LABORATORY REPORT No. 291

NUTRITION SURVEY: RANGER DEPARTMENT
FORT BENNING, GEORGIA

28 JANUARY, 1966

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FITZSIMONS GENERAL HOSPITAL
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U. S. ARMY MEDICAL RESEARCH AND NUTRITION LABORATORY
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LABORATORY
REPORT NO. 291

Project Number: 3A25601A822 Military Internal Medicine
Task Number: 02 Internal Medicine
Work Unit No.: 073 Applied Nutrition Studies of Military Populations

NUTRITION SURVEY: RANGER DEPARTMENT
FORT BENNING, GEORGIA

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FOREWORD

The Surgeon General, Department of the Army, requested by letter dated 8 June 1962, that the US Army Medical Research and Nutrition Laboratory, Fitzsimons General Hospital, Denver, Colorado 80240, conduct nutrition surveys on representative samples of US Army personnel to provide information necessary for execution of his responsibilities under AR 40-5.

In addition, in a letter dated 24 April 1964, the USAMRNL was directed to investigate a request from the Ranger Department, US Army Infantry School, Fort Benning, Georgia, for an increase of 30% in rations.

We wish to thank Colonel Jesse L. Morrow, Jr., Inf., and Colonel Irwin A. Edwards, Inf., the former and new commanding officers of the Ranger Department and their staff for their wonderful cooperation during the study. We especially wish to thank Major Charles W. Elliott, Inf. of the Ranger Department and Captain Thomas A. Davenport, Inf., commanding officer, 44th Company, 4th Student Battalion TSB for their great assistance. Last, but not least, our sincere thanks to Captain Robert M. Brumback, Inf. of the Ranger Department, to whom we owe a great debt of gratitude. This study would never have been accomplished, without his assistance.

Our sincere thanks to members of USAMRNL for their technical assistance during this study. They include SP6 Ted A. Daws, SP5 Teddy G. Johnson, SP5 John L. Deffenbaugh, PFC Graydon A. Grey, SP4 John J. Bertucelli, and SP4 Michael L. Cummins.
SUMMARY

Laboratory Report No. 291
Project No. 3A025601A822 Military Internal Medicine
Task No. 02 - Internal Medicine
Work Unit No. 073 - Applied Nutrition Studies of Military Populations

OBJECT

The primary purpose of this study was to conduct a nutrition survey on a representative sample of US Army Personnel, and to provide information necessary for execution of AMEDS responsibilities under AR 40-5. In addition, information was gathered for the Chief of Nutrition Branch, Preventive Medicine Division, OTSG to evaluate whether a requested 30% increase in rations for the Ranger Department should be authorized.

SUMMARY

AR 40-5 prescribes the minimal nutrient intake of a physically active individual living in a temperate environment and subsisting on a garrison or field type ration to be 3600 Calories/man/day. The daily food consumption of the Ranger Department, trainees, Fort Benning, Georgia over the entire training period, using the chemical analyses of the food composites, averaged 4400 Calories or an increase of 22.2% over the daily prescribed intakes. When one utilizes the caloric equivalent of the body weight change (-70 gm/man/day or 442 Calories) the energy requirement averaged 4842 Calories/man/day. This was equivalent to an increase of 34.5% over the prescribed daily minimal intake.

This fairly high requirement was not unexpected since the men worked long hours, especially during the field training phase, and were under stress imposed by continuous physical and mental pressure.
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BODY OF REPORT

WORK UNIT NO. 073 Applied Nutrition Studies of Military Populations

Nutrition Survey: Ranger Department, Fort Benning, Georgia

PROBLEM

The Surgeon General requested, by letter dated 8 June 1962, that the US Army Medical Research and Nutrition Laboratory, Fitzsimons General Hospital, Denver, Colorado 80240, conduct nutrition surveys on representative samples of US Army Personnel to provide information necessary for execution of his responsibilities under AR 40-5.

BACKGROUND

"Due to changing needs of the military, there is a continuing necessity to evaluate the capability of current and newly developed rations (both freshly prepared and as altered by varied storage conditions) to provide adequate nutrition to the soldier under a variety of duty requirements and environmental situations. The nutritional basis of our present ration system is adequate for garrison training duty on a current basis but may not be optimum for the total military life of the soldier. Longitudinal evaluations of the nutritional status, the body composition and the work performance and capacity of the soldier is essential to insure that the effective military performance of the soldier, during his duty career, is not impaired by improper nutrition. Such impairment could limit the capability of the Army's cadre at a time when instant readiness is mandatory. Previous studies, though helpful, provide only some of the necessary answers."

Recently the 44th Company, 4th Student Battalion, Student Brigade, Fort Benning, Georgia requested authorization for a 30% increase in the daily garrison ration. It was the feeling of the Commanding Officer at the Ranger Department, Fort Benning, Georgia, that this request was justified because of the weight loss observed during the three week Ranger training cycle conducted at Fort Benning. The Ranger trainees averaged 14.5 hours/day of the most strenuous peace time military training. This training includes extensive bayonet drills, confidence and obstacle courses, night patrols and physical conditioning (Appendix I).

In a preliminary study at Fort Benning, Georgia in August-September 1964, body weights were taken 4 times by USAMRNL personnel during the 3 weeks Ranger training cycle. It was observed that the 159 men in the company lost approximately 1.82 kg (4.0 lbs) during the entire training period. A complete study was conducted in November-December 1964 that served a twofold purpose; (a) to further investigate the request from the Ranger
Department, US Army Infantry School for additional rations, and (b) to perform a nutrition survey to evaluate the adequacy of the nutritional intake of men performing the most strenuous of military training.

APPROACH TO THE PROBLEM

The request for additional rations was evaluated by measuring the energy balance of the men during the entire training period. The daily energy output was estimated by the use of time motion studies, and the subsequent measurement of the energy cost of the specific physical activity tasks. Direct measurements of energy expenditure during specific training phases, which were difficult to reproduce in the home laboratory, were obtained utilizing the Mühler-Franz respirometer.

Interest existed for the interrelationships between dietary intake, energy output, body weight changes, skinfold measurements, work performance, and selected biochemical data. Specific interest also concerned the lung compartment size, smoking habits, age, body composition and work performance.

The study was conducted for a 3 week period at the Ranger Department, Fort Benning, Georgia. The subjects (approximately 135 men began the study; there were 38 dropouts) included the complete mixed officer and enlisted men's class in training during 27 November - 20 December 1964. A brief history was taken on each man to include, age, rank, military occupation, race, length of service, area of origin, smoking habits, drinking habits, history of recent illnesses or chronic diseases, and family history of obesity, heart disease, diabetes or hypertension.

The students were made available two days prior to the beginning of the Ranger course for the bicycle performance test, spirometry, blood drawing, urine collection, etc.

Dietary Evaluation of Food Intake

1. The accurate measurement of all food served and the various food wastes (plate, kitchen, and preparation) was done during a 15 day period.

2. Accurate head counts were taken at each meal.

3. Food intake was estimated using standard tables of food composition (USDA Handbook No. 8) (1) and was determined by chemical analysis of food composites. The food composites were analyzed for protein, fat, moisture, and ash. Carbohydrate was calculated by difference.

4. Information gathered also included the quantity of food consumed between meals from sources outside the regular messing area. These areas include snack bars, PX's, etc.
5. Information was also gathered on the daily food issues, food preparation, food wastes, food acceptability, milk consumption and the distribution of the protein, fat, and carbohydrate calories consumed.

6. The adequacy of the diet was determined daily for the 15 day period using both the chemically analyzed values and the calculations based on the standard tables of food composition.

Body Weights and Heights

Body heights were measured (to the nearest 0.5 centimeter) on each man, at the beginning of the training period. Body weights were determined to the nearest 20 grams three times during the entire study. Each man was weighed in the nude immediately after voiding upon arising, at the beginning of the study, at 8 days, and at the end of the December phase of the training cycle (Day 18).

Biochemical Determinations

**Bloods:** A 20 ml heparinized fasting blood was drawn at the beginning and end of the study on every 4th man, for hemoglobin, hematocrit, osmolality and plasma protein. These determinations were used as a measurement of hydration or dehydration of the test subjects.

**Urines:** One hour fasting urines were taken on each man at 3 intervals during the study, at the beginning, during the middle of training, and at the end. Total solids and specific gravity, using the micro refractometer (2), were measured on each sample. The urines were preserved at a pH of 2.0 and frozen until shipped to USAMRNL in Denver.

Skinfold Thickness Measurements

Skinfold thickness measurements at 4 sites were taken on every 4th man in the class, at the beginning, and at the end of the training period, using the Lange calipers. Measurements were done in duplicate utilizing bilateral subscapular sites and the skin of the dorsum of both arms.

Bicycle Performance

A maximal bicycle performance test, based on the Balke treadmill technique, was performed on every 4th man (same men as for bloods), at the beginning and the end of the study. Total riding time, total wattage, maximal pulse during exercise and recovery pulses were obtained for Physical Fitness Index (PFI) scoring (recovery pulses were taken at 1.0 - 1.5, 2.0 - 2.5, and 4.0 - 4.5 minutes after exercise) (3).

Each individual rode the bicycle ergometer at a low rate of energy expenditure for one minute, followed by gradually increasing the work load in each succeeding one-half minute (60 to 260 watts) in 10 watt increments each 30 seconds, until the man stopped due to exhaustion. Pulse rates were not a factor for discontinuing the maximal performance test.
Energy Expenditure

One member of the USAMRL test team was constantly assigned to
the Ranger trainees during the training cycle for time motion studies to
estimate the daily energy expenditure. In addition, metabolic rate measure-
ments for energy costs were done on many of the various physical activity
tasks performed during training, using the M-F metabolimeters. The
respiratory gas samples were analyzed for oxygen and carbon dioxide and
total respiratory volume; RQ and oxygen consumption were subsequently
calculated. Daily energy balance was computed (energy intake versus energy
output).

Lung Compartment Measurements

These measurements were taken at rest both before and after the
study on every 4th man and included a 1-2 second timed vital capacity, maximum breathing capacity, and maximum breath holding.

RESULTS

Mess hall food consumption/man/day, utilizing values calculated from
the standard food tables, averaged 3746 Calories for the 8 day preliminary
phase in camp, and 4336 Calories during the field phase, with an overall
average of 4021 Calories during the entire training period. When one considers
the food consumed from sources outside the mess hall, the total food intake
averaged 4061, 4559, and 4293 Calories/man/day for the same respective
periods (Tables I and II).

For comparison, the food consumption, determined by chemical
analyses of the food composites, showed the daily food intake from the mess
hall alone to average 3944, 4348, and 4133 Calories/man/day for the prelimi-
nary camp phase, the field phase, and the combined phases (Table II). The
calculated average from sources outside the mess hall increased the intakes
by 315, 223, and 272 Calories/man/day for a total intake of 4259, 4571, and
4405 Calories/man/day for the same respective periods (Table II).

A breakdown of the various food items consumed in gm/man/day,
during the entire study, is shown in Table IV. For example the men consumed
an average of 1378 gm of milk, 30 gm of butter, 87 gm of eggs, 90 gm of
bread, 58 gm of sugar, and 150 gm of potatoes/day. Plate waste (edible) by
individual items, served during the entire study, are tabulated in Table Va.
Plate waste, during the entire study, averaged 8.5% for all the vegetables
served, 4.4% for meats, 8.0% for breads and cereals, 6.3% for salads and
dressings, 1.1% for fruits, 10.7% for soups, 1.5% for dairy products, and
4.8% for desserts (Table Vb). Kitchen waste (edible) items averaged over
the entire study are presented in total quantity discarded, and in percentage
of the total quantity issued (Table Vb, c). These values averaged 13.6% for
vegetables, 8.1% for meats, 6.4% for soups, 3.4% for breads and cereals.
2.5% for dairy products, and 16.7% for salads and dressings. The total edible waste averaged 22.1% for vegetables, meats 12.0%, soups 17.1%, fruits 1.3%, desserts 5.4%, cereals and breads 11.4%, dairy products 4.0%, and salads with dressings 25.0% of the total offered (Table Vb). The average plate waste of all the items was 4.0%, the kitchen waste averaged 4.4%, with an overall average of 8.4% edible waste (Table Vb).

The daily energy expenditure estimated from time motion studies and energy cost data for the daily physical activities, are presented in Table VI. The daily expenditure/man/day averaged 4128 Calories for the 8 day camp period, 4369 Calories for the 8 day field phase, and 4249 Calories for the entire training period. The lowest daily expenditure was recorded on Day 15 (3251 Calories), and the highest on Day 11 (5633 Calories). Energy cost, in Calories/kg/10 minutes and Calories/minute for a 75 kg representative man, of the various military activities, used to calculate the daily energy expenditure, is presented in Appendix II.

Body weight changes showed a slight increase during the camp period, averaging +0.13 kg for 8 days for Platoons I and II, and +0.60 kg for 4 days for Platoon III. There was an appreciable decrease during the field phase averaging -1.53, and -1.01 kg for the same respective groups. The total body weight loss for the entire training period averaged -1.40, and -0.41 kg for the same groups. The total body weight loss for all men (based on the total number of days) averaged -1.15 kg, or -70.1 gm/man/day (Table VII).

Blood samples were drawn on approximately 35 men before and after the training period. Hemoglobins were unchanged averaging 14.68 before and 14.68 gm/100 ml after the training period. The blood hematocrits were slightly decreased (by 0.60%), averaging 46.5% before, and 45.9% after the training phase. The plasma proteins were significantly decreased by 0.50 gm/100 ml (P<0.001) averaging 7.93 gm before, and 7.43 gm after the training periods (Table VIII). The timed fasting urinary excretion data showed the specific gravities to be practically unchanged (1.029, 1.031 and 1.029), and the total solids to be increased during the camp phase and decreased during the field phase, averaging 7.33, 7.67, and 7.18 gm/100 ml (Table IX).

Waist circumference and skinfold thickness measurements were also taken before and after training on 35 men. The body waist measurements were significantly decreased by 2.76 cm (P<0.001) at the end of the training period. Three of the 4 skinfold measurements were not significantly different, but for no apparent reason the right subscapular skinfold was significantly increased by 0.32 mm (P<0.025) (Table X).
A maximum performance test was performed on the bicycle ergometer, before and after the training period, on a limited number of men. Even though the maximum performance time was decreased from 10.54 to 9.83 minutes, the physical fitness index scores were increased from 66 to 73. This was due to the decreased recovery pulses at the end of the training period [Table X].

Lung compartment and other measurements (BTPS) were determined before and after the training phase. Following the training cycle the forced vital capacity was decreased by 114 ml, the maximum breathing capacity was lowered by 26 liters/minute, the maximum breath holding decreased by 9 seconds, and the hand grip, using a dynamometer, by 6.5 kg [Table X].

A summary of the daily food intake, energy expenditure and energy balance information is presented in Table X. The energy balance, using the food intake data from the chemical analyses of the food composites and the estimated energy expenditures showed the men to be in a positive balance of +151 Calories/man/day, during the entire training phase. The estimated daily requirements, using the food intake from all sources and the caloric equivalent of the body weight losses, averaged 4842 Calories/man/day [Table X].

**DISCUSSION**

There was fairly close agreement in the two methods for measuring caloric intake from the mess hall. The calculated values were 112 Calories/man/day less than the values determined from the chemical analyses of the food composites. The food consumed from sources outside the military mess hall averaged 272 Calories/man/day, increasing the total daily food consumption to 4293, and 4705 Calories/man/day. The total food consumed from outside sources, which consisted primarily of candy bars, was fairly low in comparison to other American military nutrition studies. In the combined Army camp studies, published in 1959 [4] this intake averaged 727 Calories/man/day in 4 army camps; and in the Fort Carson, Colorado study the average was 566 Calories/man/day [5]. On the other hand, in an ad libitum food intake study on military troops [6], the food consumed from sources outside the mess hall averaged only 152 Calories during a 4 week period.

The distribution of Calories from the nutrients consumed averaged 14.9% from protein, 38.8% from fat, and 46.3% from carbohydrate, for the two methods of measuring food consumption. As in the other studies, the chemical analyses of the food composites for fat were low in comparison to the values calculated from the standard food tables. This results in an apparent high carbohydrate intake, because it is calculated by difference after determining the fat and protein intake. The high fat intake in the American dietary is not unusual. In the camp study [4], the fat intake averaged 45.1%; in the recent Fort Carson study [5], the fat intake in three separate units averaged 42.9%, and in the ad libitum food intake study [6], the fat intake provided 39.8% of the total calories consumed.
The NRC's Committee on Dietary Allowances (7) has recommended a
daily allowance of 1 gm of protein/kg of body weight. No recommended
allowances for fat or carbohydrate intakes are available, because only limited
data are available on a reasonable fat allowance and the characteristics of a
mixture of fatty acids that would be most favorable to promote good health.
It is the general feeling that the macronutrient distribution of food calories
is a matter of economics, food habits, and preparation. The population of
the United States is accustomed to a high fat intake because of relatively
high socioeconomic level. In countries of lower economic level the trend
is toward a diet high in carbohydrate, and low in fat. Rice and wheat pro-
ducts are relatively inexpensive, and are the main food items in these
countries. Regardless of the environmental temperature and humidity the
distributions of protein, fat, and carbohydrate calories in the diet appear to
be relatively constant (8).

AR 40-5 prescribes the Army basic minimal caloric intake to be 3600
Calories/man/day, for a physically active soldier living in a temperate
environment (9). One must remember that these standards were prepared to
serve as a guide in planning adequate menus for the young healthy soldier.
Dietary requirements are increased or decreased depending on many factors,
such as age, body weight, physical activity, and environmental temperature.
The Master Menu, which is a guide and is the basis of military feeding,
normally prescribes an excess of calories ranging from 4000 to 4200 Calories/
man/day throughout the year. The menu is calculated to yield at least 3600
edible Calories, after one deducts for the 400-600 edible Calories lost in
plate and kitchen wastes.

The troops gained body weight during the first phase of the study
(Days 1-8), which was due to the long hours of sedentary activity, due to the
lectures, demonstrations, etc., in preparation for the field phase. In the
8 day field phase, the body weight loss was more than 1 kg, even though the
food intake increased to 4571 Calories/man/day. The total weight loss for
the complete 18 days averaged -1.15 kg or -70 gm/man/day.

Even though the hemoglobin values were unchanged during the
complete training phase, the hematocrits were decreased by 0.60%. How-
ever, this change was not significant. Plasma proteins were decreased by
0.5 gm% during the training period. This change was highly significant with
a P value of <0.001. The decrease in the plasma proteins could be indica-
tive of retention of body water; however, other factors could be responsible
for the decrease in plasma proteins. Nevertheless, it is felt that it can be
unequivocally stated that no dehydration was present at the time this study was
concluded, and that the weight loss observed was not due to loss of body water.
Mean body waist circumference decreased by 2.8 cm during the course of the
training period. This is probably an indication of the loss of body fat, but
could be indicative of increased tonus of the abdominal musculature secondary
to the physical training.
The estimated daily energy expenditure averaged 4249 Calories/man/day for the entire training period, which was lower than the average daily intake of 4404 Calories. The values for energy expenditure for the various daily activities may be greatly underestimated due to multiple factors. For one, the estimated energy expenditure figures are based upon time motion studies during which one, and sometimes two men tried to monitor the activities of the entire training company consisting of 97 men. Limitation of research personnel did not permit more close monitoring of the entire group. However, it is felt that the values obtained by this technique should give average values, but under certain circumstances one would expect to miss minor activities, which, over an 18-day period, could influence the total expenditure of energy. During the field phase of the training cycle, the trainees slept outdoors with only two blankets and a poncho supplied to each man. No sleeping bags were available. Some of the days were quite cold and wet, and practically every evening, the temperature was below freezing. Therefore, the value utilized to estimate basal metabolic rate may have been an error due to increased expenditure to maintain body temperature. In addition, it was impossible to estimate the increased energy expenditure, due to the stress imposed by continuous harassment both physical and mental during the training cycle.

As mentioned previously, AR 40-5 (9) prescribes the minimal nutrient intake/man/day of a physically active individual living in a temperate environment and subsisting on a garrison or field type ration to be 3600 Calories/day. Based upon the observed data in this study, an attempt has been made to more closely pinpoint the average daily caloric intake necessary to supply the energy requirements of the men undergoing the Ranger Training Cycle. The caloric equivalent of the mean body weight loss of 1.15 kg amounted to 442 Calories/day. The daily food consumption over the entire training period, using the chemical analyses of the food composites, averaged 4404 Calories/man/day, or an increase of 22.2% over the daily prescribed intakes. When one utilizes the caloric equivalent of the body weight change, the energy requirements averaged 4846 Calories/man/day. This was equivalent to an increase of 34.5% over the prescribed daily minimal intakes. It may be assumed that the caloric value of the food intake should equal at least the values for the energy expenditure imposed by the conditions of training.

During this study, the daily food intake and the edible wastes (plate and kitchen) averaged considerably more than was issued and prescribed by the Master Menu. This extra food came from many sources including (a) an additional 10% increase in the daily ration during the Fort Benning phase of the Ranger training, (b) large quantities of surplus butter and cooking fats, (c) large quantities of fresh milk, and (d) the continuous borrowing of food from other mess halls.
Milk consumption, which averaged 1378 gm/man/day, was higher than the recent camp study at Fort Carson, where the average in three military units was 1150 gm/day. In the ad libitum food intake study (6), the milk consumption averaged 1537 gm/day. The high milk consumption was not unexpected since milk is available ad libitum in all the military messes.

The total edible food waste of 8.4% observed in this study was considerably lower than the 14.8% waste observed in the Army camp study (4). The plate waste averaged only 4.0% which was less than one-half of the 8.6% observed in the Fort Carson survey (5). There is no question that the men were consuming practically all of their food from the mess hall and very little from outside sources. The troops worked long hours, were very tired, and were not able, or did not have the desire to procure food items at the PX's or snack bars.

In general, the troops seemed to be fairly well conditioned by the end of the study. Even though the maximal work time on the bicycle ergometer was significantly decreased at the end of training, the physical fitness index scores were significantly increased from 66 to 73. This was due to the significant reduction in the post-exercise pulse rates (P<0.001).

The forced vital capacities at the end of training were not significantly different, although maximal breathing capacity, maximal breath holding, and the right and left hand grip measurements were all significantly decreased on the last day of training (P<0.05, P<0.001, and P<0.001). These significant decreases may have been due to the men being extremely tired on the last day. On this particular day, the men were awakened at 1:30 a.m., and were taken on a 16 mile forced march immediately before performance of the above tests. In addition, each man had to perform (or drop out of the course) the final confidence course activities.

**RECOMMENDATIONS**

If an increase in rations is authorized, it must be specified that it will be for the students and the training cadre. It should not be used for the supporting party. Both of these groups now eat together.

**OBSERVATIONS**

1. Food preparation, even though it had improved considerably during our stay, according to the cadre and supporting personnel, still left a lot to be desired. The troops in training constantly complained of the poor food preparation, of it being too greasy, etc. They wanted "quality not quantity".

2. The daily rations (meat, vegetables, etc.) issued at the military mess, were never checked or weighed by the kitchen personnel. The quantities were taken for granted.
3. Even though bread was brought in daily, the cooks (bakers) did all the baking of rolls and pastry. This seemed to be a waste of manpower.
BIBLIOGRAPHY


Table I

FORT BENNING, GEORGIA RANGERS STUDY - 1964

Food Consumption, Average/Man/Day
Calculated Values, Using Standard Food Tables

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<th>Fat gm</th>
<th>CHO gm</th>
<th>Calc mg</th>
<th>Iron mg</th>
<th>Vit A I.U. mg</th>
<th>Vit B1 mg</th>
<th>Vit B2 mg</th>
<th>Niacin mg</th>
<th>Vit C mg</th>
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Table II

FORT BENNING, GEORGIA RANGERS STUDY - 1964

Food Consumption, All Sources
Average/Man/Period, Calculated Values

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<th>Days of Study</th>
<th>Cal</th>
<th>Prot gm</th>
<th>Fat gm</th>
<th>CHO gm</th>
<th>Calc mg</th>
<th>Iron mg</th>
<th>Vit A L.U.</th>
<th>Vit B1 mg</th>
<th>Vit B2 mg</th>
<th>Niacin mg</th>
<th>Vit C mg</th>
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</thead>
</table>
| 1 - 8
| Mess Hall    | 3746| 143.2   | 177.2  | 388.0  | 2028    | 18.9    | 7062      | 2.06      | 3.81      | 21.4      | 139     |
| Outside Mess |     | 315     | 9.7    | 14.5   | 39.5    |         |           |           |           |           |         |
| Total        | 4061| 152.9   | 191.8  | 427.5  |         |         |           |           |           |           |         |
| 9 - 15
| Mess Hall    | 4336| 160.0   | 217.0  | 429.4  | 2688    | 20.0    | 9163      | 2.68      | 4.90      | 22.2      | 135     |
| Outside Mess |     | 223     | 9.7    | 10.2   | 30.7    |         |           |           |           |           |         |
| Total        | 4559| 169.7   | 227.2  | 460.1  |         |         |           |           |           |           |         |
| 1 - 15
| Mess Hall    | 4021| 151.6   | 195.8  | 407.7  | 2336    | 19.4    | 8042      | 2.35      | 4.32      | 21.8      | 138     |
| Outside Mess |     | 272     | 9.7    | 12.5   | 35.4    |         |           |           |           |           |         |
| Total        | 4293| 161.3   | 207.3  | 442.7  |         |         |           |           |           |           |         |
### Table IIIa

**FORT BENNING, GEORGIA RANGERS STUDY - 1964**

Food Consumption, Chemical Analyses of Food Composites

Average/Man/Day (Mess Hall Alone)

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<td>Fat, gm</td>
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<td>Fat, gm</td>
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<td>Carbohydrate, gm</td>
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Table IIIb

FORT BENNING, GEORGIA RANGER STUDY - 1964
Per Cent Distribution of Total Calories Consumed

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Table IV
FORT BENNING, GEORGIA RANGER STUDY - 1964
Food Intake of Various Food Items
Mean/Man/Day During a 15 Day Period

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<th>gm/Man/Day</th>
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<td>Cherry Pie</td>
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<td>Lemon Meringue Pie</td>
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Table IV (cont.)

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### Table Va

**FORT BENNING, GEORGIA RANGERS STUDY - 1964**

Plate Waste - Per Cent Loss During 15 Days

<table>
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<tr>
<th>Food</th>
<th>Served kg</th>
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<td>1.66</td>
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Table Va (cont.)

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<th>Plate Waste kg</th>
<th>Per Cent Waste</th>
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<td>Plate Waste kg</td>
<td>Per Cent Waste</td>
</tr>
<tr>
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<td>-----------</td>
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### Table Vb

FORT BENNING, GEORGIA RANGER STUDY - 1964

Total Edible Wastes, kg and Per Cent Loss by Food Groups*

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<th>Total Edible Waste</th>
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<td>Waste kg</td>
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<tr>
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<td>% of Total</td>
<td>Served kg</td>
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* Totals for entire study.
Table Vc

FORT BENNING, GEORGIA RANGER STUDY - 1964

Kitchen Waste, kg and Percentage of Totals Served

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22
### Table VI

**FORT BENNING, GEORGIA RANGER STUDY - 1964**

Physical Activity Schedule - Day 1  
(Time Motion Data - Beginning at 2100 Hours)

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<tr>
<th>Activity</th>
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<td>Lying on Ground (No Sleep)</td>
<td>30</td>
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</tr>
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</tr>
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</tr>
<tr>
<td>Running, One Mile</td>
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<tr>
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<td>Crawling 40 Yards</td>
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<td>Swimming 50 Meters</td>
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Table VI (cont.)
Physical Activity Schedule - Day 2

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</tr>
<tr>
<td>Rope Climb, Confidence Ladder</td>
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</tr>
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<td>Run 1.5 Miles (26 Out)</td>
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<tr>
<td>Bus Ride</td>
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<tr>
<td>Swim, 80 Meters w/Clothes, Rifle Web, Equipment</td>
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<td>Run, Back and Forth, etc. Double Time</td>
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<td>27.1</td>
</tr>
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<td>Lying Down, Resting</td>
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</tr>
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<td>Hand to Hand Combat, Practice Falls, Throws, etc.</td>
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<td>Marching, 0.2 Miles</td>
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Physical Activity Schedule - Day 3

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<td>P. T. Exercises</td>
<td>18</td>
<td>113.6</td>
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<tr>
<td>Standing Outside Normally</td>
<td>145</td>
<td>231.7</td>
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<tr>
<td>Standing Outside, Formation</td>
<td>9</td>
<td>24.4</td>
</tr>
<tr>
<td>Run 1.5 Miles (40 Dropouts)</td>
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<tr>
<td>Run Double Time</td>
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<tr>
<td>Rope Climb, Confidence Ladder</td>
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<td>17.1</td>
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<td>Meals</td>
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<tr>
<td>Moving Equipment in Barracks</td>
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<td>Bus Rides</td>
<td>61</td>
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<td>Getting Equipment, Walking, Standing</td>
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<td>Walking During Rest Periods</td>
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<tr>
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<td>Cleaning Equipment, Etc.</td>
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### Table VI (cont.)
#### Physical Activity Schedule - Day 4

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<td>Personal Toilet</td>
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<td>94.0</td>
</tr>
<tr>
<td>Lying on Ground (No Sleep)</td>
<td>30</td>
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</tr>
<tr>
<td>P. T. Exercises</td>
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</tr>
<tr>
<td>Rope Climbing, Confidence</td>
<td>4</td>
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<tr>
<td>Standing Outside Normally</td>
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<tr>
<td>Standing Outside w/Equipment and Rifle</td>
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<td>Standing Outside, Formation</td>
<td>10</td>
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<td>Running, Double Time</td>
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<td>Sitting, Lectures, Demonstrations</td>
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<tr>
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<tr>
<td>Marching</td>
<td>15</td>
<td>81.7</td>
</tr>
<tr>
<td>Walking Casually</td>
<td>20</td>
<td>85.4</td>
</tr>
<tr>
<td>Standing Casually</td>
<td>22</td>
<td>35.1</td>
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<tr>
<td>Sitting in Truck, Riding</td>
<td>26</td>
<td>47.8</td>
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<tr>
<td>Sitting in Class</td>
<td>284</td>
<td>539.4</td>
</tr>
<tr>
<td>Walking w/Equipment</td>
<td>10</td>
<td>53.3</td>
</tr>
<tr>
<td>Walking w/o Equipment</td>
<td>10</td>
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<tr>
<td>Standing w/Equipment</td>
<td>25</td>
<td>44.2</td>
</tr>
<tr>
<td>Standing w/o Equipment</td>
<td>76</td>
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</tr>
<tr>
<td>Resting, Sitting, Lying Down, Etc.</td>
<td>38</td>
<td>57.5</td>
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<tr>
<td>Practice Applying Bayonet</td>
<td>54</td>
<td>697.3</td>
</tr>
<tr>
<td>Confidence Course, Double Time</td>
<td></td>
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<tr>
<td>Between Obstacles</td>
<td>60</td>
<td>775.1</td>
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<tr>
<td>Cleaning Equipment, Relaxing, Etc.</td>
<td>55</td>
<td>186.5</td>
</tr>
<tr>
<td>Sleep</td>
<td>60</td>
<td>74.8</td>
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Table VI (cont.)
Physical Activity Schedule - Day 9

<table>
<thead>
<tr>
<th>Activity</th>
<th>Time in Minutes</th>
<th>Calories/Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resting, Relaxing, Sitting, etc. Before Bedtime</td>
<td>60</td>
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</tr>
<tr>
<td>Sleep*</td>
<td>420</td>
<td>594.5</td>
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<tr>
<td>Personal Toilet</td>
<td>45</td>
<td>104.0</td>
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<tr>
<td>Eating</td>
<td>103</td>
<td>163.0</td>
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<tr>
<td>Lectures, Classroom</td>
<td>349</td>
<td>663.2</td>
</tr>
<tr>
<td>Standing, Walking Leisurely Between Classes</td>
<td>69</td>
<td>183.7</td>
</tr>
<tr>
<td>Break, Unroll Bedroll, Etc.</td>
<td>44</td>
<td>309.2</td>
</tr>
<tr>
<td>Break, Roll up Bedroll, Etc.</td>
<td>24</td>
<td>168.6</td>
</tr>
<tr>
<td>Light Activity After Lunch</td>
<td>33</td>
<td>77.7</td>
</tr>
<tr>
<td>Formation</td>
<td>10</td>
<td>26.9</td>
</tr>
<tr>
<td>Walking Leisurely, Etc.</td>
<td>40</td>
<td>159.0</td>
</tr>
<tr>
<td>Running, Double Time</td>
<td>6</td>
<td>248.4</td>
</tr>
<tr>
<td>Bayonet Drill, Strenuous Exercise</td>
<td>15</td>
<td>193.8</td>
</tr>
<tr>
<td>Cleaning Equipment, Area</td>
<td>60</td>
<td>248.9</td>
</tr>
<tr>
<td>Sitting, Standing, Walking, Leisurely</td>
<td>60</td>
<td>160.0</td>
</tr>
<tr>
<td>Sleep (to 9 p.m. Bed at 1838 hrs)</td>
<td>70</td>
<td>98.0</td>
</tr>
<tr>
<td>Washing Clothes</td>
<td>20</td>
<td>72.8</td>
</tr>
<tr>
<td>Totals</td>
<td>1440</td>
<td>3568</td>
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* Assumed a 10% increase in MR during sleep due to cold for all days in the field (Days 9 - 15).
Table VI (cont.)
Physical Activity Schedule - Day 10

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<thead>
<tr>
<th>Activity</th>
<th>Time in Minutes</th>
<th>Calories/Time</th>
</tr>
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<tbody>
<tr>
<td>Sleep 8.5 hours</td>
<td>510</td>
<td>722.4</td>
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<td>Personal Toilet</td>
<td>30</td>
<td>62.4</td>
</tr>
<tr>
<td>Eating Breakfast</td>
<td>85</td>
<td>87.1</td>
</tr>
<tr>
<td>Standing, Walking, Leisurely</td>
<td>81</td>
<td>215.1</td>
</tr>
<tr>
<td>Classroom, Sitting</td>
<td>252</td>
<td>478.9</td>
</tr>
<tr>
<td>Walking w/Full Field Equipment and Bed Roll</td>
<td>16</td>
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<td>Class, Breaks, (Sitting, Standing)</td>
<td>21</td>
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<tr>
<td>Standing in Line, Drawing Equipment</td>
<td>10</td>
<td>26.6</td>
</tr>
<tr>
<td>Marching to Chow</td>
<td>2</td>
<td>10.9</td>
</tr>
<tr>
<td>Walking Leisurely</td>
<td>22</td>
<td>86.0</td>
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<td>Standing and Eating</td>
<td>58</td>
<td>97.7</td>
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<td>Walking on Patrol</td>
<td>140</td>
<td>897.0</td>
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<td>Walking, Sitting, Etc. Leisurely</td>
<td>196</td>
<td>521.9</td>
</tr>
<tr>
<td>Cleaning Equipment</td>
<td>28</td>
<td>94.9</td>
</tr>
<tr>
<td>Walking Briskly</td>
<td>5</td>
<td>20.5</td>
</tr>
<tr>
<td>Walking, Standing, Sitting Leisurely</td>
<td>34</td>
<td>90.5</td>
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<tr>
<td>Running</td>
<td>2</td>
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<td><strong>1440</strong></td>
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<td>Activity</td>
<td>Time in Minutes</td>
<td>Calories/Time</td>
</tr>
<tr>
<td>----------------------------------------------</td>
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<td>----------------</td>
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<tr>
<td>Sitting</td>
<td>90</td>
<td>123.1</td>
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<tr>
<td>Marching - 2400 Meters</td>
<td>46</td>
<td>251.6</td>
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<tr>
<td>Walking, Etc.</td>
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<td>40.7</td>
</tr>
<tr>
<td>Standing, Turning in Equipment</td>
<td>15</td>
<td>24.0</td>
</tr>
<tr>
<td>Preparation for Bed</td>
<td>25</td>
<td>59.7</td>
</tr>
<tr>
<td>Sleeping (0030 - 0500)</td>
<td>270</td>
<td>382.5</td>
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<tr>
<td>Dressing and Working on Equipment</td>
<td>45</td>
<td>152.5</td>
</tr>
<tr>
<td>Standing Eating</td>
<td>45</td>
<td>78.9</td>
</tr>
<tr>
<td>Working on Equipment</td>
<td>45</td>
<td>152.5</td>
</tr>
<tr>
<td>Briefing, Sitting</td>
<td>80</td>
<td>152.0</td>
</tr>
<tr>
<td>Patrol Tactics, Walking, Etc. w/Equipment - Heavy Work</td>
<td>270</td>
<td>1755.0</td>
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<tr>
<td>Eating</td>
<td>65</td>
<td>103.0</td>
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<tr>
<td>Patrol Tactics, Walking, Etc. Not Too Hard</td>
<td>200</td>
<td>1000.0</td>
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<tr>
<td>Walking Patrol in Swamps</td>
<td>44</td>
<td>293.0</td>
</tr>
<tr>
<td>Patrol Tactics, Walking, Climbing, Kneeling, Low Crawl, Etc. w/Equipment</td>
<td>150</td>
<td>1000.0</td>
</tr>
<tr>
<td>Standing Leisurely</td>
<td>40</td>
<td>63.9</td>
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Table VI (cont.)
Physical Activity Schedule - Day 12

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<tr>
<th>Activity</th>
<th>Time in Minutes</th>
<th>Calories/Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patrolling, Walking, Etc.</td>
<td>66</td>
<td>429.0</td>
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<tr>
<td>Kneeling, Crawling, Crouching, Etc.</td>
<td>34</td>
<td>241.0</td>
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<tr>
<td>Briefing, Sitting</td>
<td>35</td>
<td>62.3</td>
</tr>
<tr>
<td>Checking and Cleaning Equipment</td>
<td>44</td>
<td>182.0</td>
</tr>
<tr>
<td>Eating - Soup</td>
<td>12</td>
<td>19.0</td>
</tr>
<tr>
<td>Sleep</td>
<td>300</td>
<td>425.0</td>
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<tr>
<td>Personal Toilet</td>
<td>20</td>
<td>42.0</td>
</tr>
<tr>
<td>Breakfast - 0550-0650 hrs</td>
<td>60</td>
<td>94.9</td>
</tr>
<tr>
<td>Sitting Leisurely</td>
<td>20</td>
<td>27.4</td>
</tr>
<tr>
<td>Sitting, Classroom</td>
<td>200</td>
<td>380.0</td>
</tr>
<tr>
<td>Breaks Between Classes, Standing, Lying Down, Resting</td>
<td>118</td>
<td>245.8</td>
</tr>
<tr>
<td>Walking Leisurely</td>
<td>25</td>
<td>99.5</td>
</tr>
<tr>
<td>Standing Leisurely</td>
<td>45</td>
<td>72.0</td>
</tr>
<tr>
<td>Lunch and Supper</td>
<td>80</td>
<td>126.6</td>
</tr>
<tr>
<td>Running w/Equipment</td>
<td>2</td>
<td>150.8</td>
</tr>
<tr>
<td>Ambush Tactics, Walking, Etc.</td>
<td>100</td>
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<tr>
<td>Truck and Bus Ride, Sitting</td>
<td>55</td>
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</tr>
<tr>
<td>Bayonet Assault - Very Strenuous</td>
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<tr>
<td>Obstacle Course 6 Times - Heavy Work</td>
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<tr>
<td>4' Barricade, Run % Grade 400 Units, Back Crawl 25 Meters</td>
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<td>Clean Up, Etc.</td>
<td>10</td>
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<tr>
<td>Lying Down, Relaxing</td>
<td>40</td>
<td>66.0</td>
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<tr>
<td>Sleep - to 9 p.m.</td>
<td>60</td>
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<tr>
<td>Totals</td>
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<td>5030</td>
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Table VI (cont.)
Physical Activity Schedule - Day 13

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<th>Activity</th>
<th>Time in Minutes</th>
<th>Calories/Time</th>
</tr>
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<tbody>
<tr>
<td>Sleep - 7.5 hours</td>
<td>450</td>
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<td>Personal Toilet</td>
<td>30</td>
<td>62.4</td>
</tr>
<tr>
<td>Breakfast</td>
<td>60</td>
<td>94.9</td>
</tr>
<tr>
<td>Briefing, Classroom, Sitting</td>
<td>60</td>
<td>114.0</td>
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<tr>
<td>0700 - 1100 Released to Company Area</td>
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<tr>
<td>Shower, Clean Up, Cleaning Equipment, Etc. Sitting</td>
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<td></td>
</tr>
<tr>
<td>Leisurely</td>
<td>120</td>
<td>164.2</td>
</tr>
<tr>
<td>Working on Equipment</td>
<td>120</td>
<td>406.7</td>
</tr>
<tr>
<td>Lunch</td>
<td>60</td>
<td>94.9</td>
</tr>
<tr>
<td>Walked 2.5 Miles w/Equipment</td>
<td>102</td>
<td>809.4</td>
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<tr>
<td>Sitting Leisurely</td>
<td>32</td>
<td>43.7</td>
</tr>
<tr>
<td>Standing Leisurely</td>
<td>48</td>
<td>76.7</td>
</tr>
<tr>
<td>Lying Down, Leisurely</td>
<td>28</td>
<td>46.3</td>
</tr>
<tr>
<td>Supper</td>
<td>60</td>
<td>94.9</td>
</tr>
<tr>
<td>Walking, Sitting Leisurely</td>
<td>30</td>
<td>128.2</td>
</tr>
<tr>
<td>Standing Leisurely</td>
<td>30</td>
<td>47.9</td>
</tr>
<tr>
<td>Bus Ride</td>
<td>30</td>
<td>56.9</td>
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<tr>
<td>To 9 p.m. Night Recon. Patrol</td>
<td>180</td>
<td>1170.0</td>
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<td>Totals</td>
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<td>4048</td>
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<td>Activity</td>
<td>Time in Minutes</td>
<td>Calories/Time</td>
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<tr>
<td>Patrol</td>
<td>180</td>
<td>1170.0</td>
</tr>
<tr>
<td>Bus Ride</td>
<td>30</td>
<td>57.0</td>
</tr>
<tr>
<td>Sitting Leisurely</td>
<td>40</td>
<td>54.7</td>
</tr>
<tr>
<td>Night Recon. Patrol</td>
<td>150</td>
<td>975.0</td>
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<tr>
<td>Sleep - Up at 6:45 a.m.</td>
<td>185</td>
<td>262.2</td>
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<tr>
<td>Off from 0800 - 1200 hours, Cleaning</td>
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<tr>
<td>Gear, Sitting, Etc.</td>
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</tr>
<tr>
<td>Cleaning Equipment</td>
<td>62</td>
<td>210.0</td>
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<tr>
<td>Personal Toilet</td>
<td>43</td>
<td>89.4</td>
</tr>
<tr>
<td>Standing Eating</td>
<td>105</td>
<td>189.6</td>
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<tr>
<td>Standing Leisurely</td>
<td>27</td>
<td>43.1</td>
</tr>
<tr>
<td>Walking Leisurely</td>
<td>13</td>
<td>55.5</td>
</tr>
<tr>
<td>Miscellaneous Work on Equipment</td>
<td>187</td>
<td>633.3</td>
</tr>
<tr>
<td>Standing, Working on Equipment</td>
<td>120</td>
<td>282.3</td>
</tr>
<tr>
<td>Walking Leisurely</td>
<td>40</td>
<td>159.2</td>
</tr>
<tr>
<td>Sitting Leisurely</td>
<td>80</td>
<td>109.3</td>
</tr>
<tr>
<td>Marching</td>
<td>3</td>
<td>16.5</td>
</tr>
<tr>
<td>Double Timing Through Confidence Course</td>
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<td></td>
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<tr>
<td>Running, Climbing, Etc. w/Rifle</td>
<td>10</td>
<td>283.3</td>
</tr>
<tr>
<td>Day Ended at 1645 hours</td>
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<tr>
<td>To Bed Sleep, 1815 - 2100 hours</td>
<td>165</td>
<td>233.4</td>
</tr>
<tr>
<td>Totals</td>
<td>1440</td>
<td>4820</td>
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</table>
Table VI (cont.)
Physical Activity Schedule - Day 15

<table>
<thead>
<tr>
<th>Activity</th>
<th>Time in Minutes</th>
<th>Calories/Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep - 9 p.m.</td>
<td>520</td>
<td>738.0</td>
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<tr>
<td>Personal Toilet</td>
<td>31</td>
<td>64.5</td>
</tr>
<tr>
<td>Breakfast</td>
<td>35</td>
<td>55.4</td>
</tr>
<tr>
<td>Classroom, Sitting</td>
<td>247</td>
<td>469.4</td>
</tr>
<tr>
<td>Walking Leisurely</td>
<td>30</td>
<td>119.4</td>
</tr>
<tr>
<td>Standing Leisurely</td>
<td>27</td>
<td>43.2</td>
</tr>
<tr>
<td>Breaks Between Classes, Walking, Standing, Lying Down</td>
<td>37</td>
<td>105.4</td>
</tr>
<tr>
<td>Working Out System for Aircraft Drop</td>
<td>25</td>
<td>131.0</td>
</tr>
<tr>
<td>Marching</td>
<td>26</td>
<td>143.3</td>
</tr>
<tr>
<td>Lie. Leisurely</td>
<td>39</td>
<td>61.7</td>
</tr>
<tr>
<td>At Ease</td>
<td>18</td>
<td>30.0</td>
</tr>
<tr>
<td>Lying Round Leisurely</td>
<td>21</td>
<td>95.3</td>
</tr>
<tr>
<td>Obstacle Course</td>
<td>12</td>
<td>117.1</td>
</tr>
<tr>
<td>Cleaning Equipment</td>
<td>60</td>
<td>249.6</td>
</tr>
<tr>
<td>Policing Area</td>
<td>35</td>
<td>159.2</td>
</tr>
<tr>
<td>Eating, Standing</td>
<td>36</td>
<td>65.0</td>
</tr>
<tr>
<td>Light Activity, Standing, Walking Slowly, Clean Up, Cleaning Equipment, Etc.</td>
<td>94</td>
<td>340.0</td>
</tr>
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<td>To Bed Sleep to 9 p.m.</td>
<td>105</td>
<td>149.2</td>
</tr>
<tr>
<td>Totals</td>
<td>1440</td>
<td>3251</td>
</tr>
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<td>Activity</td>
<td>Time in Minutes</td>
<td>Calories/Time</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
<td>-----------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Sleep 2100 - 0145 Hours</td>
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<td>403.9</td>
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<tr>
<td>Personal Toilet</td>
<td>15</td>
<td>31.7</td>
</tr>
<tr>
<td>Walked 16.4 Miles, Forced, w/Full Equipment</td>
<td>244</td>
<td>1908.0</td>
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<tr>
<td>Completed 0644 hours, 10 Minute Breaks (4)</td>
<td>40</td>
<td>124.0</td>
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<tr>
<td>Foot Inspection</td>
<td>30</td>
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<tr>
<td>Breakfast</td>
<td>30</td>
<td>47.5</td>
</tr>
<tr>
<td>Confidence Course</td>
<td>15</td>
<td>123.3</td>
</tr>
<tr>
<td>Sitting on Bleachers, Waiting for Turn</td>
<td>150</td>
<td>265.6</td>
</tr>
<tr>
<td>Lunch</td>
<td>60</td>
<td>94.9</td>
</tr>
<tr>
<td>Bicycle Maximum Performance Test</td>
<td>15</td>
<td>607.1</td>
</tr>
<tr>
<td>Walking Leisurely</td>
<td>30</td>
<td>119.4</td>
</tr>
<tr>
<td>Sitting in Laboratory</td>
<td>30</td>
<td>40.9</td>
</tr>
<tr>
<td>Formation</td>
<td>15</td>
<td>43.3</td>
</tr>
<tr>
<td>Standing Leisurely</td>
<td>62</td>
<td>99.2</td>
</tr>
<tr>
<td>Walking, Lying Down, Relaxing</td>
<td>60</td>
<td>150.0</td>
</tr>
<tr>
<td>Preparing Equipment for Turn In</td>
<td>60</td>
<td>203.3</td>
</tr>
<tr>
<td>Supper</td>
<td>60</td>
<td>94.9</td>
</tr>
<tr>
<td>Light Activity</td>
<td>74</td>
<td>175.7</td>
</tr>
<tr>
<td>Clean Up</td>
<td>45</td>
<td>186.4</td>
</tr>
<tr>
<td>Sleep to 9 p.m.</td>
<td>120</td>
<td>164.5</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>1440</strong></td>
<td><strong>4936</strong></td>
</tr>
</tbody>
</table>
Table VII
FORT BENNING, GEORGIA RANGERS STUDY - 1964
Body Weight Changes, kg/Period

<table>
<thead>
<tr>
<th></th>
<th>Platoons I and II</th>
<th>Platoon III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Men</td>
<td>76</td>
<td>21</td>
</tr>
<tr>
<td>Number of Days</td>
<td>18</td>
<td>13</td>
</tr>
<tr>
<td>Body Weight, Before</td>
<td>77.33</td>
<td>73.18</td>
</tr>
<tr>
<td>Body Weight, Day 9</td>
<td>77.46</td>
<td>73.78 (4 das)</td>
</tr>
<tr>
<td>Body Weight, After</td>
<td>75.93</td>
<td>72.77</td>
</tr>
<tr>
<td>Body Weight, Change</td>
<td>-1.40</td>
<td>-0.41</td>
</tr>
<tr>
<td>Mean Body Weight Loss, All Men</td>
<td>-70.1 gm/Man/Day</td>
<td></td>
</tr>
</tbody>
</table>

* This group did not begin the study until the 5th day of training.
### Table VIII
**FORT BENNING, GEORGIA RANGERS STUDY - 1964**

**Blood Changes, Mean/Group/Period**

<table>
<thead>
<tr>
<th>No. of Men</th>
<th>Before Study</th>
<th>After End of Study</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S.D.</td>
<td>S.D.</td>
</tr>
<tr>
<td>Hemoglobin gm/100 ml</td>
<td>28</td>
<td>14.68 0.559 14.68 0.566</td>
</tr>
<tr>
<td>Hematocrit %</td>
<td>29</td>
<td>46.46 1.84 45.36 1.99</td>
</tr>
<tr>
<td>Plasma Protein gm/100</td>
<td>34</td>
<td>7.93 0.30 7.43 0.27</td>
</tr>
</tbody>
</table>

*Significance of data before and after study.*
- Hemoglobin: Not Significant
- Hematocrit: Not Significant
- Plasma Protein: $P < 0.001$, Highly Significant

---

40
<table>
<thead>
<tr>
<th>Day</th>
<th>Specific Gravity</th>
<th>Total Solids (gm %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1</td>
<td>1.029</td>
<td>7.33</td>
</tr>
<tr>
<td>Day 9</td>
<td>1.031</td>
<td>7.67</td>
</tr>
<tr>
<td>Day 16, End</td>
<td>1.029</td>
<td>7.18</td>
</tr>
</tbody>
</table>
Table X

FORT BENNING, GEORGIA RANGERS STUDY - 1964
Skinfold Thickness and Waist Circumference Measurements
Mean/Group/Period

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th></th>
<th>After</th>
<th></th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>S. D.</td>
<td>Mean</td>
<td>S. D.</td>
<td></td>
</tr>
<tr>
<td>Waist Circumference,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>P&lt;0.001</td>
</tr>
<tr>
<td>cm</td>
<td>78.60</td>
<td>4.79</td>
<td>75.84</td>
<td>4.05</td>
<td></td>
</tr>
<tr>
<td>Skinfolds</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right Arm, mm</td>
<td>10.38</td>
<td>4.09</td>
<td>10.63</td>
<td>4.49</td>
<td>N.S.</td>
</tr>
<tr>
<td>Left Arm, mm</td>
<td>10.02</td>
<td>4.41</td>
<td>10.48</td>
<td>4.42</td>
<td>N.S.</td>
</tr>
<tr>
<td>Right Scapula, mm</td>
<td>9.41</td>
<td>3.01</td>
<td>9.73</td>
<td>2.95</td>
<td>P&lt;0.025</td>
</tr>
<tr>
<td>Left Scapula, mm</td>
<td>9.57</td>
<td>3.00</td>
<td>9.98</td>
<td>3.05</td>
<td>N.S.</td>
</tr>
</tbody>
</table>
Table XI
FORT BENNING, GEORGIA RANGERS STUDY - 1964
Bicycle Performance Test
Mean/Group/Period

<table>
<thead>
<tr>
<th></th>
<th>Before Mean</th>
<th>S.D.</th>
<th>After Mean</th>
<th>S.D.</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Performance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>10.54</td>
<td>1.88</td>
<td>9.83</td>
<td>1.89</td>
<td>P&lt;0.025</td>
</tr>
<tr>
<td>Watt/Minute Work,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1703</td>
<td></td>
<td>1537</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recovery Pulses X^2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 - 1.5</td>
<td>143</td>
<td>13.1</td>
<td>129</td>
<td>17.1</td>
<td>P&lt;0.001</td>
</tr>
<tr>
<td>2 - 2.5</td>
<td>129</td>
<td>12.6</td>
<td>114</td>
<td>13.7</td>
<td>P&lt;0.001</td>
</tr>
<tr>
<td>4 - 4.5</td>
<td>116</td>
<td>9.7</td>
<td>101</td>
<td>10.1</td>
<td>P&lt;0.001</td>
</tr>
<tr>
<td>Physical Fitness</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Index</td>
<td>66</td>
<td>13.3</td>
<td>73</td>
<td>14.4</td>
<td>P&lt;0.010</td>
</tr>
</tbody>
</table>
Table XII
FORT BENNING, GEORGIA RANGERS STUDY - 1964
Spirometry and Miscellaneous Data
Mean of Each Group/Period

<table>
<thead>
<tr>
<th></th>
<th>Before Mean</th>
<th>S.D.</th>
<th>After Mean</th>
<th>S.D.</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forced Vital Capacity, ml</td>
<td>5603</td>
<td>670</td>
<td>5497</td>
<td>662</td>
<td>N.S.</td>
</tr>
<tr>
<td>FEV1 % of FVC</td>
<td>83.6</td>
<td></td>
<td>82.0</td>
<td></td>
<td>N.S.</td>
</tr>
<tr>
<td>FEV2 % of FVC</td>
<td>93.9</td>
<td></td>
<td>94.1</td>
<td></td>
<td>N.S.</td>
</tr>
<tr>
<td>FEV3 % of FVC</td>
<td>97.3</td>
<td></td>
<td>97.6</td>
<td></td>
<td>N.S.</td>
</tr>
<tr>
<td>Maximum Breathing Capacity,</td>
<td>215</td>
<td>73.8</td>
<td>189</td>
<td>32.7</td>
<td>P&lt;0.05</td>
</tr>
<tr>
<td>liters</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Breath Holding,</td>
<td>55</td>
<td>16.9</td>
<td>48</td>
<td>16.5</td>
<td>P&lt;0.001</td>
</tr>
<tr>
<td>Seconds</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grip, Right Hand, kg</td>
<td>48</td>
<td>7.8</td>
<td>42</td>
<td>8.6</td>
<td>P&lt;0.001</td>
</tr>
<tr>
<td>Grip, Left Hand, kg</td>
<td>46</td>
<td>8.3</td>
<td>39</td>
<td>8.3</td>
<td>P&lt;0.001</td>
</tr>
</tbody>
</table>
Table XIII
FORT BENNING, GEORGIA RANGERS STUDY - 1964
Summary Food Intake and Energy Expenditure

<table>
<thead>
<tr>
<th>Days</th>
<th>Food Intake</th>
<th>Estimated Energy Expenditure</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calories/Man/Day*</td>
<td>Calories/Man/Day</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Calculated</td>
<td>Analyzed</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>4480</td>
<td>4795</td>
<td>3878</td>
</tr>
<tr>
<td>2</td>
<td>4000</td>
<td>4315</td>
<td>3991</td>
</tr>
<tr>
<td>3</td>
<td>4341</td>
<td>4069</td>
<td>3614</td>
</tr>
<tr>
<td>4</td>
<td>3901</td>
<td>4225</td>
<td>4263</td>
</tr>
<tr>
<td>5</td>
<td>4016</td>
<td>4018</td>
<td>4337</td>
</tr>
<tr>
<td>6</td>
<td>3952</td>
<td>4307</td>
<td>5154</td>
</tr>
<tr>
<td>7</td>
<td>3429</td>
<td>4021</td>
<td>3460</td>
</tr>
<tr>
<td>8</td>
<td>4368</td>
<td>4315</td>
<td>4330</td>
</tr>
<tr>
<td>Mean</td>
<td>4061</td>
<td>4258</td>
<td>4128</td>
</tr>
<tr>
<td>9</td>
<td>4269</td>
<td>4641</td>
<td>3568</td>
</tr>
<tr>
<td>10</td>
<td>4479</td>
<td>4508</td>
<td>3667</td>
</tr>
<tr>
<td>11</td>
<td>4749</td>
<td>4281</td>
<td>5633</td>
</tr>
<tr>
<td>12</td>
<td>4611</td>
<td>4957</td>
<td>5030</td>
</tr>
<tr>
<td>13</td>
<td>5050</td>
<td>4595</td>
<td>4048</td>
</tr>
<tr>
<td>14</td>
<td>4529</td>
<td>4799</td>
<td>4820</td>
</tr>
<tr>
<td>15</td>
<td>4215</td>
<td>4215</td>
<td>3251</td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
<td>4936</td>
</tr>
<tr>
<td>Mean</td>
<td>4559</td>
<td>4571</td>
<td>4369</td>
</tr>
<tr>
<td>Mean All</td>
<td>4293</td>
<td>4404</td>
<td>4249</td>
</tr>
</tbody>
</table>

* Food intake from all sources
Table XIV
FORT BENNING, GEORGIA RANGERS STUDY - 1964
Energy Balance, Calories/Man/Day

<table>
<thead>
<tr>
<th>Days</th>
<th>1 - 8</th>
<th>9 - 16</th>
<th>1 - 16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Intake, All Sources *</td>
<td>4256</td>
<td>4571</td>
<td>4404</td>
</tr>
<tr>
<td>Energy Expenditure**</td>
<td>4128</td>
<td>4369</td>
<td>4249</td>
</tr>
<tr>
<td>Balance</td>
<td>+128</td>
<td>+252</td>
<td>+155</td>
</tr>
</tbody>
</table>

* Using chemically analyzed food composite values.

** Energy expenditure estimated from time motion data. Values for energy cost of various activities may be greatly underestimated.
During Bivouac the evenings were down to freezing (no sleeping bags) and no estimate was included for the continuous harassment and mental stress during training.
Table XV

FORT BENNING, GEORGIA RANGERS STUDY - 1964

Estimated Energy Requirement During Training

<table>
<thead>
<tr>
<th>Estimation from Body Weight Changes</th>
<th>Calories/Man/Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Intake, All Sources, Cal/Day</td>
<td>4404</td>
</tr>
<tr>
<td>Body Weight Change: -1.15 kg or -70 gm/Man/Day</td>
<td></td>
</tr>
<tr>
<td>Body Weight Caloric Equivalent (6.3 Cal/gm)</td>
<td>442</td>
</tr>
<tr>
<td>Requirement for Body Weight Change Alone*</td>
<td>4846</td>
</tr>
</tbody>
</table>

* Based on body weight changes alone, assuming the same proportion of protein, fat and water being lost.
APPENDIX I

FORT BENNING, GEORGIA RANGERS STUDY - 1964

Ranger Department Training Schedule

29 Nov AM (Sunday) - Physical Combat Proficiency Tests, Swimming, etc.
PM OFF until next AM

30 Nov AM PE, Inspections, Combat water survival tests
PM Fundamentals and Theory of Map Reading (3 hrs)
Hand to Hand Combat, Demonstration, Training, etc. (1 hr)

1 Dec AM PE, Lectures, Demonstrations
PM Lectures, Demonstrations

2 Dec AM PE, Inspections, Demonstrations, Lectures, etc.
PM Demonstrations, Lectures

3 Dec AM PE, Inspections, Demonstrations, Lectures
PM Ranger Demolition
Night Navigation until 2230 hours.

4 Dec AM PE, Hand to Hand Combat
1000 - 1700 hours, Day Off

5 Dec AM PE, Map Reading
PM Hand to Hand Combat Exercise
1520 - 2400 hours, Compass Course (Field Problem)

6 Dec AM(Sunday) - OFF
PM Obstacle Course, Bayonet Drill, etc.
Off at 1700 hours

7 Dec AM Lectures, Demonstrations
PM To 1515 hours Demonstrations
Bayonet Drill, Conditioning Course (2 hours)

8 Dec AM Techniques of Patrolling
PM Principles of Actions at the Objectives - Lectures
Bayonet Drill (50 minutes)

9 Dec AM-PM - Lectures to 1700 hours
1900 hours, Patrolling Techniques, Night Combat

10 Dec Strenuous Day (in mud) Full Field Equipment,
Patrol Tactics

11 Dec Fairly easy, Tactical Survival
Bayonet Assault Drills, Obstacle Course (110 min)

12 Dec AM Perfecting Patrol Techniques (Walking, not strenuous)
PM Night Reconnaissance Patrol (fairly strenuous) (8 hours)
Appendix I (cont.)

13 Dec AM (Sunday) - Sat around cleaning equipment
   PM       Conditioning Course (1 hour)
            To bed early

14 Dec AM       Aerial Resupply and Helicopter Terminal Guidance
   PM       Training Summary
            Obstacle Course (12 minutes)
            To bed early

15 Dec
   Up at 1:30 AM
   16 mile Forced March to 0700 hours
   Final Confidence Course
   END
## APPENDIX II

**FORT BENNING, GEORGIA RANGERS STUDY - 1964**

Physical Activities, Energy Expenditure*

<table>
<thead>
<tr>
<th>Activities</th>
<th>Cal/kg/10 Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleeping</td>
<td>0.172</td>
</tr>
<tr>
<td>Eating, Sitting</td>
<td>0.204</td>
</tr>
<tr>
<td>Eating, Standing</td>
<td>0.230</td>
</tr>
<tr>
<td>Lying Down, Resting (Breaks)</td>
<td>0.195</td>
</tr>
<tr>
<td>Lying on the Ground</td>
<td>0.220</td>
</tr>
<tr>
<td>Sitting, Leisurely*</td>
<td>0.183</td>
</tr>
<tr>
<td>Sitting, Lecture, Etc.*</td>
<td>0.253</td>
</tr>
<tr>
<td>Sitting, Riding Bus, Truck</td>
<td>0.245</td>
</tr>
<tr>
<td>Sitting, in Bunkers</td>
<td>0.245</td>
</tr>
<tr>
<td>Standing Casually Outside*</td>
<td>0.213</td>
</tr>
<tr>
<td>Standing Formation</td>
<td>0.356</td>
</tr>
<tr>
<td>Walking Normally, Light Activity*</td>
<td>0.530</td>
</tr>
<tr>
<td>Walking Normally w/Field Equipment*</td>
<td>0.783</td>
</tr>
<tr>
<td>Walking, Forced March w/Field Equipment</td>
<td>0.969</td>
</tr>
<tr>
<td>Marching</td>
<td>0.705</td>
</tr>
<tr>
<td>Run, Double Time</td>
<td>2.656</td>
</tr>
<tr>
<td>Running</td>
<td>5.514</td>
</tr>
<tr>
<td>Personal Toilet (Washing, Shaving)</td>
<td>0.278</td>
</tr>
<tr>
<td>Dressing, Etc.</td>
<td>0.466</td>
</tr>
<tr>
<td>Getting Equipment (Labor Detail, Light)</td>
<td>0.410</td>
</tr>
<tr>
<td>Moving Equipment, Labor Detail, Moderate</td>
<td>0.703</td>
</tr>
<tr>
<td>Cleaning, Etc. (Sweeping Floor, Etc.)</td>
<td>0.535</td>
</tr>
<tr>
<td>Cleaning Equipment, Etc.</td>
<td>0.437</td>
</tr>
<tr>
<td>Break, Unroll Bedroll, Etc.</td>
<td>0.703</td>
</tr>
<tr>
<td>Break, Rollup Bedroll, Etc.</td>
<td>0.703</td>
</tr>
<tr>
<td>Policing Area</td>
<td>0.360</td>
</tr>
</tbody>
</table>
Appendix II (cont.)

Foot Inspection 0.245
Standing, Inspection of Equipment, Etc. 0.206
Washing Clothes 0.364
PT Exercise (Calisthenics) 0.814
Rope Climb 1.470
Swimming 5.205
Crawling 0.977
Kneeling 0.175
Hand to Hand Combat (1/2 Resting) 0.977
Bayonet Drill 1.298
Obstacle Course 0.977
Confidence Course* 1.054
Practice, Application Bayonet 0.960
Patrolling in Woods, Etc. 0.954
Kneeling, Crawling, Crouching, Etc. 0.977
Pushups 1.510
Walking, 4.3 mph 0.969
Walking, 2.5 miles in 100 Minutes 0.636
Walking, 120 Paces/Minute w/o Equipment* 1.518
Walking, 120 Paces/Minute w/Equipment* 1.532
Sitting w/ Web Equipment* 0.270
Mile in (5 min) w/o Web Equipment* 2.400
Army PT Repetitions - 6* 1.517
9* 1.517
Double Time 180 Pace/Minute w/ Web Equipment* 2.015
Standing at Ease w/Web Equipment* 0.230
Walking Leisurely w/ Web Equipment* 0.753
Walking, Leisurely w/ Web Equipment and Bedroll* 0.940

* These values performed at Fort Benning, Georgia. All other values from Consolazio, Pecora and Johnson (1963) (3).
AR 40-5 prescribes the minimal nutrient intake of a physically active individual living in a temperate environment and subsisting on a garrison or field type ration to be 3600 Calories/man/day. The daily food consumption of the Ranger Department trainees, Fort Benning, Georgia, over the entire training period, using the chemical analyses of the food composites averaged 4404 Calories or an increase of 22.2% over the daily prescribed intakes. When one utilizes the caloric equivalent of the body weight change (-70 gm/man/day or 442 Calories) the energy requirements averaged 4846 Calories/man/day. This was equivalent to an increase of 34.5% over the prescribed daily minimal intakes.

This fairly high requirement was not unexpected since the men worked long hours, especially during the field training phase, and were under stress imposed by continuous physical and mental harassment.
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13. **Abstract**: Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

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### Key Words

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| Nutritional Surveys
| Food Intake, Military
| Energy Requirements
| Heavy Physical Activity Requirements

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**Security Classification**

**UNCLASSIFIED**
**Abstract**

AR 40-5 prescribes the minimal nutrient intake of a physically active individual living in a temperate environment and subsisting on a garrison or field type ration to be 3600 Calories/man/day. The daily food consumption of the Ranger Department trainees, Fort Benning, Georgia, over the entire training period, using the chemical analyses of the food composites averaged 4404 Calories or an increase of 22.2% over the daily prescribed intakes. When one utilizes the caloric equivalent of the body weight change (-70 gm/man/day or 442 Calories) the energy requirements averaged 4846 Calories/man/day. This was equivalent to an increase of 34.5% over the prescribed daily minimal intakes.

This fairly high requirement was not unexpected since the men worked long hours, especially during the field training phase, and were under stress imposed by continuous physical and mental harassment.
Nutrition Surveys
Food Intake, Military
Energy Requirements
Heavy Physical Activity Requirements

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UNCLASSIFIED

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*UNCLASSIFIED Security Classification*
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