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N81  
No. 2702

FOOD CONSUMPTION OF COLLEGE ATHLETES

THESIS

Presented to the Graduate Council of the  
North Texas State College in Partial  
Fulfillment of the Requirements

For the Degree of

MASTER OF SCIENCE

By

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"

Denton, Texas

August, 1959

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## INTRODUCTION

While there have been studies made on the food consumption of college women (5, 6, 16) and two studies comparing the food consumption of both sexes (13, 18) only a few considered the average male college student (7, 19). None of these studies were found to include the food consumed by college athletes. However, Van Itallie, Sinisterra and Stare (17) have indicated that special feeding for this group is of psychological value and that the determining of the caloric needs of the athlete from the usual height-weight tables is unfair, due to the higher corporeal density of the tissues of the athlete.

Since 435 colleges and universities are members of the National Collegiate Athletic Association and 450 belong to the National Association of Intercollegiate Athletics (1, 8), the food consumption of these young men is of interest to the institutional dietitian unless other facilities are provided for the athletes.

The present study was undertaken to calculate the nutritive value of the food consumed by male college athletes eating a self-selected diet in the college athletes dining room.

## PROCEDURE

The sixty athletes studied attended North Texas State College in the spring of 1958 and the following school year of 1958-1959. Thirty-four were football players (Group F); sixteen were basketball players (Group B); and ten were track men (Group T). The age range of these men was from 18 to 25 years with a mean of 18.9, 20.6 and 20 years of age for Groups F, B and T, respectively.

To determine the food consumption of these groups, charts were set up for each meal's menu and the food on each subject's tray was checked as he passed through the cafeteria line. The number of servings of each item the student selected was recorded. The condiments, jelly and honey were available, ad libitum. Since the athletes served themselves these items, it was impossible to keep an accurate measure of the amounts used and therefore these items were not included in the final calculations.

The entire group of athletes ate in a special athlete's room which had its own serving line. The food consumed by the members of each sport was computed separately due to the different periods of training and competition. The food eaten by each group was tabulated during three periods, Monday through Friday, inclusive: one while the team was in training prior to the actual competitive season ("Pre"), one

during season participation ("Par"), and one following this period ("Post") when the men were at rest as far as sport participation was concerned.\*

Plate waste was obtained at each meal for the correction of the original food selection totals. The group of men taking part in this study had specially marked trays to identify their waste and to insure that all these trays were checked for waste.

The daily food intake was calculated using Food Values of Portions Commonly Used by Bowes and Church (3). These were averaged for each period for each group and the averages compared with the National Research Council's recommended daily allowances.

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\*The periods for Group F were only four days each since the group was often out of town on Friday during the "Par" period.

## RESULTS AND DISCUSSION

The athletes of the present study ranged in weight from 130 pounds to 260 pounds and in height from 68 inches to 79 inches. None of the age groupings given in the National Research Council's (NRC) chart of recommended daily allowances (14) match those of the present study. The mean age of Group F, which was 18.9 years, put its members at the top of the 16-19-year old boys, but their mean weight and height was 59.4 pounds heavier and 2.9 inches taller than the reference boy used in this age group for the NRC's table. Groups B and T with a mean age of 20.6 and 20, respectively, would not be included in this group, yet they are at an age when growth may or may not be complete and muscular development is still taking place. Therefore, it seems inappropriate to group them with the reference man of twenty-five years of age. For these reasons, the calorie allowances for these two groups were calculated using the formula suggested by NRC for use in adapting calorie allowances for individuals whose weight and height are different from those of the reference man. The formula used was:

$$\text{Calorie allowance for men: } 0.95(815 \div 36.6W^*)$$

The mean weight of each of the three groups was used as the desirable weight and the calorie allowances thus calculated

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\*W--desirable weight in kilograms.



are given in Table I along with the height, weight and age range of each group.

For the various other nutrients, NRC's proportions for determining individual daily allowances were used, when it was practical.

TABLE I  
HEIGHT, WEIGHT AND AGE WITH CALCULATED  
CALORIE ALLOWANCES

Group	Members	Height in Inches			Weight in Pounds			Age			CAA*
		Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	
F	34	68	75	72	160	260	198	18	25	18.9	3910
B	16	68	79	75	163	220	185	19	22	20.6	3690
T	10	68	74	71	130	195	157	18	22	20.0	3200

\*Calculated calorie allowance using formula  $0.95(815/36.6W^*)$  with W being the mean weight in kilograms.

At North Texas State College a special dining room was provided for the athletes in order to give them an opportunity to meet their requirements on a self-selection basis. They were not limited as to the kind of food and the number of servings which they were permitted to choose. Consequently, the athlete's choice usually included a number of servings and a variety of food at each meal.

The breakfast menu provided a choice of three juices, three fresh fruits, choice of several prepared cereals (cooked cereal in cold weather), bacon, eggs (both fried and scrambled), doughnuts or breakfast sweet as coffee cake or sweet rolls, enriched white bread toast spread with fortified margarine, and beverages (coffee, milk, chocolate milk, and orange drink). Two choices of jelly were on the counter each morning, while a pitcher of honey was kept on the table at all meals at the request of the coaches. The typical breakfast chosen consisted of four slices of bacon, two eggs, two slices of toast spread with fortified margarine, two glasses of juice and two one-half pint bottles of homogenized milk, or one half pint of homogenized milk and a half pint of chocolate milk. A bottled non-carbonated orange drink was also popular even though reconstituted frozen orange juice was usually available.

For noon and night meals, the menu pattern usually consisted of two meats, three salads (one fruit, one vegetable, and one congealed), four vegetables, and two "made" desserts plus several flavors of ice cream. For beverage, there was a choice of iced tea, homogenized milk, chocolate milk and orange drink. Bread (both whole wheat and enriched white) was served each meal with hot rolls made from enriched flour at noon and a quick hot bread at night. The quick bread used was either hot biscuits, cornbread, cornbread muffins, or other muffins, depending on the menu. The flour used in the

quick breads was enriched but the cornmeal was not enriched. Fortified margarine was served each meal. Appropriate condiments such as mustard and catsup were available at each meal as were mayonnaise, French dressing and other dressings. The typical noon or night meal as chosen by the athletes usually consisted of a double serving of meat, three servings of vegetables, a "made" dessert with ice cream, three servings of beverages, four hot rolls or four slices of enriched bread. Salads were not too popular except for the fruit salads or any salad with hard-cooked egg. Either a deviled egg or a green salad with one-half egg for a garnish was popular.

The only exception to the above described regimen was the pre-game, or pre-event meal. This meal, whenever possible, was served three hours before the scheduled event to the members of the participating group. The menu was requested by the coaching staff, and consisted of roast beef, baked potato, sliced canned peaches, dry toast with honey and hot or iced tea. Although this menu from which they made their selection was more limited, they were allowed as much of these foods as they desired. The total amount of food consumed at this meal was always much smaller than at the other meals.

The servings used in the athletes' serving line were found to be approximately one and a half times as large as the ones given in Bowes and Church's tables (3). Therefore, appropriate increases were made in calculating the nutritive value of each serving. The nutritive values of these

self-selected diets are described under the heading of each nutrient.

### Calories

Keys (11) states that there are no special requirements for the athletes. He indicates, however, that the calorie intake adequate to meet their needs would be much higher than most people would require.

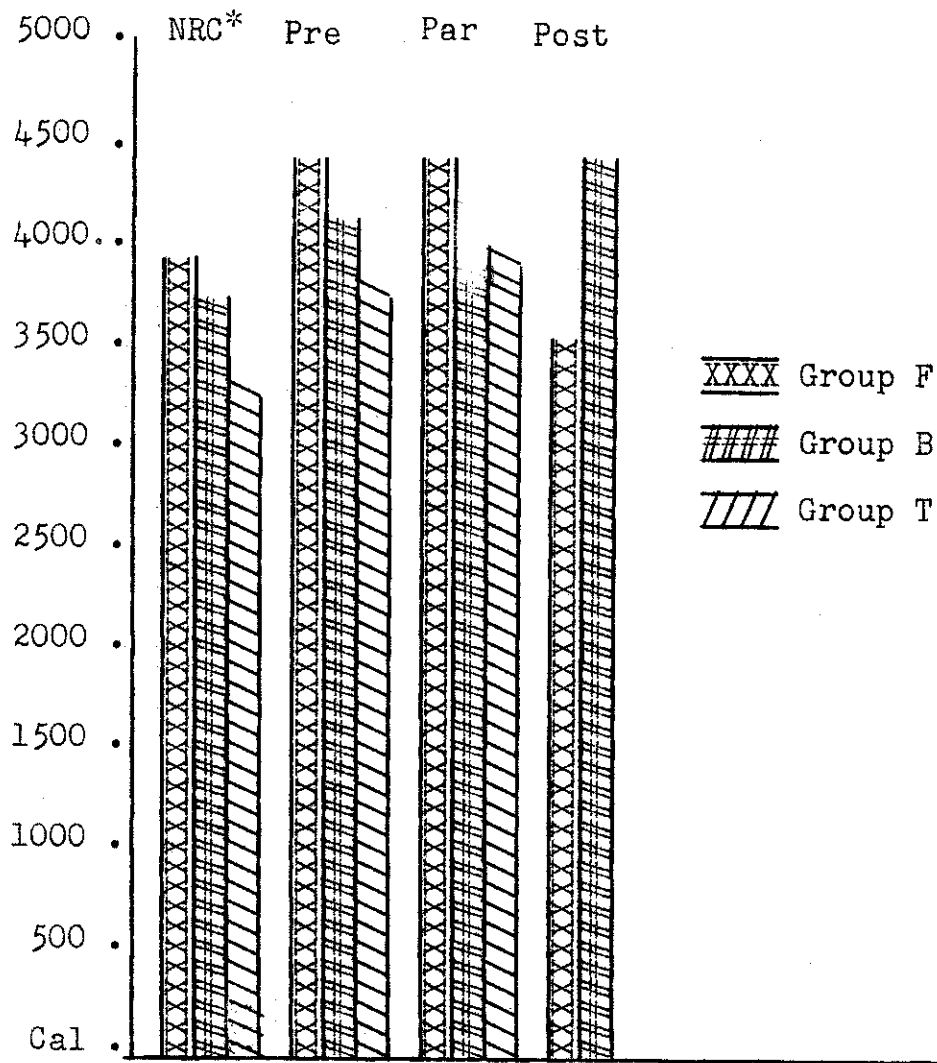
In the present study, the calorie intake for Group F was approximately the same for the "Pre" and "Par" periods, ranging from 4571 to 5226 calories per day (Figure 1) with an average of 4630 calories for "Pre" and 4615 for "Par". In the "Post" period the range was less, namely, 3976 to 4114 calories per day with an average of 4021.

Even during this "Post" period, which was the period of least activity, the members of Group F had a calorie intake greater than that recommended by NRC. This is in keeping with the results of the study of Konishi and co-workers (12) with young men in the service on an ad libitum regimen. They found that the mean calorie intake of the service men studied was above the dietary allowances recommended by NRC and was also above the minimum allowances specified by the Armed Forces for individuals under comparable activity levels. Konishi and co-workers found that this increased calorie consumption was accompanied by an average weight increase of 2.03 kilograms per man over the four-week period of the study.

In a study made by the Army Personnel Research Committee of the Medical Research Council in collaboration with the Army (15) it was found that the  $18\frac{1}{2}$  -  $19\frac{1}{2}$ -year old recruits under a strenuous schedule consumed 58.4 calories per kilogram of body weight. These subjects also showed a mean weight increase of 1.35 kilograms per man. The energy expenditure of these recruits might compare roughly with that of the athletes during the "Pre" and "Par" period of the present study. In Group B the athletes had an average intake of 49 calories per kilogram of body weight; Group F's average was 51 calories per kilogram of body weight; while Group T had an intake of 58 calories per kilogram of body weight for these two periods. However, the Army study included total calorie consumption from all sources. The present study included only the foods consumed in the athletes' dining room with the omission of all condiments, jelly, honey and salad dressings. No attempt was made to record the food obtained elsewhere. Furthermore, changes in body weight of the athletes in the present study were not available for comparison with the Army recruits.

The outstanding difference in calorie intake between Group F and Group B was the fact that Group F was higher for "Pre" and "Par" periods and dropped for the "Post" period while Group B was lower for the "Pre" and "Par" periods and increased for the "Post" period. Although no record was kept of the weight changes during this study, the coaching staff

of Group B placed great stress upon the need to lower weight in some instances and for the majority to avoid any weight increase during the "Pre" and "Par" periods. However, the calorie intake of the group suggests that they increased their weight during the "Post" period.



\*NRC recommended allowances

Fig. 1--The calorie intakes of Groups F, B, and T, with the recommended daily allowances for the mean height and weight of each group.

Since the season of participation for Group T extended beyond the close of the academic year, it was impossible to obtain food consumption data during their "Post" period. The calorie intake of this group closely resembled that of Group B for the "Pre" and "Par" periods, but since the men of Group T were shorter and lighter than those of Group B, this represented a proportionally larger intake of calories. As previously stated, Group T had an average intake of 58 calories per kilogram of body weight while the average of Group B for these two periods was 49 and Group F's was 51 calories per kilogram of body weight.

Distribution of calories.---The present-day American diet contains about 10 per cent of the total calories from protein, 40-45 per cent from fats, and the remaining percentage from carbohydrates. In the present study, as shown in Table II, it was found that the protein intake more nearly approached the 15 per cent of the total calories which Johnston (10) believes necessary for circumpubertal growth and special stresses of children 10-20 years of age. The greatest variance in protein intakes was seen with Group F which had an intake of only 13 per cent during the "Pre" period but 16 per cent during the "Par" and "Post" periods. Table II shows the percentage of fat in the diets of the athletes studied to be in keeping with the national pattern. However, Keys (11) recommends that athletes should get no more than 30 per cent of their calories from fat. The percentage of carbohydrates

TABLE II  
 PERCENTAGE OF TOTAL CALORIES FROM PROTEINS,  
 FATS AND CARBOHYDRATES

Group	Period	Proteins	Fats	Carbohydrates
F	Pre	13	42	44
	Par	16	46	38
	Post	16	43	41
B	Pre	14	44	42
	Par	14	43	42
	Post	14	44	42
T	Pre	15	46	38
	Par	14	46	39

was slightly lower than the usual diet in the United States. The highest percentage of carbohydrates was 44 per cent consumed by Group F during the "Pre" period with an average for the three periods of only 41 per cent. Group T had the lowest percentage intake of carbohydrates of the groups studied; 38 per cent for "Pre" and 39 per cent for "Par". While Group B had an intake of 42 per cent of the total calories from carbohydrates for all three periods.

#### Protein

NRC (14) has suggested that 100 grams of protein per day is a safe allowance for children 10 to 20 years of age. Group F and Group T's average age falls within this range and Group B is only 0.6 of a year above this age group. Therefore, this allowance is used for comparison with all three groups in Figure 2. The protein intake of the three groups



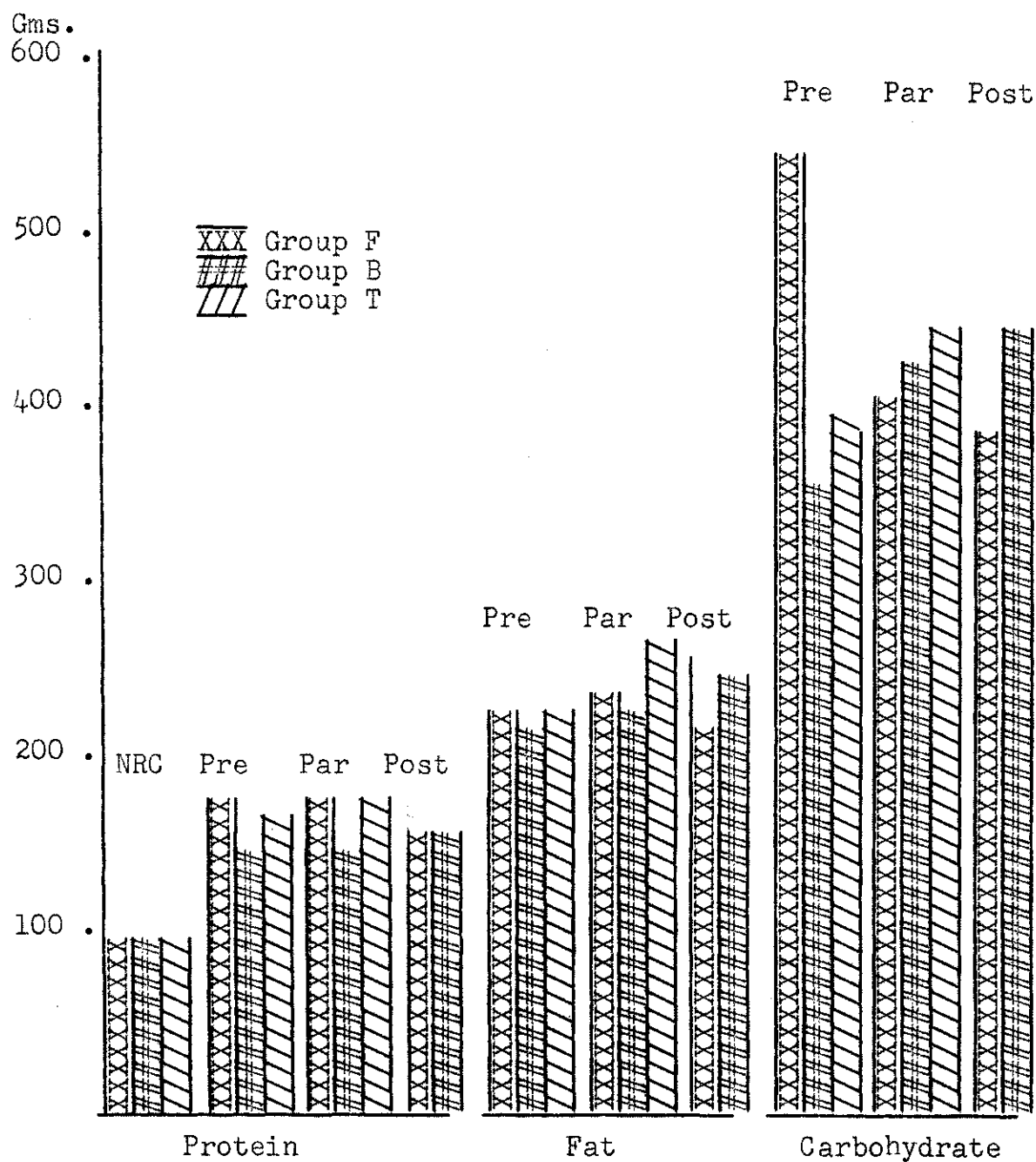


Fig. 2--The total protein, fat and carbohydrate intakes of Groups F, B and T, with NRC's recommended daily allowance for protein.

of athletes greatly exceeded the recommended daily allowances. Group B consumed less protein than did Groups F and T in the "Pre" and "Par" periods, but was similar with Group F in the "Post" period. Again, since Group T was the smallest in height, even though the number of grams of protein was approximately the same as for Group F, it represented a proportionally larger intake of protein. Group T averaged 2.6 grams of protein per kilogram of body weight for "Pre" and "Par" and Group F averaged 2.0 grams per kilogram of body weight for the same periods. Group B's protein intake averaged 1.7 grams per kilogram of body weight for these periods. For the "Post" period the average for Group F and Group B was 1.8 and 1.9, respectively.

#### Fats

The place of fat in human nutrition seems to be in the limelight of nutritional interest today. Due to the role of fat in atherosclerosis and other cardiovascular ailments, the present trend is to lower the total fat intake. Not only does Keys (11) recommend that no more than 30 per cent of the total calories consumed by athletes come from fat but also that not more than one third of this amount be saturated fats. Therefore, not only the total fat intake but also the kind of fat consumed must be considered.

The degree of unsaturation of fats is roughly proportional to their linoleic acid content and Coons (4) states that fats

with less than 10 per cent linoleic acid comprise nearly 80 per cent of the dietary fats in the United States, while oils with 40-60 per cent linoleic make up only 10 per cent of the dietary fat. The remainder comes from sources with values in between 10 and 40 per cent linoleic acid. The source and kind of food fats consumed by the subjects in the present study indicate that these percentages apply to their fat intakes also.

Konishi and co-workers (12) reported that milk was the greatest single source of fat calories in the diets of the soldiers studied. This was not attributed to the percentage of fat in milk per se or in milk equivalents, but to the quantity of fresh milk consumed which averaged 1357 grams ( $1\frac{1}{2}$  quarts) daily for each man. The subjects of the present study showed a similarly high consumption of milk which accounted for approximately one third of the day's fat. Beef and veal were another chief source of fat in the diets of the athletes. Both the milk and the meat mentioned contain about 50 per cent saturated fats, which according to Keys (11) should not exceed 6-7 per cent of the total calories. In the present study, these sources, plus margarine and hydrogenated shortenings, constituted about 36 per cent of the total calories.

The high intake of milk for Group T ( $1\frac{1}{2}$  quarts daily) accounted for the high fat intakes of this group as reported in Figure 2.

### Carbohydrates

In Figure 2 the carbohydrate intake of Group F in the "Pre" period seems exceptionally high but when this is expressed per kilogram of body weight the picture changes. For the "Pre" period the intake of carbohydrates per kilogram of body weight was 6.2 grams for Group F, 4.5 for Group B and 6.0 for Group T. In the "Par" period Group F consumed only 5.0 grams per kilogram of body weight; Group B, 5.4 while Group T increased to 7.0 grams of carbohydrate per kilogram of body weight. In the "Post" period the intake of carbohydrate per kilogram of body weight was 4.7 grams for Group F and 5.7 grams for Group B.

### Minerals

Calcium.--The recommended daily allowances of calcium for the male reaches its peak during the ages of 13-19 years at 1.4 grams per day (14). Group F is within this age range and since Groups B and T are only slightly older, this value was used for comparison with all three groups. The calcium intakes of all three groups were above the allowances for the adolescent, as seen in Table III.

Phosphorus.--Although phosphorus is not included in the NRC's recommended daily dietary allowances table, in the discussion of the minerals in the diet (14) NRC states that all evidence indicates that phosphorus allowances should be at least equal to those for calcium in diets for children.

TABLE III

## COMPARISON OF MINERAL AND VITAMIN INTAKES WITH NRC RECOMMENDED ALLOWANCES

Group	Time	Calcium gm	Phos- phorus gm	Iron mg	Vitamin A IU	Vitamin B1 mg	Vitamin B2 mg	Niacin* mg	Ascorbic Acid mg	Vitamin D IU
NRC**		1.4		15.0	5,000	2.00	2.5	25	100	400
Group F	Pre	1.67	2.62	26.4	13,196	2.90	3.56	57	186	428
	Par	2.03	3.18	24.5	9,774	2.78	4.04	56	87	369
	Post	1.87	2.08	24.1	14,459	2.41	2.64	51	209	349
NRC**		1.4		15.0	5,000	2.00	2.5	25	75-100	400
Group B	Pre	2.23	2.93	20.3	9,287	2.20	3.89	44	133	412
	Par	2.09	2.53	18.1	16,104	2.00	4.01	43	95	440
	Post	2.35	2.81	19.8	9,618	2.24	4.12	46	138	452
NRC**		1.4		15.0	5,000	2.00	2.50	25	75-100	400
Group T	Pre	2.12	2.65	19.9	10,000	2.23	3.98	50	136	438
	Par	2.27	2.68	23.3	11,431	2.31	3.76	49	253	601

\*Niacin equivalents.

\*\*NRC recommended allowances for the mean height, weight and age of each group.

Whether the individuals of this study are considered children or adults, their phosphorus intakes are ample, the mean intakes of the three groups ranging from 2.0 to 4.6 grams per day. These phosphorus intakes are given with the mineral and vitamin intakes in Table III.

Iron.--The age of the subjects of this study suggests that they were at the end of the adolescent period and that their need for iron may be considered the same as the adolescent's. The mean intakes of iron for all periods were well above the 15 milligrams per day recommended by the NRC. The mean iron intakes for Group F were 26.4, 24.5 and 24.1 milligrams per day; for Group B, 20.3, 18.1 and 19.8 milligrams per day; for Group T, 19.9 and 23.3 milligrams per day. This high iron intake was anticipated from the relatively high intake of meat and eggs by these athletes.

#### Vitamins

Vitamin A.--The requirements for vitamin A seem to be proportional to body weight (14) and the 5000 International Units recommended by NRC was calculated on a lower body weight than that of the athletes of this study. However, since the intakes of vitamin A for all groups studied exceeded 5,000 International Units by from 4,000 to 11,000 units, these intakes appear to be ample.

Thiamine.--It is recognized that the requirements for thiamine (vitamin B<sub>1</sub>) vary with different persons and presumably with the amount of carbohydrates and calories in the

diet. It is also one of the body nutrients of which the body stores are never large and are readily exhausted by certain stresses (NRC, 14). In view of these considerations the NRC's recommended thiamine allowance provides 0.5 milligrams per 1000 calories. Therefore, in Table III, this value is used to estimate the needs on the basis of the athletes' increased caloric intakes rather than the recommended allowance of 1.8 milligrams. Since the caloric intake varied for the three periods, the requirement for thiamine for each group would vary with each period. However, for convenience in comparison, the mean caloric intake for the three periods was used in calculating the requirement of this vitamin. Allowing 0.5 milligrams per 1000 calories and using the mean daily caloric intake of three periods for each group, the value of 2 milligrams of thiamine per day was obtained. With the exception of Group B's intake for the "Par" period which was exactly 2 milligrams, the intakes of thiamine for all groups for all periods exceeded this allowance by 0.2 to 0.9 milligrams per day.

Riboflavin.--The requirement of Riboflavin (B<sub>2</sub>) does not appear to be related to caloric intake or to muscular activity, but there is an apparent relationship to body weight, as in the case with protein (NRC 14). Therefore, the factor 0.025 (used by NRC) times the protein allowance was used to calculate the riboflavin allowance for each group. The average value thus found, 2.5 milligrams per day, was used for comparison

with the riboflavin intakes for each group in Table III. The intakes of the athletes exceeded this allowance by 1 to 1.5 milligrams per day.

Niacin.--In NRC's recommended daily dietary allowances, the values for niacin are expressed as niacin equivalents, since protein contributes a precursor of niacin to the diet. It is assumed that 1 per cent of the protein intake is tryptophan (the precursor) and that 60 milligrams of tryptophan may be converted by the body to 1 milligram of niacin (NRC 14). Therefore, for comparison with this standard, the niacin equivalents were calculated for each group and included with the niacin in Table III. Due to the high protein intake of the three groups of athletes in this study, all niacin intakes are much higher than the NRC's recommended daily allowances.

Ascorbic acid.--NRC's recommended daily allowance of ascorbic acid is 100 milligrams for the 16-19-year old boy which drops to 75 for the adult man. Group F showed a deficiency of this vitamin during the "Par" period with an intake of only 87 milligrams. The total intake of ascorbic acid by these athletes is less than that of the other vitamins which are all in excess of NRC's recommendations. If a relationship exists between the vitamins then the ascorbic acid intake of these athletes should be increased.

Vitamin D.--Vitamin D is needed throughout the growth period, but the actual requirement has not been determined accurately. However, it is known that 400 International Units



daily is ample for good calcium retention in children when the milk intake is adequate. In adolescence the need for vitamin D is as great as in infancy but the need for supplemental vitamin D by vigorous adults seems to be minimal according to NRC (14). Group F of the present study falls short of the 400 units during the "Par" and "Post" periods, but since the mean age of this group put them at the end of the growth period, this does not seem to be a serious fault. It must also be considered that these men are exposed to a great deal of sunshine daily and are thus getting an additional supply of this vitamin.

The average nutrient intakes of the athletes studied are in excess of the NRC's recommended daily allowances. However, these athletes were heavier and taller than the reference man or boy used in calculating the NRC's allowances and these allowances were not planned for the strenuous work of competitive athletics.

## SUMMARY

The food intakes of sixty college athletes: thirty-four football players (Group F), sixteen basketball players (Group B) and ten track men (Group T) were checked for three five-day periods--Monday through Friday inclusive. The periods for Group F were only four days each since this group was out of town on Fridays during the "Par" period. One period studied was before the season of competition took place ("Pre"), one was during the season of participation ("Par") and one was after the season was completed ("Post"). Since the season of participation for the track group extended beyond the academic school year, no data for the "Post" period could be collected for Group T.

All the subjects of the present study ate in the athletes' dining room under an ad libitum regimen. Only the food eaten in the athletes' dining room was included in the study. Since the condiments, jelly, honey, mayonnaise, and other dressings were served by the athletes themselves, these items were not included in the calculations. No attempt was made to check the food obtained from other sources. The mean calculations of each nutrient for each group for each period were compared with the NRC's recommended daily allowances.

The calorie intake of all three groups for each period was higher than recommended by NRC for their height and weight.

Group F had an intake of 4600 calories daily for the "Pre" and "Par" periods and 4000 for the "Post" period. Group B had an average daily intake of 4100, 4000, and 4700 for the "Pre", "Par" and "Post" periods, respectively. Group T's caloric intake was 4100 per day during the "Pre" period and 4300 per day during the "Par" period.

Approximately 15 per cent of the total calories were from protein, 44 per cent from fat and 41 per cent from carbohydrates. The diets were high in saturated fatty acid food sources.

The intake of minerals for all groups during the periods of this study exceeded the NRC's daily recommended allowances. The average intake of calcium was 1.86 grams for Group F, 2.22 for Group B and 2.20 for Group T. The phosphorus intakes averaged 2.63, 2.75 and 2.66 grams for Groups F, B, and T, respectively. The mean iron intake of Group F was 24.9; Group B, 19.4; and Group T, 21.6 milligrams per day.

The vitamin intakes of this study were all adequate according to NRC's recommendation with the exception of ascorbic acid. The intake of this vitamin was 87 milligrams for Group F for the "Par" period and 95 for Group B for the same period. The average intakes of vitamin A for the three periods was 12,000, 11,000 and 10,000 units daily for Groups F, B and T, respectively. The mean daily intakes of thiamine were 2.69, 2.50 and 2.27 milligrams; of riboflavin, 3.41, 4.0 and 3.87 milligrams; and of vitamin D 382, 435, and 519 International Units for Groups F, B, and T, respectively.

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