intake of each nutrient was classified in one of four categories according to the proportion of the recommended allowance which was furnished by the reported two-day diet. These categories are: A) equal to or greater than allowance; B) not more than 20 per cent less than allowance; C) from one-third to 20 per cent less than allowance; D) more than one-third less than allowance. The allowances adopted by the Committee on Food and Nutrition "were planned to provide a reasonable margin of safety" and were not minimum requirements. For purposes of this analysis, two-thirds of the allowance was adopted as a minimum intake below which a diet might be considered probably deficient. The limits of

Table 9. Percentages of diets in which the estimated content for eight different nutrients was various proportions of the recommended allowances, based on 250 two-day diets reported by aircraft employes in California, November 1941-February 1942.

| Nutrient | Percentage of Diets With Specified Amount | | | | | Daily Allowance Recommended |
|---|---|---|---|---|---|---|
| | Total | Percentage of Recommended Allowance | | | | |
| | | 100 or More | 80–99 | 67–99 | Under 67 | |
| Protein | 100.0 | 85.2 | 10.0 | 4.0 | 0.8 | 70 Gms. |
| Iron | 100.0 | 78.0 | 13.2 | 4.8 | 4.0 | 12 Mg. |
| Niacin | 100.0 | 70.0 | 18.4 | 4.4 | 7.2 | 18 Mg. |
| Vitamin A | 100.0 | 58.0 | 16.8 | 10.4 | 14.8 | 5,000 I.U. |
| Thiamin | 100.0 | 53.6 | 20.4 | 12.0 | 14.0 | 1.8 Mg. |
| Calcium | 100.0 | 52.0 | 12.4 | 10.8 | 24.8 | 0.80 Gm. |
| Ascorbic Acid | 100.0 | 33.2 | 10.0 | 10.8 | 46.0 | 75.0 Mg. |
| Riboflavin | 100.0 | 29.2 | 16.0 | 11.6 | 43.2 | 2.7 Mg. |

21 to 33 per cent less than the allowance were arbitrarily chosen for a marginal diet, which may be deemed "unsafe" and in need of improvement. A diet which furnished at least 80 per cent of the allowances for specific nutrients has been considered reasonably satisfactory.[4]

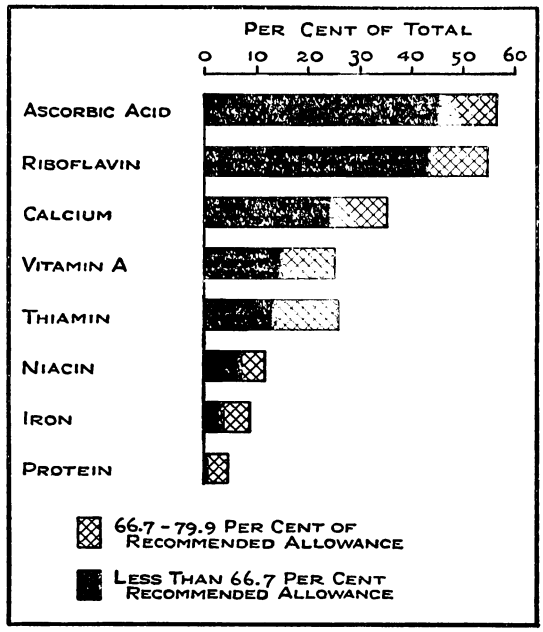


Fig. 6. Percentages of 250 diets for two days in which the estimated amounts of seven different nutrients were less than 80 per cent and less than 67 per cent of the recommended allowance for a specific nutrient.

For the various nutrients, there was a great difference in the percentages of diets which met the recommended allowances. The percentage distributions of the diets according to the four classes are given in Table 9 for protein, calcium, and iron, and five vitamins. Protein was most often obtained in adequate amounts and 85 per cent of the diets furnished the allowance or more. The iron allowance was met by 78 per cent of the diets and the niacin allowance by 70 per cent. The allowances for vitamin A, thiamin, and calcium were met by 58, 54, and 52 per cent of the diets, respectively. The ascorbic acid and riboflavin content met the allowances in 33 and 29 per cent of the diets, respectively.

[4] The full allowance for nutrients is highly desirable. The level for a satisfactory diet adopted here is based on the following considerations: (1) a conservative intake requirement was desired which would not overestimate the deficiencies in diet; (2) some reduction in content of foods for loss in cooking was made in computing vitamin values and allowances of the Committee on Food and Nutrition "do not allow for any extensive losses in cooking;" (3) underestimate of quantity and errors of omission in reporting no doubt affected some diet histories; (4) individual differences in requirements for various nutrients exist.

Table 10. Classification of diets according to number and type of nutrients furnished at intake level of specified minimum for any of 7 nutrients, including calcium, iron, vitamin A, ascorbic acid, niacin, riboflavin, and thiamin. (Class A = allowance or more; Class B = 80-99 per cent of allowance; Class C = 67-79 per cent of allowance; Class D = less than 67 per cent of allowance.)

| Number of Nutrients in Lowest Intake Class Found in Individual Diet | Number | Per Cent of Total |
|---|---|---|
| Total Diets | 250 | 100.0 |
| Class A, 7 Nutrients | 19 | 7.6 |
| Class B, 1 or More Nutrients | 24 | 9.6 |
| Class C, 1 or More Nutrients | 28 | 11.2 |
| 1 Nutrient Only | 24 | 9.6 |
| 2 Nutrients | 4 | 1.6 |
| Class D, 1 or More Nutrients | 179 | 71.6 |
| 1 Nutrient Only | 74 | 29.6 |
| 2 Nutrients | 47 | 18.8 |
| 3 Nutrients | 32 | 12.8 |
| 4 Nutrients | 14 | 5.6 |
| 5 Nutrients | 7 | 2.8 |
| 6 Nutrients | 5 | 2.0 |
| Specific Nutrients in Lowest Intake Class | | |
| *Class C* | | |
| *1 Nutrient* | | |
| Riboflavin | 11 | 4.4 |
| Ascorbic Acid | 10 | 4.0 |
| Calcium, Thiamin, Niacin, One Each | 3 | 1.2 |
| *2 Nutrients* | | |
| Riboflavin and: Ascorbic Acid, Thiamin, Vitamin A, One Each | 3 | 1.2 |
| Ascorbic Acid and Vitamin A | 1 | 0.4 |
| *Class D* | | |
| *1 Nutrient* | | |
| Ascorbic Acid | 47 | 18.8 |
| Riboflavin | 16 | 6.4 |
| Calcium | 5 | 2.0 |
| Vitamin A | 5 | 2.0 |
| Iron | 1 | 0.4 |
| *2 Nutrients* | | |
| Riboflavin and Ascorbic Acid | 16 | 6.4 |
| Riboflavin and Calcium | 12 | 4.8 |
| Riboflavin and Thiamin | 4 | 1.6 |
| Riboflavin and Vitamin A | 3 | 1.2 |
| Riboflavin and Niacin | 3 | 1.2 |

Table 10. (Continued)

| Number of Nutrients in Lowest Intake Class Found in Individual Diet | Number | Per Cent of Total |
|---|---|---|
| Specific Nutrients in Lowest Intake Class (Continued) | | |
| 2 *Nutrients—Continued* | | |
| Ascorbic Acid and Thiamin | 3 | 1.2 |
| Ascorbic Acid and Vitamin A | 2 | 0.8 |
| Ascorbic Acid and Calcium | 2 | 0.8 |
| Calcium and Thiamin | 2 | 0.8 |
| 3 *Nutrients* | | |
| Riboflavin, Ascorbic Acid, and Calcium | 10 | 4.0 |
| Riboflavin, Ascorbic Acid, and Vitamin A | 6 | 2.4 |
| Riboflavin, Calcium, and Vitamin A | 3 | 1.2 |
| Riboflavin, Thiamin, and Niacin | 3 | 1.2 |
| " Other Combinations | 10 | 4.0 |
| 4 *Nutrients* | | |
| Riboflavin, Ascorbic Acid, Calcium, and Vitamin A | 7 | 2.8 |
| Riboflavin, Ascorbic Acid, Calcium, and Thiamin | 4 | 1.6 |
| Other Combinations | 3 | 1.2 |
| 5 *Nutrients* | | |
| Riboflavin, Ascorbic Acid, Calcium, Niacin, and One Other | 4 | 1.6 |
| Other Combinations | 3 | 1.2 |
| 6 *Nutrients* | | |
| Riboflavin, Calcium, Niacin, Thiamin, and Two Others | 5 | 2.0 |

The relative frequency of diets with less than 80 per cent of allowances for the different nutrients is portrayed in Figure 6. The order is approximately the reverse of that found for the percentages of diets which met the allowances, as the percentage of diets within 20 per cent of the allowance was not large for any nutrient. Diets were deficient by more than one-third of the allowance in the following descending order of frequency for specific nutrients: ascorbic acid, 46 per cent; riboflavin, 43 per cent; calcium, 25 per cent; vitamin A,[5] 15 per cent; thiamin, 14 per cent; niacin, 7 per cent; and iron, 4 per cent. Less than 1 per cent of the diets furnished less than two-thirds of the protein requirement.

*Multiple Nutrient Deficiencies.* For the two minerals and five

[5] The very high content of vitamin A of some vegetables may make an average intake for a two-day period unusually high and atypical of the consumption level over a longer period.

vitamins, deficiencies of more than one-third of allowance averaged 1.54 per person; and deficiencies of more than 20 per cent averaged 2.19 per person. But for those employes whose diets were deficient by more than 20 per cent for at least one nutrient, the average number of deficiencies was 2.61, and for employes with diets deficient by one-third for one or more nutrients, the average number of nutrient deficiencies was 2.15.

Of greater interest than the average number of deficiencies is the distribution of diets according to the number of nutrients which were obtained in inadequate amounts. This information is given in Table 10. Only 8 per cent of these men had obtained a diet which furnished all seven nutrients in amounts equal to or greater than the allowances; and not quite 10 per cent had diets which furnished 80 to 99 per cent of the recommended allowances. Thus, 17 per cent of the men had moderately good or excellent diets. The other 83 per cent of the men needed some improvement in their diets. This includes the 11 per cent of the employes who had marginal diets or diets in which the amount of one or more nutrients was from 67 to 79 per cent of the allowance; and the remaining 72 per cent who obtained less than 67 per cent of the allowance for at least one of the seven nutrients.

The marginal diets were most often low in only one nutrient, but a few had two nutrients in the marginal classification. The nutrient in which these marginal diets failed was either ascorbic acid or riboflavin in most instances.

The number of nutrients in individual diets which were less than two-thirds of allowances ranged from one to six. Thirty per cent of all diets had less than two-thirds of the allowance for only one nutrient; 19 per cent had this degree of deficiency for two nutrients; 13 per cent for three nutrients, and 10 per cent for four to six nutrients.

When the diet was deficient in only one nutrient, the specific nutrient involved was ascorbic acid in nearly two-thirds and ribo-

flavin in slightly over one-fifth of such diets. When multiple deficiencies occurred, ascorbic acid was one of the deficiencies in nearly two-thirds of these diets also; but riboflavin was part of the multiple deficiency combinations in 84 per cent of the diets with two or more nutrients supplied in amounts less than two-thirds of allowances. Calcium was one of the deficient nutrients in 54 per cent of the multiple deficiency diets, but was the sole deficiency in only 2 per cent of all diets or 6.8 per cent of single deficiency diets.

The rare occurrence of thiamin, vitamin A, niacin, and iron as single dietary deficiencies or of combinations of these nutrients without riboflavin, calcium, or ascorbic acid also being deficient suggests two observations on the eating habits of this group. A small, but significant, proportion of these men apparently ate a very restricted diet, and a generally increased consumption as well as improved food choices probably was needed. For most of the men, a better consumption of milk and of citrus fruits, tomatoes, and certain green vegetables would correct the major deficiencies of riboflavin, calcium, and ascorbic acid and raise the intake of most other nutrients. Conversely, if an average mixed diet contains sufficient amounts of riboflavin and ascorbic acid, it will seldom be deficient in the other nutrients.

## ENERGY VALUE OF DIETS

The estimated number of calories in the total amount of food reported is shown in Table 11. For 34 per cent of these men the estimated energy value equalled or exceeded the 3,000 calories daily recommended for the average man with moderate activity. The medium number of calories for the group was about 2,675; and about one-fourth of the men had diets which furnished less than 2,200 calories daily.

A better indication of the adequacy of these diets in calories may be obtained if the intake is considered in relation to the individual's requirement. The basal requirement for each employe was esti-

mated on the basis of age, height, and weight from tables published by Boothby, Berkson, and Dunn (6). The percentage of this basal requirement which was furnished by the total food reported was computed for each individual. The distributions of these diets according to the percentage of basal requirement is given in Table 12.

Table 11. Average number of calories per day estimated for two-day diet histories of 250 aircraft workers in California, November 1941—February 1942.

| Number of Calories | Number of Diets | Per Cent of Total |
|---|---|---|
| TOTAL | 250 | 100.0 |
| Less Than 1,800 | 22 | 8.8 |
| 1,800–2,199 | 44 | 17.6 |
| 2,200–2,599 | 50 | 20.0 |
| 2,600–2,999 | 50 | 20.0 |
| 3,000–3,399 | 44 | 17.6 |
| 3,400–3,799 | 23 | 9.2 |
| 3,800–4,199 | 7 | 2.8 |
| 4,200–4,599 | 6 | 2.4 |
| 4,600 or More | 4 | 1.6 |

About one-fourth of the men reported amounts of food for two days which furnished 180 per cent or more of their estimated basal requirement. This amount should be adequate for men working eight hours a day at moderately active work. For another 36 per cent of the men, the caloric intake was from 140 to 179 per cent of basal requirements. But nearly 40 per cent of the men reported diets which would furnish less than 140 per cent of basal metabolic needs, and this level of caloric intake would be insufficient for men engaged in work involving physical activity.

As the quantity of food eaten was reported from memory and estimated, it would be easy to conclude that these low estimates of caloric intake were the result of incomplete diet records or gross underestimation. No doubt, some men did have more than the estimated number of calories, and it is very unlikely that any men were consuming less than their basal need, although 5 per cent of them reported such a diet for a two-day period. But even if considerable allowance is made for omissions of some food items or underestimates of quantity, the evidence is strong that a consider-

able number of these men were eating low-calorie diets which were below a consumption level believed to be adequate. Furthermore, the frequency of low-calorie diets among this group is in line with the findings of other dietary studies in which data were collected by the family inventory method or by weighing the foods eaten. Thus, a study in Toronto (2c) of individual diets for one week, based on weighed amounts of food, reported that ninety-three male wage earners had an average daily caloric intake of 2,540 calories; and a study in Halifax (2a) showed that male workers in eighty-two families had an average consumption of 2,622 calories per day. Considerable evidence is available to indicate that it is not unusual for wage earners to eat a diet with less energy value than is deemed desirable.

Table 12. Calories furnished by two-day diets expressed as the percentage of individual basal caloric requirement.

| Per Cent of Basal Requirement | Number of Diets | Per Cent of Total |
|---|---|---|
| TOTAL | 250 | 100.0 |
| Less Than 100.0 | 13 | 5.2 |
| 100.0–119.9 | 37 | 14.8 |
| 120.0–139.9 | 47 | 18.8 |
| 140.0–159.9 | 46 | 18.4 |
| 160.0–179.9 | 43 | 17.2 |
| 180.0–199.9 | 29 | 11.6 |
| 200.0–219.9 | 19 | 7.6 |
| 220.0–239.9 | 5 | 2.0 |
| 240.0 or More | 11 | 4.4 |

For the employes in this Study, these data suggest that from one-fourth to one-third of the men probably had insufficient calories in the two-day period for which the quantitative diet was reported. The significance of a low intake of calories would depend on whether it was typical or usual for the individual.

### C. Vitamin and Mineral Supplements

The use of concentrated or synthetic vitamin and mineral preparations was not extensive among these employes. The men who reported taking any prepared supplement comprised only 8.8 per cent of the group. This included only six persons, or 0.5 per cent who reported a mineral supplement. The majority of those who

| Vitamin or Mineral in Supplement | Number of Persons | Per Cent | |
|---|---|---|---|
| | | Of Total Persons | Of Those Taking a Supplement |
| Total Persons | 1,103 | 100.0 | |
| Total—1 or More Types of Supplement | 97[1] | 8.8 | 100.0[1] |
| Vitamin A (+ or − D) | 48 | 4.4 | 49.5 |
| B Complex | 39 | 3.5 | 40.2 |
| Yeast | 12 | 1.1 | 12.4 |
| Thiamin | 14 | 1.3 | 14.4 |
| Ascorbic Acid | 12 | 1.1 | 12.4 |
| Calcium | 4 | 0.4 | 4.1 |
| Iron or Liver Extract | 2 | 0.2 | 2.1 |
| Other and Not Specific | 11 | 1.0 | 11.3 |

[1] Numbers of persons taking specified supplement do not add to total because many took more than one type of supplement.

Table 13. Frequency of use of specific vitamin or mineral supplements among a group of aircraft employes in California.

took any vitamin or mineral product were taking more than one kind, usually a multiple vitamin product.

Both vitamin A and B complex, separately or in a combination product, were taken by slightly over one-fourth of those taking vitamins and by about 2.4 per cent of all persons interviewed. Detailed information on use of supplements is given in Table 13. Vitamin A, either alone or with other vitamins,[6] was reported by 4.4 per cent of the men; B complex, alone or with other vitamins or minerals, was reported by 3.5 per cent; and yeast by 1.1 per cent. Thiamin alone was being taken by 1.2 per cent of the men, and no other single vitamin was taken by more than one or two persons. Some ascorbic acid was taken by 1.1 per cent of the men, and all but one person obtained his ascorbic acid from a multi-vitamin preparation. Of the six men who reported any mineral supplement, four were taking calcium, and all of these also were taking one or more vitamins; two were taking iron or liver extract.

[6] These were vitamins other than vitamin D. Most vitamin A products reported included D, but a number of men were unable to give definite information as to the trade name or content of product taken.

## Summary

Diet histories on the consumption of selected foods during one week were collected for 1,103 aircraft workers in Southern California between November 15, 1941 and February 15, 1942. The reported use of each of five foods or food groups was compared with amounts recommended in the dietary pattern prepared by the National Research Council, Committee on Food and Nutrition with the following results:

(1) Percentages of diets which included amounts per week equal to or slightly below that recommended were:

| | *Per Cent* |
|---|---|
| Green or yellow vegetables, 6 or more | 21 |
| Citrus fruits or tomatoes, 7 or more | 36 |
| Milk, 10 or more glasses | 51 |
| Eggs, 4 or more | 59 |
| Lean meat, fish, etc., 5 or more times | 95 |

(2) percentages of diets which included amounts definitely below that recommended were:

| | *Per Cent* |
|---|---|
| Green or yellow vegetables, 3 or less—43 per cent<br>Less than 7 vegetables, with 5 or less green or yellow—13 per cent | 56 |
| Citrus fruits or tomatoes, 4 or less | 49 |
| Milk, 5 glasses or less | 33 |
| Eggs, 1 or none | 23 |
| Lean meat, etc., 2 or less times | 1 |

When amounts of all five foods in an individual diet are considered, it is found that: 2 per cent of the diets included amounts of each of the five foods as described in (1) above; 11 per cent had smaller amounts for one or more foods but none as low as described in (2) above; and 87 per cent of the diets had amounts as low as described in (2) above for one or more food groups. The latter group

of 87 per cent included: 32 per cent of diets low in one food group, 36 per cent low in two food groups, 16 per cent low in three food groups, and 3 per cent low in four food groups.

There was little difference in the diets of men recently arrived in California and those who had lived there five years or longer.

Young men had somewhat better diets than the older men. Men under 25 years of age drank more milk and ate more citrus fruits than those 25 years or older, but had a similar consumption of green and yellow vegetables and eggs.

Two hundred and fifty complete two-day diet records, for which estimated amounts of each food were reported, were analyzed to obtain approximate values for their nutritive content in calories, protein, calcium, iron, vitamin A, ascorbic acid, niacin, thiamin, and riboflavin. The percentages of these diets in which the amount of a specific nutrient was less than two-thirds of the recommended daily allowance were: protein, 0.8 per cent; iron, 4.0 per cent; niacin, 7.2 per cent; thiamin, 14.0 per cent; vitamin A, 14.8 per cent; calcium, 24.8 per cent; riboflavin, 43.2 per cent; ascorbic acid, 46.0 per cent.

Among the 250 two-day diets, there was 71.6 per cent in which one or more of the mineral and vitamin nutrients was less than two-thirds of the daily allowance. The average number of nutrients below this intake level was 2.15.

The median caloric value was 2,675 calories per day, and only 34 per cent of the diets furnished an estimated 3,000 calories or more per day.

## Appendix I

Description of qualitative classes used in rating weekly diet histories. A is satisfactory, B is marginal, and C is unsatisfactory.

*Milk:*

A—10 or more glasses
B—6-9 glasses
C—5 or less glasses

*Vegetables—Green or Yellow:*

A—6 or more green or yellow vegetables
B—4 or 5 green or yellow vegetables, at least 7 total for all kinds
C—3 or less green or yellow vegetables, or less than 7 total with 4 or 5 green or yellow vegetables

*Citrus Fruit and Tomato:*

A—Citrus fruits and tomatoes—7 or more
B—Citrus fruits and tomatoes—5 or 6
C—Citrus fruits and tomatoes—4 or less

*Eggs:*

A—4 or more
B—2 or 3
C—1 or 0

*Lean Meat, Fish, or Poultry:*

A—5 or more times
B—3 or 4
C—2 or less

The dietary "pattern" to meet recommended allowances outlined by the Committee on Food and Nutrition, National Research Council, is as follows:

Milk, adults—1 pint daily
Vegetables, 2 servings daily—1 green or yellow
Fruit, 2 servings daily—1 citrus or tomato and 1 other
Eggs, 3 or 4 times per week
Meat, 1 serving daily
Whole grain or "enriched" cereal and bread, at least half of the intake
Butter, or fortified oleomargarine (100-500 calories)
Potato, 1 or more servings

## References

1. Food and Nutrition of Industrial Workers in Wartime. Report of the Committee on Nutrition in Industry. National Research Council, Washington, D. C., 1942.

2. Canadian Studies on Nutrition. *Canadian Public Health Journal,* May, 1941, 32, p. 5.
(a) Young, Gordon E.: A Dietary Study in Halifax.
(b) Sylvestre, J. Ernest et Nadeau, Honoré: Enquête sur l'Alimentation Habituelle des Familles de Petits-Salariés dans la Ville de Québec.
(c) Palterson, Jean and McHenry, E. W.: A Dietary Investigation in Toronto Families Having Annual Incomes Between $1,500 and $2,400.
(d) Hunter, George and Pett, L. Bradley: A Dietary Survey in Edmonton.

3. Stiebeling, Hazel K. and Phipard, Esther F.: Diets of Families of Employed Wage Earners and Clerical Workers in Cities. Washington, U. S. Department of Agriculture, 1939, Circular No. 507, 142 pp.

4. Sources of Food Values:
(a) Arnold, A.: Schreffler, C. B.; and Lipsius, S. T.: Chemical Determination of Nicotinic Acid. *Industrial and Engineering Chemistry,* (Anal. Ed.), 1941, 13, pp. 62-63.
(b) Aykroyd, W. R. and Swaminathan, M.: The Nicotinic Acid Content of Cereals and Pellagra. *Indian Journal of Medical Research,* 1940, 27, pp. 667-677.
(c) Chatfield, Charlotte and Adams, Georgian: Proximate Composition of American Food Materials. Washington, U. S. Department of Agriculture, 1940, Circular No. 549, 92 pp.
(d) Del Regno, F.: Nicotinic Acid Content of Some Foods. *Quaderni Nutrizione,* 1939, 6, pp. 368-373.
(e) Fixsen, M. A. B. and Roscoe, M. H.: Tables of the Vitamin Content of Human and Animal Foods. *Nutrition Abstracts and Reviews,* 1940, 9, pp. 795-861.
(f) Kodicek, E.: Estimation of Nicotinic Acid in Animal Tissues, Blood and Certain Foodstuffs. I, II. *Biochemical Journal,* 1940, 34, pp. 712-723; 724-735.
(g) Leong, P. C.: Nicotinic Acid Content of Foods. *Journal of the Malayan Branch of the British Medical Association,* 1940, 4, pp. 261-278.
(h) Munsell, H. E.: Vitamins and Their Occurrence in Foods. The Milbank Memorial Fund *Quarterly,* October, 1940, xviii, No. 4, pp. 311-344.
(i) Richardson, J. E. and Mayfield, H. L.: Vitamin C Content of Winter Fruits and Vegetables. Montana State College Agricultural Experiment Station Bulletin No. 390, May, 1941.
(j) Sherman, H. C.: CHEMISTRY OF FOOD AND NUTRITION. New York, The Macmillan Company, 1941, 6th ed., p. 379.
(k) Waisman, H. A. and Elvehjem, C. A.: THE VITAMIN CONTENT OF MEAT. New York, The Macmillan Company, 1941.

5. National Research Council, Committee on Food and Nutrition: Recommended Dietary Allowances, May, 1941. Mimeographed report distributed by the Federal Security Agency, Washington, D. C.

6. Boothby, Walter M.; Berkson, Joseph; and Dunn, Halbert L.: Studies of the Energy of Metabolism of Normal Individuals: A Standard for Basal Metabolism with a Nomogram for Clinical Application. *American Journal of Physiology,* July, 1936, 116, No. 2, p. 480.