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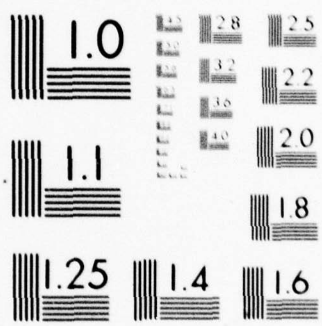

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NUTRIENT INTAKES AND SOME SOCIO-ANTHROPOMETIC CHARACTERISTICS OF TWENTYNINE PALMS MARINE CORPS PERSONNEL BEFORE FOOD SERVICE SYSTEM MODIFICATIONS - MARCH 1977

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DIVISION OF NUTRITION TECHNOLOGY

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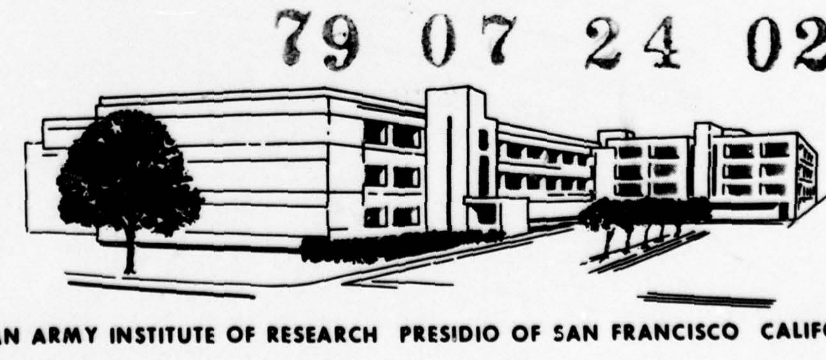

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Data were collected on nutrient intakes, dining hall attendance, and some socio-anthropometric characteristics of enlisted Marine Corps personnel at Twentynine Palms (TNP), California. The study was designed to (1) assess the nutritional adequacy of the average daily diet, and (2) evaluate the contribution of the existing feeding system upon nutrient intakes. Thirty-six RIK women, 109 RIK men, 116 COMRATS - married men, and 54 COMRATS - single men were studied.

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On the average, all groups ate about two meals per day. Percent dining hall utilization for RIK men was about 50%, whereas RIK women had a percent dining hall utilization rate of 22%. Overall, dining hall meals eaten by RIK personnel seemed to provide adequate nutrition, except vitamin A content should be higher and the percentage of fat calories lower.

ABSTRACT

Data were collected on nutrient intakes, dining hall attendance, and some socio-anthropometric characteristics of enlisted Marine Corps personnel at Twentynine Palms (TNP), California. The study was designed to (1) assess the nutritional adequacy of the average daily diet, and (2) evaluate the contribution of the existing feeding system upon nutrient intakes. Thirty-six RIK women, 109 RIK men, 116 COMRATS - married men, and 54 COMRATS - single men were studied.

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Our recommendations based on the nutritional evaluations of the enlisted personnel at TNP are as follows:

1. Investigate the energy requirements of men and women Marines at the Twentynine Palms Marine Corps Base.

2. Dining facilities should direct attention towards including higher vitamin A content foods in the menu, coupled with an education program to increase their consumption.

3. Dining facilities should provide low fat (2% fat) milk in serving line dispensers and increase menu usage of meats with a lower percentage of fat (i.e. reformed meats, leaner cuts of meat, turkey frankfurters, poultry, fish, etc.) in order to assist the Marine in lowering the percentage of fat calories consumed from dining hall meals.

4. Encourage increased usage of base dining hall facilities by RIK personnel, particularly the women.

5. Develop a Marine Nutrition Education and Awareness Program to help Marines prevent and correct their own nutrition problems.

6. Encourage and instruct all groups to elevate vitamin A in their diets. Additionally, RIK personnel need to increase thiamin consumption and the women need to elevate the level of iron in their diets.

PREFACE

The authors wish to acknowledge the excellent support received from COL W.J. Hallisey, Chief of Staff, and CPT W.A. Robinson, Chief Food Service Officer, during the Twentynine Palms Marine Corps Base study. In addition, we would like to thank the 315 enlisted personnel who participated in the dietary interviews, their personnel officers, and the unit commanders, whose wholehearted cooperation greatly contributed to the success of the study.

The authors also wish to recognize the following LAIR personnel: Mr. John T. Hixson for his valuable assistance in data processing; Mr. Alan L. Hopkins for assistance in statistical analysis of the data; Ms Frances Coulter, Ms Eva Obarzanek, Mr. Joseph Capone, Ms Lynne Capone, Ms Ina Chu, Ms Deborah Holderness, Ms Laura Jacobs, and Ms Linda Jadeson for their outstanding efforts as dietary interviewers; and SP-4 Janet Thompson, Mr. Mike Morris and Ms Carolynn Lewis for their technical assistance.

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INTRODUCTION

Twentynine Palms Marine Corps Base is located in the California desert, about 50 miles northeast of Palm Springs, and is a Marine air-ground-combat training center. Troop activities at the base include: communications and electronics school students and permanent personnel, headquarters and service personnel, combat troops, and combat support personnel.

During March 1974, the United States Marine Corps (USMC) submitted to the Department of Defense Food Research, Development, Testing and Engineering Program a request for analysis of Twentynine Palms (TNP), California, Marine Corps' food service system. The major purpose of the analysis was to improve acceptance and utilization of the base dining halls by enlisted Marines. The Operations Research/Systems Analysis Office of the United States Army Natick Research and Development Command is responsible for the basic requirements of the request as submitted by USMC, while the Department of Nutrition, Letterman Army Institute of Research (LAIR) is responsible for evaluating the nutritional impact of the food service system changes when they occur.

The first nutrition study was conducted by LAIR in March 1977, during which time temperate environmental conditions existed. The study was designed to evaluate the contribution of the current Marine feeding system at TNP upon the Marines' nutrient intakes and nutritional status. While the study encompassed many aspects, this report presents the nutrient intakes and some of the socio-anthropometric characteristics of Marine enlisted personnel at TNP prior to modification of the food service system.

METHODS

Subject Selection. Within the Marine Corps enlisted population seven separate groups with assumed different eating habits were identified. The differences among groups thought to influence eating habits were: (a) ration status (Ration-in-Kind vs. Commuted rations), (b) the assigned unit (it was assumed that the different duties performed by units would affect activity level and hence, caloric consumption), (c) marital status (married vs. single), and (d) men vs. women.

Rations-in-Kind (RIK) and Commuted Rations (COMRATS) are two systems by which the Armed Services provide food to military personnel. RIK allows for three meals per day served by a military dining facility, and the food (whether consumed or not) is considered as a portion of the service member's salary. COMRATS provides money (for food purchase) in lieu of food to military personnel. Personnel must receive permission or be granted permission by regulation to qualify for COMRATS. Since the policy at TNP restricted those Marines receiving COMRATS from eating in the dining halls, except under special circumstances, any changes in the food service system would primarily impact RIK personnel. However, baseline data on COMRATS personnel was gathered to serve as control data for future studies.

The seven groups studied were as follows:

GROUP	RATION STATUS	MARITAL STATUS	SEX	UNIT[1]
R1	RIK	Single	Male	C&E, H&S
R2	RIK	Single	Male	FT, FSSG
RF1	RIK	Single	Female	C&E, H&S
CM1	COMRATS	Married	Male	C&E, H&S
CM2	COMRATS	Married	Male	FT, FSSG
CS1	COMRATS	Single	Male	C&E, H&S
CS2	COMRATS	Single	Male	FT, FSSG

[1] C&E = Communications and Electronics School.

H&S = Headquarters and Service Battalion.

FT = Force Troops (Tank Battalion and Field Artillery Groups).

FSSG = Force Service Support Group

Unit personnel officers were asked to select at random approximately 55 subjects per group from their rosters. Due to the non-availability of sufficient numbers of single men receiving COMRATS and of women Marines, these groups contained less than 40 subjects.

Anthropometric and Demographic Data. Height, weight, and four skinfolds (right and left scapula and triceps) were measured on all subjects during the clinical evaluation. Additionally, birth date and information on housing, rank, months in service, and regularity of nutrient supplement consumption were recorded at that time. Details on methodology are to be covered in reports summarizing the clinical and anthropometric results of the study. Each subject was evaluated against Army height-weight standards[1] and percent body fat was estimated for all males according to the method of Chinn and Allen[2]:

1. DA Regulation 600-9. Washington, DC 1976.
2. Chinn, K.S.K. and T.M. Allen. Report No. 248 USAMRNL, 1960.

$$\text{Percent Body Fat} = [.534(.01\overline{S} - .04)^{\frac{1}{4}} - .061]M + 1.10H^{3.02} - 6.4 + .234A$$

Where:

$$\overline{S}\ (\text{in mm}) = \left(\frac{\text{right scapula} + \text{left scapula}}{2}\right) + \left(\frac{\text{right triceps} + \text{left triceps}}{2}\right)$$

M = weight in kilograms
H = height in meters
A = age in years

Percent body fat was not estimated for females since the measured skinfolds are not accurate indicators of body fat in women. Additionally, it should be noted that all references to percent body fat in this report are only estimates as derived from the above equation.

Dietary Record and Interviews. Individual food consumption data were collected for a 14-day survey period. Each subject was informed as to the purpose of the survey and assigned to one of eight interviewers trained in nutrition and dietetics and experienced in dietary interview techniques. The interviewers met once with a subject prior to commencement of the survey, and then twice weekly (3- to 4-day intervals) during the 14 days. Each interview lasted for about 20 minutes. At the first interview, the subject was instructed in the procedures for recording daily food intake on pocket-sized cards and urged to record the information immediately following each meal or snack. Information recorded included: (a) foods and beverages (excluding water), (b) quantity of each item consumed, (c) method of food preparation, i.e., baked, fried, etc., for all foods consumed, (d) times at which food and beverages were consumed, and (e) where each item was consumed (dining hall, home, restaurants, vendors). At all subsequent interviews, the recorded information was reviewed and clarified by the interviewer.

Upon conclusion of the survey, each interviewer converted the individual food consumption data of his/her assigned subjects to a form suitable for computer processing. To obtain nutrient intake data, each item and the quantity of it consumed were coded according to the LAIR Nutrient Factor File which is a computerized compilation of many food composition tables. When necessary, recipes were estimated for complex food items (such as casseroles), and nutrients computed from nutrient values of the ingredients. Each item consumed was also coded according to where it was eaten (the source). The sources are defined as follows:

1. Dining Hall - Refers only to the enlisted dining halls at TNP.

2. Home - Foods prepared and consumed at home or items prepared at home and consumed elsewhere (e.g., bag lunch, picnic, etc.).

3. Restaurant - Commercial food outlets which provide seating to consume foods on site.

4. Vendors - Vending machines and commercial outlets where seating is not provided.

Additionally, the interviewer categorized each item consumed as a component of either a "meal" or a "snack" by reviewing the individual's entire daily food record. Therefore, a hamburger and a can of soda might constitute a meal in one case and be classified as an in-between-meal snack in another case.

Nutritional Standards. Shown in Table 1 are the military dietary allowances[3] (MDA) and the nutrient density allowances (MDA expressed per 1000 kcal) which were used to evaluate the reported nutrient intakes. The former are the nutritional standards established for the Armed Services, whereas the latter are allowances based on the MDA but derived by the authors.

The MDA are based on the Recommended Dietary Allowances (RDA)[4] but adapted to meet the needs of healthy military personnel of average height and weight, between the ages of 17-25 years, who are moderately active and living in a temperate environment. The recommendations contained in the MDA differ from those in the RDA for only three nutrients: energy, protein, and ascorbic acid. The reasons for the variations are explained in Schnakenberg et al.[5] Energy allowances have been established to meet the mean requirements of a normally distributed population. All other nutrients have a margin of safety above the mean requirement included in the allowance. In assessing the nutritional adequacy of dietary intakes, if the amounts of nutrients consumed fall below the MDA for a particular group, some individuals can be assumed to be at nutritional risk. When the proportion of individuals with low intakes is extensive, the risk of nutritional deficiency is increased. In this report, nutrient intakes for all nutrients, except energy, were termed adequate if consumption equalled or exceeded the standard, marginal if consumption was between 70% and 100% of the standard, and low if consumption was less than 70% of the standard.

Utilization of nutrient density allowances in evaluation of dietary intakes will probably become more common since it is likely that the next edition of the RDA will address the concept. Nutrient density is the expression of dietary allowances in terms of energy. (In this report the MDA has been expressed on a per 1000 kcal basis.) This concept has a number of useful applications: (1) it allows food manufacturers, governmental agencies, and consumers an additional means of evaluating the nutritional quality of foodstuffs independent of serving size;

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3. AR 40-25/BUMEDINST 10110. 3E/AFR 160-95. Washington D.C. 1976.
4. National Research Council. Washington D.C. 1974.
5. Schnakenberg D.D. et al. Report No. 60. LAIR, 1978.

(2) it allows institutions a means of evaluating meals served to mixed age-sex groupings; and (3) it is an additional means of evaluating population dietary intakes when there is reason to question the accuracy of the reported total daily energy intakes.

However, the concept has limitations which should be kept in mind. Requirements for various nutrients and, therefore, allowances which are based upon those requirements, are not strictly related to energy in many cases. For example, vitamin C, vitamin A, sodium, potassium, are completely essential even with a zero caloric intake. (The RDA indicates only thiamine, riboflavin, and niacin to be related to energy intake.) Additionally, individuals with low energy requirements will have higher nutrient density requirements than those with high energy needs. Perhaps, nutrient density allowances should be established for individuals whose nutrient-to-energy needs are greatest. In the absence of knowledge of the range of a population's energy requirements, allowances can be based on the mean energy requirement, but application of the standard is only suitable to populations and not individuals.

<u>Statistical Analyses</u>. A 2 x 3 factor analysis of covariance (2 unit groupings x 3 ration status groupings) was used to test for significant effects ($P < 0.05$) of unit and ration status groupings on mean total daily nutrient intakes of male groups. The covariates used were age and body weight. Mean male group values for anthropometric data, months in service, daily caloric composition, and daily nutrient density were tested for significant effects of unit and ration status groupings with a 2 x 3 factor analysis of variance (ANOVA). Those variables found to be significant by analysis of covariance or variance for ration status grouping were then tested with the Tukey Multiple Comparison Test for significant differences between ration status groupings.

Significant differences between mean values for total daily nutrient intakes per dining hall meal consumed by groups R1 and RF1 were tested by a one-way analysis of covariance. Covariates used were age and body weight. A one-way ANOVA was used to test for significant differences between mean values for anthropometric data and months in service of groups R1 and RF1. The mean values of RIK male and female groups (R1 and R2 vs. RF1) for average daily caloric consumption, average daily nutrient density, and average nutrient density per dining hall meal consumed were tested with a one-way ANOVA for significant differences. Significant differences between group mean values for meals per day, average daily energy from meals and snacks, average daily energy from various sources, and characteristics of RIK males with low, marginal, and adequate vitamin A intakes were tested with one-way ANOVAs followed by the Tukey Multiple Comparisons Test for those variables found to be significant.

In the report which follows, differences are stipulated as significant if $P < 0.05$.

RESULTS

Anthropometric and Demographic Characteristics. Presented in Table 2 are the anthropometric and demographic characteristics of the seven groups studied. All groups contained 50 to 60 people except the female and CS groups. Statistical analyses yielded no significant differences between male groups due to unit grouping, but significant differences due to ration status groupings were identified. Age, estimated percent body fat, and months in service differed significantly between male ration groups, but height, weight, skinfolds and predicted fat free mass did not. The average RIK male was younger (about 21 years of age), had fewer months of service (between 1 and 2 years), and had a lower percent body fat (11.6%) than the average CM or CS man. The average CM man was 24 years old, had 5 years in service, and was about 13.7% body fat. The average age for a CS man was 28 years, his length of service was about 10 years, and his body fat about 15%. Approximately 10% of the CM and CS groups exceeded the weight for height standards, but only about 3% of the RIK male groups did. Greater than 90% of the RIK males lived in the billets, and about the same percentage of CM personnel lived outside the billets. The majority of CS1 men lived in the billets, whereas the opposite was true for CS2 personnel.

RIK females differed significantly from R1 males for height and weight, but not for age or months in service. A smaller percentage of the RIK females lived in the billets than the RIK males (77% vs 93%, respectively). About 11% of the female group exceeded the weight for height standards established for women.

The significant differences in mean estimated percent body fat among ration groupings are probably reflective of the differences in ages among the groups. Presented in Table 3 is the percentage of body fat of the male Marines according to age. As expected, percent body fat increased with age, but the percent fat in all age groupings is lower than had been found in previous studies of the military population.[6]

Total Daily Nutrient Intake. Presented in Tables 4A and 4B are the total daily nutrient intakes from food and beverages for each of the groups. Intakes are expressed as the group mean and, where applicable, as percent of the military standard. Additionally, a median value is indicated when for two or more groups it was noticeably different from the mean. Results from statistical analysis of these data (male groups only) are shown in Table 5. Statistically significant differences were found for protein, fat, calcium, phosphorus, and thiamin intakes between men from FT and FSSG units and those from C&E and H&S units. Significant differences were also found among male ration groupings (RIK, CM, and CS) for energy, calcium, phosphorus, and riboflavin consumption. Total

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6. Krzywicki, H.J., and C.F. Consolazio. In: Body Composition in Animals and man. pp 492-511. National Acad Sciences, 1968.

daily nutrient intakes for RIK women were significantly different from RIK men from the same units for all nutrients.

1. Energy. All male groups except R1 had mean energy intakes 450-700 kcal and median intakes 550-800 kcal below the military standard. Mean and median intakes of the female group were about 200 kcal and 300 kcal, respectively, less than the MDA. Correction of energy intake for body weight (kcal/kg body weight) still resulted in mean energy intakes less than the MDA. (The military standard recommends about 44 kcal/kg for men and about 38 kcal/kg for women.) Although no significant differences in energy intake were found due to unit grouping, significant differences were found due to ration grouping. RIK men had higher energy consumption than the CM and CS groups which did not significantly differ from each other.

2. Protein. All groups had mean protein intakes greater than the standard, except R2, CS2, and RF1 which had intakes only slightly below the standard. Median intakes were lower than mean intakes for all groups, and the expression of protein intake on a per kg body weight basis resulted in all groups having intakes that exceeded 1.2g per kg body weight. (The RDA for protein per kg body weight is 0.8g/kg.) Personnel from C&E and H&S units had significantly higher protein intakes than those from FT and FSSG units.

3. Fat. Daily mean fat intake was significantly different between unit groupings. Men from C&E and H&S units consumed greater amounts than those from FT and FSSG units.

4. Minerals. All groups had adequate mean intakes of calcium and phosphorus. Statistically significant differences in mean calcium and phosphorus intakes were found between men of different unit and ration status groupings. Higher intakes were found for men from C&E and H&S units than from FT and FSSG units. RIK men had higher intakes than CM men, and CS men had the lowest intakes. The calcium to phosphorus ratio for all groups was at the lower end of the acceptable range as suggested by the RDA. The mean daily iron intake for women was low at 56% of the standard and the mean intakes for male groups ranged from 75% to 88% of the MDA. However, the men's MDA for iron was established at 18 mg per day solely to insure that 17 and 18 year old males, who are still in the growth phase, receive an adequate amount of iron. For men 19 years or older, a daily intake of 10 mg is sufficient. None of the personnel in the CS groups were less than 19 years of age and therefore, their mean intakes were adequate. Less than 5% of the men in the CM1, CM2, and R2 groups were 17 or 18 years old, and thus for all practical purposes the mean intakes for those groups were adequate. About 20% of the R1 population was below 19 years of age.

5. Vitamins. Mean intakes of vitamin A were marginal for all groups, ranging from 70% to 97% of the MDA. Evaluation of median

intakes resulted in R1, CM1, CM2, and CS1 as having marginal intakes, and R2, RF1, and CS2 with low intakes. Median intakes are probably more indicative of vitamin A group intake, since a few individuals with high intakes can elevate the group mean.

All groups received adequate vitamin C. Mean intakes ranged from 122-153% of the MDA.

The MDA for thiamin, riboflavin, and niacin are based on energy intake (i.e. 0.5 mg thiamin, 0.6 mg riboflavin, and 6.6 mg niacin per 1000 kcal consumed). Therefore, in Table 4B the percentage of the standard for these nutrients has been calculated based on (1) the MDA for energy (3200 kcal for men, 2200 kcal for women) and (2) the reported kcal consumed by each group. However, only the former will be discussed.

Mean thiamin intakes were significantly different between unit groupings. The intake of personnel from C&E and H&S units was higher than those from FT and FSSG units. All of the groups had marginal thiamin consumption, although R1 was only slightly below the MDA.

Mean riboflavin intake was significantly different among ration status groupings. RIK men consumed more riboflavin daily than CM personnel who, in turn, consumed more than CS men. Mean riboflavin intake was adequate for all groups except CS groups. CS groups had intakes slightly below the MDA.

Total daily mean niacin intakes were adequate for all groups except the women. The niacin intake of the females was slightly below the allowance at 93% of the MDA.

Total Daily Caloric Composition and Nutrient Density. Table 6 presents the average total daily caloric composition (percent protein, fat, carbohydrate, and alcohol calories) and the mean nutrient density intakes for each ration status group. Statistical analysis of the data between male groups yielded significant differences among ration groups, but not between unit groupings. Additionally, no significant differences were found between the mean intake values for RIK males and females, except for percent alcohol calories and vitamin C intake. Therefore, data have been condensed in Table 6 to the three ration groupings.

Percent protein, fat, and carbohydrate calories (about 15%, 39%, and 40%, respectively) were not significantly different between groups. However, significant differences between groups were found for percent alcohol calories. RIK and CS male groups consumed greater mean percent alcohol calories than CM personnel. RIK females consumed significantly less of their calories from alcohol than RIK males. Median percent alcohol calories values were lower than mean values for all groups. Utilizing median values, RIK and CS male groups consumed 100-150 kcal per day from alcohol, CM men about 50 kcal, and RIK women about 10 kcal.

Alcohol calories are the calories contributed by the ethyl alcohol content of alcoholic beverages. If the calories derived from alcohol were calculated as fat calories, since metabolism of alcohol is closely related to that of fat, calories from fat exceeded the MDA for all groups except RFI.

Among ration groups, significant differences were found for mean protein, calcium, iron, and niacin dietary intake densities. RIK personnel had a significantly higher calcium intake density but lower iron and niacin intake densities than CS personnel. Also, RIK personnel consumed food of lower protein and iron density than CM men. Mean daily iron and vitamin A intake densities were marginal for RIK male personnel but low for RIK females. Thiamin density was slightly below the nutrient density standard for both RIK and CS personnel. RIK women consumed food of a significantly higher vitamin C density than RIK males, although in both cases the nutrient density was adequate.

Evaluation of Daily Nutrient Intake. The percentage of each group consuming low, marginal, and adequate nutrient intakes is shown in Tables 7, 8, and 9. Nutrient intakes were evaluated both on a total daily basis and on a nutrient density basis.

On a total daily intake basis, a significant portion of all male groups had low intakes of a number of nutrients. Between 37% and 70% of male groups had low total daily vitamin A intakes. Low daily thiamin consumption was found for 28% to 47% of CM, CS, and R2 men. CS groups had low riboflavin intakes for between 25% and 30% of the population and low calcium intakes for about 20% of the groups. When intake was evaluated on a nutrient density basis, vitamin A intake density was low for 20% to 48% of the men and thiamin intake densities were low for 17% of the R2 personnel.

Between 25% and 78% of RIK females consumed low total daily dietary intakes for all nutrients except phosphorus. On a nutrient density basis, between 20% and 78% of the women had low protein, iron, vitamin A and thiamin intake densities. The MDA for protein is higher than actual requirements. If the women's daily protein intake and protein nutrient intake are evaluated against the RDA for protein, none of the women consumed low intakes.

Daily Total Meals and Sources of Energy Intake. Total meals per day and the percentages of the daily energy derived from dining halls, home, restaurants, vendors, meals, and snacks are shown in Table 10. Although all groups consumed about two meals per day, significant differences existed between groups for mean percentage of daily energy from a source. Percent daily energy from a source was indicative of the percentage of daily intake of other nutrients from that source (no significant differences were found between mean percentage values for energy and other nutrients). RIK males consumed about one-half of their daily energy from the dining hall, whereas RIK females consumed about one-fifth. RIK females, in turn, consumed a significantly greater percentage of daily energy from restaurants than CM personnel. CM men consumed a significantly higher percentage of energy from home than CS men. CM personnel also consumed a significantly lower daily percentage of energy from vendors than RIK personnel. RIK personnel consumed about 20% of their total daily energy from snacks, CM personnel about 15%, and CS personnel about 22%.

<u>Contribution of the Dining Halls to RIK Nutrition</u>. Presented in Table 11 are the number of weekday and weekend total daily meals and dining hall meals consumed by RIK personnel. Weekday and weekend total daily meal consumption patterns among RIK groups were not significantly different. Sixty-five percent or more of each group's population consumed two or more daily meals. On weekends, however, all groups had more personnel consuming two meals per day and less consuming three daily meals than on weekdays. About 12% of the R1 men, 26% of the R2 men, and 51% of the women did not eat any weekday meals at the dining hall, and on weekends these numbers increased to 42%, 47%, and 79% respectively. Thirty percent of the RIK men consumed one dining hall meal daily. About 30% of the women also ate one dining hall meal per weekday, but only 15% of the females per weekend day. Two or more weekday meals were consumed at the dining hall by 58% of R1 men, 43% of R2 men, and 19% of the women. These group percentages decreased by about one-half for the males and by about two-thirds for the females on the weekend days.

Additional data on dining hall attendance patterns of RIK personnel are presented in Table 12. During the entire study, no dining hall meals were consumed by about 28% of the women, 6% of R2 men, and 2% of R1 men. The average dining hall utilization rate was about 52% for the individuals in group R1, 42% for those in group R2, and 22% for RIK women.

Table 13 presents the average nutrient intake for RIK personnel per dining hall meal consumed. Only those individuals who consumed one or more dining hall meal were included in the calculations of the means (i.e., about 96% of RIK males and 72% of RIK females). No significant differences in the mean values were found between male RIK groups (R1 and R2) and, hence, they have been presented as one group. Differences in mean nutrient consumption between RIK males and females were significant for all values except percent protein, fat, and carbohydrate calories, crude fiber, CA:P ratio, and vitamin A. Percent protein and fat calories for RIK men and women were 4 to 5% higher than the MDA. Mean vitamin A values exceeded median values by 500-600 IU.

Table 14 shows the average nutrient density for RIK personnel per dining hall meal consumed. The women had higher nutrient intake densities than the men for all nutrients, although the difference was significant only for iron and vitamin A. Median vitamin A intake densities were approximately 500 IU and 1300 IU less than the mean density intakes for RIK males and females, respectively. All nutrient intake densities were adequate for males and females except iron and median vitamin A densities which were marginal.

The percentages of RIK populations that had low, marginal, or adequate nutrient intake densities per dining hall meal consumed are shown in Table 15. Meals with low densities of iron and vitamin A were consumed by 42% and 35%, respectively, of the women. RIK males had 15% of their population consuming meals of low vitamin A density. Significant proportions of the male and female groups were consuming marginal nutrient densities of iron, vitamin A, vitamin C, thiamin, and niacin.

Comparison of RIK Men with Low, Marginal, or Adequate Total Daily Vitamin A Intakes. Tables 16A and 16B compare RIK male subjects (groups R1 and R2 combined) with low, marginal, or adequate total daily vitamin A intakes. No significant differences were found among groups for age, height, weight, or percent body fat although it is of interest to note that individuals in the low and marginal groups were shorter and fatter than those in the adequate group. Those with low intakes ate significantly fewer total daily meals and dining hall meals per day and they consumed significantly lower total daily energy and energy from the dining hall than those with adequate vitamin A intakes. The percent daily calories from home, restaurants, vendors, snacks, and alcohol were not significantly different among groups. Total daily intake for all nutrients except vitamin C were significantly less for those with low intakes than for those with adequate intakes. However, when daily nutrient intakes were expressed on a nutrient density basis, only vitamin A was significantly different between the low and adequate intake groups. The low vitamin A intake group had low daily intakes of iron in addition to vitamin A and marginal intakes for protein, thiamin, and riboflavin. This group also had low nutrient intake densities for vitamin A and marginal intake densities for iron and thiamin. In contrast, personnel with adequate vitamin A intakes had adequate nutrient intakes and dietary nutrient densities for all nutrients except iron, which was only slightly below the MDA.

Nutrient Supplement Consumption. Shown in Table 17 is the percentage of each group which regularly consumed nutrient supplements. Consumption of one or more supplements was greater in the female, CM, and CS groups (about 30% of each population) than the male RIK groups (about 15% of the men). Multi-vitamin tablets were most frequently taken followed by iron supplements. As mentioned previously, nutrient supplement consumption was not included in the calculated nutrient intakes.

DISCUSSION AND CONCLUSIONS

This study was designed to assess the nutritional adequacy of the average diet of enlisted personnel at Twentynine Palms Marine Corps Base in California. Information gathered from this study will serve as baseline data to measure the effects of changes in the food service system on the nutrient intakes of Marine personnel.

Dietary nutritional adequacy was assessed in three ways: (1) comparison of the group's mean total daily nutrient intake from foods and beverages with the military nutritional standard (MDA), (2) comparison of the group's mean nutrient intake densities with the MDA expressed on a per 1000 kcal basis, and (3) comparison of the mean daily nutrient intake and nutrient intake density of individuals within a group to the MDA, and then expression of the results as the percentage of individuals within a group with low, marginal, and adequate intakes. Since the mean value of a group can mask the fact that a substantial portion of the individuals within a group may have nutrient intakes far below or above the nutritional standard, examination of the distribution of low, marginal, and adequate nutrient intakes within a population better identifies the nutritional adequacy of their diet. However, considering that the variability between individuals as to nutrient requirements and taking into account that calculated total nutrient intake does not reflect actual nutrient absorption, evaluation of dietary nutrient intake must be considered in relation to records on clinical and biochemical nutritional assessment.

The energy allowance set by the MDA is a mean value of a normally distributed population. Thus, if the average intake of a normally distributed group approximates the MDA for energy, then for all practical purposes the energy needs of all in the group are considered adequate. Group R1 was the only group which reported energy intakes with both a normal distribution and a mean intake about equal to the MDA. None of the other groups had a normal distribution of energy intakes and their means were below the MDA. Furthermore, more than 70% of the individuals in groups R2, CS2, and RF1, and more than 60% of those in Groups CM1 and CM2 reported energy consumptions that were 500 kcal or more below the MDA. A daily energy deficit of 500 kcal represents a weight loss of about one pound per week. None of the Marines studied were below military weight for height standards, and although the estimated percentages of body fat for the males were significantly lower than values of previously studied military populations, they were within the normal range.[6]

Since energy expenditure and weight loss were not monitored during the study, the reason(s) for low energy intake is (are) unknown. Possible explanations are that (a) the assumed moderate activity level was higher than actually performed, (b) a significant proportion of the individuals within the population may have been dieting (a weight control program was in effect), (c) underestimation of energy intakes due to under-reporting by the subjects, and/or (d) the energy MDA is probably inappropriate to use with older individuals (military energy allowances are established for individuals between 17 and 25 years old and energy requirements decrease with age).

In addition to reported low energy consumptions, the Marines also reported low intakes for a significant number of other nutrients. Between 37% and 78% of all populations reported low total daily intakes of vitamin A. All groups except R1 had between 28% and 50% of their personnel reporting low daily thiamin consumption. Additionally, between 20% and 36% of the personnel in groups CS1, CS2, and RF1 had low daily calcium and riboflavin intakes, and more than 25% of the women reported low total daily intakes of niacin and vitamin C.

In the absence of energy expenditure and weight change data, evaluation of nutrient intake data and recommendations for improvement are incomplete. If reported energy intakes were accurate and adequate, then selection of "high nutrient density" foods would be necessary to eliminate low total daily nutrient intakes. If reported energy intakes were accurate but inadequate, then an overall increase of a variety of foods would probably take care of both daily energy and low nutrient intakes. However, if the reported energy intakes were low because of under reporting by subjects, then nearly all total daily nutrient intakes would also be low. Therefore, in order to evaluate the Marines' total daily nutrient intakes, and in order to propose valid recommendations based on such an evaluation, it is essential that energy expenditure and weight change be studied in future Twentynine Palms nutrient intake studies.

The nutrient density concept is useful to evaluate nutrient intakes in the event of daily energy intake uncertainty. Although only total daily nutrient intake can indicate whether or not there is a risk of nutritional deficiency (as discussed previously), nutrient intake density can help point out potential problem areas. On the basis of nutrient density evaluation, vitamin A intakes for all groups, thiamin for groups R2 and RF1, and iron for all women were found to be low.

On the average, all groups ate two meals per day. RIK men consumed significantly more meals at the dining hall than RIK women. Overall, the dining hall meals consumed by RIK personnel seemed to provide adequate nutrition, except that vitamin A content should be higher and the percentage fat calories lower. Additionally, modifications in the menu should be monitored closely so as not to decrease further thiamin, niacin, or vitamin C content which are now marginal for a significant percentage of the population.

A greater percentage of RIK women reported overall lower total daily nutrient intakes and nutrient densities than RIK men. This indicated that the women were consuming insufficient quantities of food and that the food selected provided calories but few nutrients (i.e. "junk food"). Since women require less calories than men but similar daily quantities of most other nutrients, women must exert more care than men in their food selection. Adequate iron consumption is a particular problem for women and in spite of careful food selection many need iron supplementation in order to meet the MDA.

It must be remembered, however, that the food service is limited in its capability to improve the nutrition of individuals. If nutritionally adequate and acceptable food is provided, it then becomes the Marine's responsibility to improve his/her nutrition. A Marine program to provide nutritional guidance in altering food selection and food habits should be developed in order to correct and prevent nutritional problems of individuals.

RECOMMENDATIONS

1. Investigate the energy requirements of men and women Marines at the Twentynine Palms Marine Corps Base.

2. Dining facilities should direct attention towards including higher vitamin A content foods in the menu, coupled with an education program to increase their consumption.

3. Dining facilities should provide low fat (2% fat) milk in serving line dispensers and increase menu usage of meats with a lower percentage of fat (i.e. reformed meats, leaner cuts of meat, turkey frankfurters, poultry, fish, etc.) in order to assist the Marine in lowering the percentage of fat calories consumed from dining hall meals.

4. Encourage increased usage of base dining hall facilities by RIK personnel, particularly the women.

5. Develop a Marine Nutrition Education and Awareness Program to help Marines prevent and correct their own nutrition problems.

6. Encourage and instruct all groups to elevate vitamin A in their diets. Additionally, groups R2 and RF1 need to increase thiamin consumption and the women need to elevate the level of iron in their diets.

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APPENDIX A

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TABLE 1

NUTRITIONAL STANDARDS

NUTRIENT	DAILY DIETARY NUTRIENT ALLOWANCES MALE	DAILY DIETARY NUTRIENT ALLOWANCES FEMALE	NUTRIENT DENSITY ALLOWANCES[2] MALE	NUTRIENT DENSITY ALLOWANCES[2] FEMALE
ENERGY (KCAL)	3200	2200	-	-
PROTEIN (G)	100	80	31.2	36.4
% FAT CALORIES	<40%	<40%	<40%	<40%
CALCIUM (MG)	800	800	250	364
PHOSPHORUS (MG)	800	800	250	364
IRON (MG)	18	18	5.6	8.2
VITAMIN A (IU)	5000	5000	1562	2273
VITAMIN C (MG)	60	60	18.8	27.3
THIAMIN (MG)	1.6	1.1	0.5	0.5
RIBOFLAVIN (MG)	2.0	1.4	0.6	0.6
NIACIN (MG)	21	15	6.6	6.6

[1] AR 40-25/BUMEDINST 1011.3E, 30 AUGUST 1976 (as corrected).
[2] Daily Dietary Nutrient Allowances expressed per 1000 kcal. This standard is a creation of the authors.

TABLE 2

ANTHROPOMETRIC AND DEMOGRAPHIC CHARACTERISTICS

	RATIONS-IN-KIND			COMRATS-MARRIED		COMRATS-SINGLE	
	R1	R2	RFI	CM1	CM2	CS1	CS2
NO. IN GROUP	57	52	36	59	57	34	20
AGE (YRS)	20.5 ± 1.6[1]	22.0 ± 4.2	20.9 ± 2.3	24.4 ± 5.1	23.2 ± 4.0	29.7 ± 7.6	26.3 ± 6.9
AGE RANGE (YRS)	18.5 - 43.7	18.4 - 25.0	18.3 - 30.4	18.8 - 47.2	18.9 - 36.0	19.8 - 49.2	19.7 - 44.1
HEIGHT (CM)	178.4 ± 7.2	177.0 ± 6.9	165.6 ± 6.4	176.7 ± 6.1	176.0 ± 7.3	176.4 ± 7.0	178.8 ± 7.0
WEIGHT (KG)	73.1 ± 8.7	73.7 ± 9.6	58.5 ± 6.9	76.6 ± 11.4	72.3 ± 9.2	74.3 ± 8.2	76.4 ± 12.5
PERCENT BODY FAT	12.5 ± 2.8	13.6 ± 3.3	------	15.1 ± 3.8	13.9 ± 3.6	16.2 ± 4.8	15.9 ± 4.5
SKINFOLDS (CM)[2]							
R. TRICEP	8.7 ± 3.2	9.1 ± 3.4	15.6 ± 3.7	9.6 ± 4.0	8.9 ± 3.5	8.1 ± 2.8	9.9 ± 4.4
L. TRICEP	8.8 ± 3.4	9.1 ± 3.6	15.4 ± 3.8	9.5 ± 3.9	8.8 ± 3.5	8.6 ± 3.1	9.3 ± 4.0
R. SCAPULA	10.1 ± 2.6	11.3 ± 3.6	11.0 ± 3.7	12.8 ± 4.5	11.5 ± 3.9	12.6 ± 5.1	13.1 ± 4.9
L. SCAPULA	10.2 ± 2.6	11.6 ± 3.6	11.5 ± 3.6	13.4 ± 4.7	11.8 ± 3.9	13.5 ± 5.8	13.5 ± 5.4
FAT FREE MASS (KG)	63.9 ± 7.1	63.6 ± 7.3	------	64.8 ± 8.4	62.1 ± 6.9	62.1 ± 6.8	63.8 ± 8.4
NO. EXCEEDED WT. FOR HT. STANDARD[3]	0	3	4	8	5	2	3
MONTHS IN SERVICE							
MEAN ± S.D.	16.4 ± 10.8	38.4 ± 46.9	18.7 ± 19.5	60.2 ± 57.1	46.8 ± 42.9	120.4 ± 71.2	95.8 ± 94.4
MEDIAN	11.0	24.0	11.0	45.0	37.0	104.0	49.5
PERCENT IN BILLETS	91.2	94.2	77.2	5.1	1.8	73.5	35.0
RANK (PERCENT OF GROUP)							
E1 - E3	68.5	50.0	72.3	18.7	29.8	2.9	15.0
E4 - E6	31.5	48.1	27.7	72.8	66.7	61.8	65.0
E7 - E9	0	1.9	0	8.5	3.5	35.3	20.0

[1]MEAN ± STANDARD DEVIATION. [2]R.=Right, L.=Left. [3]AR 600-9, 30 NOVEMBER 1976.

TABLE 3

ESTIMATED PERCENTAGE OF BODY FAT IN MALE MARINES[1]

AGE GROUP	NUMBER	PERCENT FAT
17-19	59	12.6 ± 3.0[2]
20-24	154	13.4 ± 3.1
25-29	33	16.0 ± 3.1
30-34	18	17.8 ± 4.2
35-39	7	19.6 ± 2.4
40-44	5	21.8 ± 1.5
45-50	3	25.1 ± 4.0

[1]RIK and COMRATS males combined.
[2]Mean ± standard deviation.

TABLE 4A

AVERAGE TOTAL DAILY NUTRIENT INTAKE[1]

	RATIONS-IN-KIND			COMRATS-MARRIED		COMRATS-SINGLE	
	R1	R2	RF1	CM1	CM2	CS1	CS2
QUANTITY (G)							
MEAN ± S.D.	2899 ± 904	2730 ± 1020	1781 ± 688	2537 ± 108	2556 ± 756	2809 ± 994	2657 ± 937
ENERGY (KCAL)							
MEAN ± S.D.	3105 ± 688	2751 ± 711	1991 ± 659	2637 ± 684	2709 ± 620	2680 ± 755	2503 ± 435
MEDIAN	3003	2651	1862	2398	2660	2525	2518
MEAN INTAKE:							
% OF STANDARD[2]	97	86	91	82	85	84	78
PER KG BW[3]	42.9 ± 10.0	38.0 ± 10.9	34.2 ± 11.3	35.0 ± 9.5	38.1 ± 10.0	36.4 ± 10.9	33.4 ± 7.7
PROTEIN (G)							
MEAN ± S.D.	112.4 ± 28.7	96.7 ± 28.1	71.0 ± 24.6	105.5 ± 26.2	104.0 ± 23.3	101.5 ± 34.3	93.3 ± 27.3
MEDIAN	105.5	88.4	69.4	103.4	99.4	88.4	90.5
MEAN INTAKE:							
% OF STANDARD	112	97	89	106	104	102	93
PER KG BW	1.55 ± 0.40	1.34 ± 0.44	1.22 ± 0.40	1.39 ± 0.36	1.46 ± 0.36	1.40 ± 0.49	1.23 ± 0.33
FAT (G)							
MEAN ± S.D.	132 ± 35	114 ± 37	90 ± 33	119 ± 32	119 ± 30	117 ± 40	105 ± 27
MEDIAN	131	103	85	112	115	106	106
CARBOHYDRATE (G)							
MEAN ± S.D.	320 ± 77	274 ± 73	217 ± 84	265 ± 80	279 ± 87	252 ± 98	246 ± 61
MEDIAN	320	264	197	249	278	236	247
CRUDE FIBER (G)							
MEAN ± S.D.	3.5 ± 1.2	3.2 ± 1.3	2.4 ± 1.0	3.4 ± 1.5	3.2 ± 1.1	3.2 ± 1.5	3.2 ± 1.2

[1]Nutrient intake from foods and beverages only.

[2]Percentage of military nutritional standard computed from group mean. The following evaluation applies to all nutrients except energy: Adequate = 100% or greater of standard; marginal = > 70% to < 100% of standard; low = < 70% of standard.

[3]kg body weight.

TABLE 4B

AVERAGE TOTAL DAILY NUTRIENT INTAKE

	RATIONS-IN-KIND			COMRATS-MARRIED		COMRATS-SINGLE	
	R1	R2	RF1	CM1	CM2	CS1	CS2
CALCIUM (MG)							
MEAN ± S.D.	1428 ± 522	1094 ± 495	878 ± 492	1018 ± 403	1022 ± 367	934 ± 453	838 ± 266
% OF STANDARD[1]	178	137	110	127	127	116	105
PHOSPHORUS (MG)							
MEAN ± S.D.	2041 ± 530	1726 ± 563	1233 ± 484	1656 ± 432	1662 ± 370	1666 ± 591	1534 ± 363
% OF STANDARD	255	216	154	207	208	209	192
CA:P RATIO							
MEAN ± S.D.	0.69 ± 0.13	0.62 ± 0.15	0.70 ± 0.13	0.60 ± 0.15	0.61 ± 0.14	0.55 ± 0.13	0.54 ± 0.09
IRON (MG)							
MEAN ± S.D.	15.2 ± 4.1	13.6 ± 3.7	10.0 ± 3.2	15.8 ± 4.4	15.3 ± 3.4	15.6 ± 4.5	14.7 ± 3.8
% OF STANDARD	84	75	56	88	85	87	82

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TABLE 4B

AVERAGE TOTAL DAILY NUTRIENT INTAKE

	RATIONS-IN-KIND			COMRATS-MARRIED		COMRATS-SINGLE	
	R1	R2	RF1	CM1	CM2	CS1	CS2
VITAMIN A (IU)							
MEAN ± S.D.	4522 ± 2525	3902 ± 2821	3473 ± 2728	4522 ± 2708	4407 ± 2288	4125 ± 4440	4850 ± 4292
% OF STANDARD	90	78	70	90	88	83	97
MEDIAN	4004	2927	3044	4050	3977	3477	3247
% OF STANDARD	80	58	69	81	80	70	65
VITAMIN C (MG)							
MEAN ± S.D.	92 ± 44	81 ± 39	75 ± 48	88 ± 51	73 ± 36	89 ± 67	78 ± 34
% OF STANDARD	153	135	125	147	122	148	129
THIAMIN (MG)							
MEAN ± S.D.	1.53 ± 0.42	1.25 ± 0.46	0.90 ± 0.33	1.40 ± 0.43	1.44 ± 0.43	1.29 ± 0.47	1.14 ± 0.33
% OF STANDARD[2]	96 (99)	78 (91)	82 (90)	88 (106)	90 (107)	81 (96)	71 (91)
RIBOFLAVIN (MG)							
MEAN ± S.D.	2.66 ± 0.84	2.21 ± 0.81	1.47 ± 0.72	2.03 ± 0.61	2.12 ± 0.53	1.96 ± 0.77	1.88 ± 0.55
% OF STANDARD[2]	133 (143)	111 (134)	105 (123)	102 (128)	106 (131)	98 (122)	94 (125)
NIACIN (MG)							
MEAN ± S.D.	23.8 ± 7.1	22.4 ± 6.8	13.9 ± 5.2	23.0 ± 6.4	22.9 ± 6.0	24.5 ± 7.8	22.9 ± 6.1
% OF STANDARD[2]	113 (116)	107 (120)	93 (106)	110 (132)	109 (128)	117 (138)	109 (139)

[1] SEE FOOTNOTE TABLE 4A

[2] The allowances for thiamine, riboflavin, and niacin are related to energy intake. Value in parentheses indicates percent of standard when the standard has been equated with caloric intake.

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TABLE 5

TWO-BY-THREE FACTOR ANALYSIS OF COVARIANCE[1] OF TOTAL DAILY NUTRIENT INTAKE DATA

NUTRIENT	UNIT[2] (P-Value)	RATION STATUS[3] (P-Value)
ENERGY	NS[4]	.049
PROTEIN	.016	NS
FAT	.013	NS
CALCIUM	.003	.003
PHOSPHORUS	.010	.015
THIAMIN	.017	NS
RIBOFLAVIN	NS	.003

[1]Covariates were age and body weight.
[2]Unit: Force Troops and FSSG males or C&E and H&S Bn males.
[3]Ration Status: Ration-in-Kind, COMRATS-Married, or COMRATS-Single.
[4]NS = Not significant at $P < 0.05$.

TABLE 6

AVERAGE DAILY CALORIC COMPOSITION AND NUTRIENT DENSITY

	RATIONS-IN-KIND[1]	COMRATS-MARRIED	COMRATS-SINGLE
DAILY CALORIC COMPOSITION			
% PROTEIN KCAL	14.4 ± 2.4[2]	15.9 ± 2.4	15.0 ± 2.9
% FAT KCAL	37.9 ± 6.4	40.2 ± 4.8	38.6 ± 6.7
% CARBOHYDRATE KCAL	40.7 ± 5.5	40.4 ± 6.0	38.0 ± 6.7
% ALCOHOL KCAL	6.4 ± 8.0^{A} (2.2 ± 3.5)	3.4 ± 4.2^{B}	7.9 ± 7.8^{A}
MEDIAN	3.4 (0.4)	1.8	5.6
NUTRIENT DENSITY			
PROTEIN (G)	36.0 ± 5.9^{A}	39.7 ± 5.9^{B}	37.6 ± 7.2^{AB}
CALCIUM (MG)	428 ± 138^{A}	385 ± 130^{AB}	340 ± 104^{B}
PHOSPHORUS (MG)	643 ± 99	627 ± 91	616 ± 96
IRON (MG)	5.0 ± 0.9^{A}[3]	5.9 ± 0.9^{B}	5.9 ± 1.1^{B}
VITAMIN A (IU)	1431 ± 862[3]	1711 ± 1002	1716 ± 1745
VITAMIN C (MG)	30 ± 13 (40 ± 27)	30 ± 18	32 ± 18
THIAMIN (MG)	0.47 ± 0.09[3]	0.53 ± 0.10	0.47 ± 0.12[3]
RIBOFLAVIN (MG)	0.83 ± 0.19	0.79 ± 0.17	0.73 ± 0.18
NIACIN (MG)	8.0 ± 1.8^{A}	8.7 ± 1.8^{AB}	9.2 ± 1.8^{B}

[1]No significant differences were found between male and female RIK personnel except for % alcohol kcal and vitamin C density. Female values for those dietary components are indicated in parenthesis.

[2]Mean ± Standard Deviation.

A, B, AB Mean values within a row not followed by a common letter are significantly different at $P < 0.05$

[3]Underlining indicates those values less than Nutrient Density Allowance.

TABLE 7

EVALUATION OF AVERAGE DAILY TOTAL NUTRIENT INTAKE AND NUTRIENT DENSITY
RATIONS-IN-KIND PERSONNEL

	PERCENTAGE OF GROUP								
	LOW[1]			MARGINAL[1]			ADEQUATE[1]		
	R1	R2	RF1	R1	R2	RF1	R1	R2	RF1
TOTAL DAILY INTAKE									
PROTEIN	5.3	9.6	36.1	33.3	55.8	36.1	61.4	34.6	27.8
CALCIUM	1.8	11.5	25.0	10.5	15.4	27.8	87.7	73.1	47.2
PHOSPHORUS	0	0	0	0	0	16.7	100	100	83.3
IRON	0	1.9	78.0	10.5	9.6	22.0	89.5	88.5	0
VITAMIN A	36.8	69.2	61.1	29.8	9.6	25.0	33.3	21.2	13.9
VITAMIN C	8.8	11.5	25.0	15.8	25.0	19.4	75.4	63.5	55.6
THIAMIN	14.0	46.2	44.0	43.9	38.5	25.0	42.1	15.4	30.6
RIBOFLAVIN	8.8	9.6	30.6	8.8	38.5	25.0	82.5	51.9	44.4
NIACIN	10.5	9.6	27.8	24.6	40.4	33.3	64.9	50.0	38.9
NUTRIENT DENSITY									
PROTEIN	0	1.9	33.3	19.3	19.2	36.1	80.7	78.8	30.6
CALCIUM	0	5.8	8.3	5.3	11.5	13.9	94.7	82.7	77.8
PHOSPHORUS	0	0	0	0	0	0	100	100	100
IRON	0	0	77.8	1.8	5.8	22.0	98.2	94.2	0
VITAMIN A	38.6	48.1	58.3	28.1	28.8	27.8	33.3	23.1	13.9
VITAMIN C	5.3	11.5	13.9	15.8	11.5	25.0	78.9	76.9	61.1
THIAMIN	0	17.3	19.4	54.4	48.1	44.0	45.6	34.6	36.1
RIBOFLAVIN	1.8	1.9	2.8	7.0	11.5	22.2	91.2	86.5	75.0
NIACIN	1.8	1.9	0	24.6	17.3	47.2	73.7	80.8	52.8

[1] LOW = NUTRIENT INTAKE LESS THAN 70% OF STANDARD.
MARGINAL = NUTRIENT INTAKE BETWEEN 70% AND 99.9% OF STANDARD.
ADEQUATE = NUTRIENT INTAKE 100% OR GREATER OF STANDARD.

TABLE 8

EVALUATION OF AVERAGE DAILY TOTAL NUTRIENT INTAKE AND NUTRITION DENSITY

COMBATS-MARRIED PERSONNEL

	PERCENTAGE OF GROUP					
	LOW[1]		MARGINAL[1]		ADEQUATE[1]	
	CM1	CM2	CM1	CM2	CM1	CM2
TOTAL DAILY INTAKE						
PROTEIN	3.4	1.8	42.4	49.1	54.2	49.1
CALCIUM	15.3	10.5	16.9	22.8	67.8	66.7
PHOSPHORUS	0	0	0	0	100	100
IRON	0	0	3.4	3.5	96.6	96.5
VITAMIN A	39.0	43.9	32.2	31.6	28.8	24.6
VITAMIN C	13.6	17.5	16.9	29.8	69.5	52.6
THIAMIN	28.8	28.1	47.5	38.6	23.7	33.3
RIBOFLAVIN	10.2	7.0	45.8	42.1	44.1	50.9
NIACIN	3.4	5.3	35.6	36.8	61.0	57.9
NUTRIENT DENSITY						
PROTEIN	0	0	0	12.3	100	87.7
CALCIUM	1.7	3.5	11.9	7.0	86.4	89.5
PHOSPHORUS	0	0	0	0	100	100
IRON	0	0	0	0	100	100
VITAMIN A	20.3	24.6	30.5	29.8	49.2	45.6
VITAMIN C	6.8	8.8	11.9	14.0	81.4	77.2
THIAMIN	1.7	3.5	37.3	31.6	61.0	64.9
RIBOFLAVIN	0	0	10.2	5.3	89.8	94.7
NIACIN	0	0	11.9	3.5	88.1	96.5

[1] SEE TABLE 7 FOOTNOTE.

TABLE 9

EVALUATION OF AVERAGE DAILY TOTAL NUTRIENT INTAKE AND NUTRIENT DENSITY

COMRATS-SINGLE PERSONNEL

	PERCENTAGE OF GROUP					
	LOW[1]		MARGINAL[1]		ADEQUATE[1]	
	CS1	CS2	CS1	CS2	CS1	CS2
TOTAL DAILY INTAKE						
PROTEIN	5.9	20.0	58.8	55.0	35.3	25.0
CALCIUM	17.6	20.0	29.4	35.0	52.9	45.0
PHOSPHORUS	0	0	2.9	0	97.1	100
IRON	0	0	2.9	10.0	97.1	90.0
VITAMIN A	50.0	60.0	35.3	15.0	14.7	25.0
VITAMIN C	14.7	15.0	29.4	15.0	55.9	70.0
THIAMIN	47.1	40.0	32.4	45.0	20.6	15.0
RIBOFLAVIN	29.4	25.0	38.2	30.0	32.4	45.0
NIACIN	8.8	5.0	26.5	40.0	64.7	55.0
NUTRIENT DENSITY						
PROTEIN	0	0	8.8	25.0	91.2	75.0
CALCIUM	2.9	0	23.5	20.0	73.5	80.0
PHOSPHORUS	0	0	0	0	100	100
IRON	0	0	0	0	100	100
VITAMIN A	38.2	40.0	32.4	20.0	29.4	40.0
VITAMIN C	8.8	15.0	23.5	5.0	67.6	80.0
THIAMIN	11.8	5.0	44.1	70.0	44.1	25.0
RIBOFLAVIN	2.9	0	17.6	20.0	79.4	80.0
NIACIN	0	0	8.8	0	91.2	100

[1] SEE FOOTNOTE TABLE 7.

TABLE 10

MEALS PER DAY AND PERCENTAGE OF AVERAGE DAILY ENERGY INTAKE FROM MEALS AND SNACKS AND BY SOURCE[1]

	RATIONS-IN-KIND		COMRATS-MARRIED	COMRATS-SINGLE
	MALE	FEMALE		
TOTAL MEALS PER DAY	2.07 ± 0.50^{A}	2.19 ± 0.52^{A}	2.27 ± 0.61^{A}	2.13 ± 0.41^{A}
PERCENT AVERAGE DAILY ENERGY FROM:				
DINING HALLS[2]	52.1 ± 23.0^{A}	22.1 ± 24.3^{B}	3.3 ± 7.7^{C}	7.4 ± 12.7^{C}
HOME	18.1 ± 19.1^{A}	39.1 ± 29.8^{B}	82.6 ± 14.2^{D}	58.0 ± 24.7^{C}
RESTAURANTS	19.1 ± 16.1^{A}	23.8 ± 17.0^{A}	8.0 ± 9.8^{B}	24.1 ± 20.9^{A}
VENDORS	10.7 ± 9.2^{A}	15.0 ± 12.3^{A}	6.1 ± 7.2^{B}	10.5 ± 11.2^{AB}
PERCENT AVERAGE DAILY ENERGY FROM:				
MEALS	80.6 ± 12.7^{AB}	79.6 ± 11.7^{AB}	84.4 ± 10.3^{A}	77.8 ± 11.2^{B}
SNACKS	19.4 ± 12.7^{AB}	20.4 ± 11.7^{AB}	15.5 ± 10.3^{A}	22.2 ± 11.2^{B}

[1] Values are mean ± standard deviation. Mean values within a row not followed by a common letter are significantly different at $P < .05$.

[2] Marine policy dictated that personnel receiving COMRATS could not eat in the dining halls except under special circumstances.

TABLE 11

RIK PERSONNEL WEEKDAY AND WEEKEND MEAL CONSUMPTION

	DINING HALL MEALS[1]			TOTAL DAILY MEALS		
	R1 (%)	R2 (%)	RF1 (%)	R1 (%)	R2 (%)	RF1 (%)
WEEKDAYS						
0 MEAL/DAY	12.1 ± 1.3[2] ^{A}	26.5 ± 1.6 ^{B}	51.1 ± 2.0 ^{C}	0.9 ± 0.4	3.4 ± 1.1	1.7 ± 0.6
1 MEAL/DAY	30.3 ± 2.4	30.8 ± 1.9	29.7 ± 2.6	15.1 ± 1.4	19.8 ± 1.5	22.8 ± 2.2
2 MEAL/DAY	40.9 ± 2.9 ^{A}	33.7 ± 2.0 ^{A}	13.0 ± 2.0 ^{B}	50.0 ± 2.2	45.4 ± 2.5	38.6 ± 2.6
3 MEAL/DAY	16.5 ± 1.7	8.8 ± 1.5	6.1 ± 1.5	32.8 ± 1.6	30.2 ± 2.4	34.4 ± 2.3
4 MEAL/DAY	0.2 ± 0.2	0.2 ± 0.2	0	1.2 ± 0.4	1.1 ± 0.4	2.5 ± 0.6
WEEKENDS						
0 MEAL/DAY	41.7 ± 0.8 ^{A}	46.6 ± 2.0 ^{A}	79.2 ± 1.8 ^{B}	4.4 ± 1.8	3.8 ± 1.6	2.1 ± 0.7
1 MEAL/DAY	33.3 ± 2.8 ^{A}	29.8 ± 3.0 ^{A}	15.3 ± 1.4 ^{B}	24.6 ± 1.9	26.9 ± 2.6	22.9 ± 5.7
2 MEAL/DAY	22.4 ± 0.8 ^{A}	19.7 ± 2.5 ^{A}	5.6 ± 1.1 ^{B}	55.2 ± 3.7	53.8 ± 1.8	57.6 ± 6.2
3 MEAL/DAY	2.2 ± 2.2	3.4 ± 0.9	0	14.5 ± 2.3	14.4 ± 1.2	17.4 ± 0.7
4 MEAL/DAY	0	0.5 ± 0.5	0	0.9 ± 0.5	1.0 ± 1.0	0.7 ± 0.7

[1] Three meals per weekday and two per weekend day were served at the dining halls.

[2] Mean ± Standard Deviation. Values within a row not followed by a common letter are significantly different at $P < 0.05$.

TABLE 12

DINING HALL UTILIZATION

	PERCENTAGE OF POPULATION		
	R1	R2	RF1
TOTAL DINING HALL MEALS PER STUDY[1]			
0	1.8	5.8	27.8
1-5	1.8	5.8	25.0
6-10	8.8	11.5	11.1
11-15	15.8	21.2	13.9
16-20	17.5	28.8	5.6
21-25	35.1	15.4	13.9
26-30	10.5	7.7	2.8
31-35	5.3	3.8	0
36-38	3.5	0	0
AVERAGE PERCENT DINING HALL UTILIZATION[2]	51.8 ± 21.0	41.5 ± 20.8	22.3 ± 23.3

[1]A total of 38 meals were served at the dining hall during the study period.

[2]Dining Hall Utilization = $\frac{\text{Mean Dining Hall Meals Consumed/Study Period}}{\text{Total Dining Hall Meals Served/Study Period}} \times 100$

TABLE 13

AVERAGE NUTRIENT INTAKE

PER DINING HALL MEAL CONSUMED[1]

NUTRIENT	RIK-MALE	RIK-FEMALE
ENERGY (KCAL)	1152 ± 363[2]	719 ± 238*
PROTEIN (G)	49.1 ± 15.1	31.9 ± 9.9*
% PROTEIN KCAL	16.6 ± 3.9	18.7 ± 3.3
FAT (G)	58 ± 19	35 ± 14*
% FAT KCAL	43.9 ± 9.6	44.2 ± 6.4
CARBOHYDRATE (G)	110 ± 41	69 ± 26*
% CARBOHYDRATE KCAL	36.4 ± 9.0	38.7 ± 5.6
CRUDE FIBER (G)	1.6 ± 0.7	1.1 ± 0.5
CALCIUM (MG)	635 ± 270	423 ± 256*
PHOSPHORUS (MG)	838 ± 279	551 ± 217*
CA:P RATIO	0.71 ± 0.20	0.73 ± 0.18
IRON (MG)	6.3 ± 1.9	4.3 ± 1.2*
VITAMIN A (IU)	2314 ± 1896	2143 ± 2403
MEDIAN	1841	1589
VITAMIN C (MG)	35.1 ± 19.1	25.1 ± 13.2*
THIAMIN (MG)	0.65 ± 0.23	0.41 ± 0.15*
RIBOFLAVIN (MG)	1.18 ± 0.44	0.77 ± 0.38*
NIACIN (MG)	8.53 ± 2.90	5.2 ± 2.0*

[1] Only personnel that consumed one or more dining hall meals during the study were utilized in calculation of the means (i.e., 105 males, 26 females).

[2] Mean ± Standard Deviation.

*Significantly different from RIK Male at $P < 0.05$.

TABLE 14

AVERAGE NUTRIENT DENSITY PER DINING HALL MEAL CONSUMED

NUTRIENT	RIK-MALE	RIK-FEMALE
PROTEIN (G)	41.5 ± 9.6[1]	45.2 ± 8.2
CALCIUM (MG)	530 ± 196	581 ± 239
PHOSPHORUS (MG)	704 ± 178	771 ± 165
IRON (MG)	5.4 ± 1.3	6.1 ± 1.4*
VITAMIN A (IU)	1945 ± 1573	3032 ± 3306*
MEDIAN	1487	1718
VITAMIN C (MG)	29 ± 14	36 ± 19
THIAMIN (MG)	0.55 ± 0.13	0.58 ± 0.14
RIBOFLAVIN (MG)	1.00 ± 0.31	1.07 ± 0.38
NIACIN (MG)	7.2 ± 2.2	7.3 ± 2.1

[1]MEAN ± STANDARD DEVIATION. * SIGNIFICANTLY DIFFERENT FROM RIK-MALE AT P < .05. ____ UNDERLINING INDICATES THOSE VALUES LESS THAN MILITARY STANDARD PER 1000 KCAL.

TABLE 15

EVALUATION OF AVERAGE NUTRIENT DENSITY PER DINING HALL MEAL CONSUMED

RATIONS-IN-KIND PERSONNEL

NUTRIENT	PERCENTAGE OF POPULATION: LOW[1] MALE	LOW[1] FEMALE	MARGINAL[1] MALE	MARGINAL[1] FEMALE	ADEQUATE[1] MALE	ADEQUATE[1] FEMALE
PROTEIN	0	0	1.0	11.5	99.1	88.5
CALCIUM	1.9	11.5	2.0	7.7	96.1	80.8
PHOSPHORUS	0	0	0	0	100.0	100.0
IRON	0.9	42.3	62.7	50.0	36.4	7.7
VITAMIN A	15.1	34.6	38.2	65.4	46.6	0
VITAMIN C	3.8	11.5	13.4	30.8	82.9	57.7
THIAMIN	0	0	18.2	23.0	81.8	77.0
RIBOFLAVIN	0.9	0	0	3.8	99.1	96.2
NIACIN	1.0	11.5	26.7	42.3	72.3	46.2

[1] SEE FOOTNOTE TABLE 7.

TABLE 16A

COMPARISON OF SUBJECTS WITH

LOW, MARGINAL, OR ADEQUATE DAILY VITAMIN A INTAKES.

I. PHYSICAL CHARACTERISTICS, MEALS PER DAY, AND SOURCES OF DAILY ENERGY.

	RATIONS-IN-KIND, MALE		
	LOW	MARGINAL	ADEQUATE
% OF SUBJECTS[1]	52.3	20.2	27.5
AGE (YRS)	21.3 ± 3.9[2]	20.6 ± 1.5	21.6 ± 2.6
HEIGHT (CM)	176.2 ± 6.1	177.9 ± 6.0	180.4 ± 8.8
WEIGHT (KG)	74.2 ± 9.2	72.7 ± 7.4	72.5 ± 10.0
% BODY FAT	13.4 ± 3.3	12.9 ± 2.6	12.4 ± 2.9
NO. TOTAL MEALS/DAY	1.89 ± 0.41 A	2.08 ± 0.32 AB	2.29 ± 0.41 B
NO. DINING HALL MEALS/DAY	1.06 ± 0.54 A	1.39 ± 0.52 AB	1.59 ± 0.55 B
TOTAL DAILY ENERGY INTAKE	2606 ± 635 A	3186 ± 500 B	3381 ± 702 B
% KCAL FROM DINING HALL	44.7 ± 23.0 A	59.1 ± 22.0 B	61.0 ± 19.1 B
% KCAL FROM HOME	19.8 ± 20.8	14.9 ± 12.5	17.1 ± 19.9
% KCAL FROM RESTAURANTS	22.1 ± 18.8	17.7 ± 13.6	14.5 ± 10.6
% KCAL FROM VENDORS	13.4 ± 9.3	8.4 ± 9.5	7.4 ± 7.2
% KCAL FROM SNACKS	22.4 ± 14.1	16.2 ± 10.3	16.2 ± 10.3
% ALCOHOL KCAL	7.5 ± 9.2	5.4 ± 6.2	5.1 ± 6.5

[1] Total of 109 subjects.

[2] Mean ± Standard Deviation.

A,B,AB Mean values within a row not followed by a common letter are significantly different at $P < 0.05$.

TABLE 16B

COMPARISON OF SUBJECTS WITH

LOW, MARGINAL OR ADEQUATE DAILY VITAMIN A INTAKES.

II. AVERAGE DAILY NUTRIENT INTAKES.

	RATIONS-IN-KIND, MALE		
	LOW	MARGINAL	ADEQUATE
TOTAL DAILY INTAKE			
PROTEIN	88.3 ± 19.7^{A}	116.6 ± 17.9^{B}	127.7 ± 32.2^{B}
CALCIUM	122.3 ± 43.6^{A}	202.6 ± 59.1^{B}	195.2 ± 70.2^{B}
IRON	69.4 ± 14.6^{A}	83.5 ± 13.8^{AB}	98.3 ± 26.5^{B}
VITAMIN A	48.1 ± 13.5^{A}	83.9 ± 7.4^{B}	154.0 ± 51.7^{C}
VITAMIN C	124.0 ± 60.2	154.4 ± 84.5	175.3 ± 64.5
THIAMIN	71.8 ± 18.6^{A}	95.9 ± 20.1^{B}	109.6 ± 32.7^{B}
RIBOFLAVIN	96.6 ± 29.8^{A}	141.5 ± 34.4^{B}	156.8 ± 38.0^{B}
NIACIN	102.1 ± 33.8^{A}	104.4 ± 22.3^{AB}	129.9 ± 33.4^{B}
NUTRIENT DENSITY			
PROTEIN	111.0 ± 21.0	118.2 ± 16.2	120.7 ± 15.2
CALCIUM	152.2 ± 49.5^{A}	202.6 ± 49.9^{B}	184.0 ± 56.8^{AB}
IRON	87.7 ± 19.3	84.9 ± 14.8	92.8 ± 12.6
VITAMIN A	61.0 ± 18.1^{A}	86.8 ± 19.1^{A}	153.4 ± 68.1^{B}
VITAMIN C	155.4 ± 72.3	155.7 ± 80.5	167.2 ± 56.9
THIAMIN	89.9 ± 19.5	96.0 ± 10.7	102.7 ± 17.8
RIBOFLAVIN	125.1 ± 29.5	147.7 ± 26.9	155.5 ± 26.5
NIACIN	125.6 ± 28.9	105.2 ± 21.5	123.1 ± 24.9

A,B,AB,C See footnote, Table 16A.

TABLE 17

PERCENTAGE OF GROUPS REGULARLY CONSUMING NUTRIENT SUPPLEMENTS

NUTRIENT SUPPLEMENT	RATIONS-IN-KIND			COMRATS-MARRIED		COMRATS-SINGLE	
	R1	R2	RF1	CM1	CM2	CS1	CS2
MULTI-VITAMIN	12.5	12.1	19.5	20.3	29.8	20.6	20.0
VITAMIN B-COMPLEX	2.9	1.9	7.3	1.7	0	8.8	0
VITAMIN C	3.6	5.6	7.3	8.5	7.0	14.7	0
VITAMIN E	1.8	1.9	4.9	5.1	3.5	11.8	5.0
MULTI-MINERAL	1.8	1.9	7.3	0	5.3	5.9	0
IRON	5.4	3.7	9.8	13.6	14.0	11.8	5.0
PROTEIN	0	0	2.4	0	5.3	2.9	0
ONE OR MORE OF THE ABOVE	14.0	15.4	30.6	28.8	36.8	29.4	20.0

HIGH VITAMIN A CONTENT FOODS

Increase menu frequency of following foods. However, select <u>only</u> those of high customer acceptance.

<u>Juices</u>: Tomato, vegetable, apricot nectar, peach nectar

<u>Fruits</u>: Apricots, peaches, plums, cantaloupe, and watermelon. Utilize fresh, when in season, since vitamin A content is the highest in fresh fruit.

<u>Vegetables</u>: All <u>strongly</u> colored yellow or green vegetables, sweet potatoes, tomatoes. Serve these plain or incorporate into salads, soups, stews, and casseroles. Elevate vitamin A in tossed salads by serving mixed greens (combination of romaine, red and green leaf, and iceberg lettuces) instead of iceberg lettuce alone.

<u>Desserts</u>: Peach, apricot, pumpkin, and sweet potato pies and carrot cake.

APPENDIX B

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