REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	03/2002	Journal Article

4. TITLE AND SUBTITLE
Nutrition Knowledge and Supplement Use among Elite U.S. Army Soldiers

5. FUNDING NUMBERS

6. AUTHOR(S)
MAJ Maria E. Bovill, William J. Tharion, Harris R. Lieberman

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Military Nutrition Division
United States ARMY Research Institute of Environmental Medicine
Kansas Street
Natick, MA 01760-5007

8. PERFORMING ORGANIZATION REPORT NUMBER
M02-59

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for Public Release
Distribution Unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

A U.S. Army Special Forces (SF) unit was studied to determine characteristics of supplement users, assess nutrition knowledge, and intensify nutrition information sources. SF-qualified (n=119) and non-SF, support soldiers (n=38) participated. Most soldiers (87%) reported current supplement use with more SF (90%) than non-SF, support soldiers (76%) using supplements (p </- 0.05). Supplements SF reported using most were multivitamins, sports bars/drinks, and vitamin C. The mean nutrition knowledge score for all soldiers was 48.5 +/- 15.2 correct responses. Most soldiers incorrectly believe protein is used for energy (58%). The most common informatioon sources reportedly used were popular magazines/books (75%), freinds/teamates (55%), physicians/nurses, radio/television (34%) and the internet (31%)

14. SUBJECT TERMS	15. NUMBER OF PAGES
	999
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UL

MILITARY MEDICINE, 168, 12:997, 2003

Nutrition Knowledge and Supplement Use among Elite U.S. Army Soldiers

Guarantor: MAJ Maria E. Bovill, SP USA
Contributors: MAJ Maria E. Bovill, SP USA; William J. Tharion, MS MBA; Harris R. Lieberman, PhD

A U.S. Army Special Forces (SF) unit was studied to determine characteristics of supplement users, assess nutrition knowledge, and identify nutrition information sources. SF-qualified (n = 119) and non-SF, support soldiers (n = 38) participated. Most soldiers (87%) reported current supplement use with more SF (90%) than non-SF, support soldiers (76%) using supplements ($p \leq 0.05$). Supplements SF reported using most were multivitamins, sports bars/drinks, and vitamin C. The mean nutrition knowledge score for all soldiers was 48.5 ± 15.2% correct responses. Most soldiers incorrectly believe protein is used for energy for short-term athletic events (64%) and that vitamins provide energy (58%). The most common information sources reportedly used were popular magazines/books (75%), friends/teammates (55%), physicians/nurses, radio/television (34%), and the Internet (31%).

Introduction

U.S. Army Special Forces (SF) are elite military units that must maintain operational readiness for short-notice deployment. Physical training is frequent and includes distance running and sprinting, distance marching with rucksacks, swimming, weight lifting, climbing, and parachuting. They must be able to recover quickly between training sessions to sustain these physical demands. SF are often compared with competitive athletes and may adopt similar nutritional strategies. Sobal and Marquart[1] reviewed 51 studies of vitamin/mineral supplement use by athletes and estimated a 46% mean prevalence. Elite athletes at national, international, and Olympic levels had a mean supplement use of 59%, higher than both college (43%) and high school (47%) athletes and the general population (35–40%). Research with U.S. Army soldiers indicates that 64% in SF and Ranger selection and training schools consume supplements.[2] Supplement use among SF who have completed initial selection courses and have been assigned to operational units has not been reported.

In the United States, supplement sales have grown almost 80% from $8.8 billion in 1994 to $15.7 billion in 2000.[3] In 1999, Americans spent approximately $1.4 billion on sports supplements and approximately 1.2 million people reported regular use.[4] However, individuals with limited nutrition knowledge (NK) may be influenced by misinformation, leading to practices that could impair performance, be detrimental to their health, or simply waste money. Studies of athletes, coaches, and trainers indicate they exhibit low NK and often believe in questionable nutrition practices.[5,6] The limited information available regarding NK of military personnel indicates they also possess low levels of NK,[7,8] but NK of operational SF units has not been assessed.

Military Nutrition Division, U.S. Army Research Institute of Environmental Medicine, Natick, MA 01760.

The views, opinions, and/or findings in this report are those of the authors and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other official documentation. Human subjects participated in this study after giving free and informed consent. Investigators adhered to regulations described in the appropriate documents, U.S. Army Regulation 70-25 and U.S. Army Medical Research and Materiel Command Regulation 70-25 on Use of Volunteers in Research. For the protection of human volunteers, the investigators adhered to policies of applicable Federal Law CFR 46. Citation of commercial organizations and trade names in this report do not constitute an official Department of the Army endorsement or approval of the products or services of these organizations.

Reprints: William J. Tharion, Military Nutrition Division, U.S. Army Research Institute of Environmental Medicine, 42 Kansas St., Natick, MA 01760-5007.

This manuscript was received for review in October 2002. The revised manuscript was accepted for publication in March 2003.

Methods

Subjects

Volunteers recruited from an SF unit were SF-qualified soldiers and non-SF-qualified, support soldiers (SP). SP provide logistical and administrative support, but they do not participate in the same intensive training as SF-qualified soldiers. Because women are excluded from SF units, all subjects were men. A total of 176 soldiers volunteered between November 1999 and July 2000; however, due to incomplete or nonresponses, the final sample consisted of 157 subjects.

Materials

A questionnaire was administered to obtain demographic, medical history, health habits, and supplement use information. Supplement use categories were: never, past but not present, occasionally (less than once/week), frequently (one to six times/week), and daily. NK was assessed by modification of a previously developed questionnaire.[5] Our questionnaire contained 54 items focusing on five sports nutrition subtopics: general nutrition, supplementation, special dietary considerations, pre-event meals, and fluid and hydration. Additional questions inquired about nutrition information sources.

Data Analyses

Data were analyzed using the Statistical Program for Social Sciences software (version 10.0, SPSS, Chicago, Illinois). Subjects were classified as supplement users (SU) if they used supplements at all at the time the questionnaire was administered. Descriptive data are reported as means ± SD or frequencies and percentages. Groups compared were SF with SP and SU to nonusers (NU). Analyses of variance, χ^2 analyses, and Fisher's exact test were performed to determine mean differences for demographic and health habit variables and supplement use frequency by military group (SF vs. SP). Fisher's exact test was used instead of Pearson's χ^2 for 2 × 2 tables that did not meet χ^2 size requirements.[9] NK scores were categorized as highest 50% and lowest 50% of scores. Logistic regression was performed to determine significant predictors of supplement use from demo-

graphic variables and various NK scores. This model used the same definition of supplement use as above but eliminated subjects who reported only using carbohydrate replacement drinks, bars, and gels because many consume these products not as a supplement but just as a beverage or food. Statistical significance was set at $p \leq 0.05$.

Results

SF were older ($p \leq 0.001$), heavier ($p \leq 0.01$), and less ethnically diverse ($p \leq 0.001$) than SP (Table I). There were no demographic differences between SU and NU.

Supplement Use

Most (87%) soldiers reported using supplements at least occasionally, although SF reported more frequent use than SP: 90 vs. 76%, respectively ($p \leq 0.05$). Those supplements used by 10% or more of all soldiers are listed in Table II. There were significant differences between groups in the use of meal replacement drinks ($p \leq 0.001$) and sports bars ($p \leq 0.001$).

Exercise frequency (the number of times per week a soldier ran, swam, weight trained, or did other physical exercise) and NK percent correct responses were predictive of supplement use and determined by logistic regression ($p \leq 0.001$). Regression goodness-of-fit was met as indicated by the nonsignificant χ^2 value ($p = 0.95$) in the Hosmer and Lemeshow test. A correct prediction of group membership was obtained 71.3% of the time with 100 of 108 SU correctly identified; however, only 12 of 49 NU were correctly identified (Table III). Prediction of NU was hampered by the relatively small sample size. Odds ratios were 1.123 ($p \leq 0.05$) for exercise frequency and 1.034 ($p \leq 0.01$) for NK percent correct responses. These ratios greater than 1.0 indicate that those who exercised more frequently and had a higher NK score were more likely to be SU.

Nutrition Knowledge

SUs had a higher NK score than NU ($p \leq 0.05$) (Fig. 1). The mean NK score for all soldiers was 48.5 ± 15.2% correct responses with SF scoring higher than SP ($p \leq 0.05$; Fig. 1). Those with the highest NK scores were higher ranking ($p \leq 0.001$) and older ($p \leq 0.01$). Only one lower ranking (E1–E4) soldier (less than 2%) had a high NK score.

NK scores differed by exercise frequency ($p \leq 0.05$). Only 8% of those who had high NK exercised fewer than 7 times/week compared with almost 25% of those who had low NK. In addition, only 5% of those who scored high on NK did no strength training, whereas 22% of those with low NK did no strength training.

TABLE II

PERCENTAGE (NUMBER) OF SOLIDERS BY GROUP REPORTING SUPPLEMENT USE

	SF	SP	All
N	119	38	157
Vitamins and minerals			
Multivitamin	46.2% (55)	34.2% (13)	43.3% (68)
Vitamin C	20.2% (24)	34.2% (13)	23.6% (37)
Vitamin E	11.8% (14)	15.8% (6)	12.7% (20)
Calcium	9.2% (11)	23.7% (9)	12.7% (20)
Energy aids			
Sports drinks	70.6% (84)	55.3% (21)	66.9% (105)
Sports bars[a]	52.1% (62)	13.2% (5)	42.7% (67)
Meal replacement drinks[a]	19.3% (23)	0.0% (0)	14.6% (23)
Sports gels	14.5% (17)	2.6% (1)	11.6% (18)
Protein, creatine, and amino acids			
Protein powders	23.5% (28)	15.8% (6)	21.7% (34)
Creatine	17.6% (21)	15.8% (6)	17.2% (27)

[a] $p \leq 0.001$ between groups.

TABLE III

PREDICTION CLASSIFICATION

	Predicted		
Observed	NU	SU	Percent correct
NU (*N* = 49)	12	37	24.5
SU (*N* = 108)	8	100	92.8
Overall percent	12.7	87.3	71.3

TABLE I

DEMOGRAPHICS BY SOLDIER TYPE

	SF	SP	All
N	119	38	157
Age[a] (years)	33.0 ± 4.7	26.4 ± 6.5	31.4 ± 5.9
Height (cm)	179.8 ± 6.9	177.5 ± 6.9	179.2 ± 6.9
Weight[b] (kg)	84.9 ± 10.8	79.4 ± 11.2	83.6 ± 11.1
Body mass index[c] (kg/m^2)	26.1 ± 2.4	25.1 ± 2.9	25.9 ± 2.6
Ethnic Group[a] (*n*)			
Caucasian	89.8% (106)	52.6% (20)	80.8% (126)
Hispanic	3.3% (4)	13.2% (5)	5.7% (9)
African American	0.8% (1)	15.8% (6)	4.5% (7)
Asian/Pacific Islander	0.0% (0)	10.5% (4)	2.6% (4)
American Indian	1.7% (2)	2.6% (1)	1.9% (3)
Other	5.1% (6)	5.3% (2)	5.1% (8)

Data are mean ± SD or percentages and frequencies.
[a] $p \leq 0.001$ between groups.
[b] $p \leq 0.01$ between groups.
[c] $p \leq 0.05$ between groups.

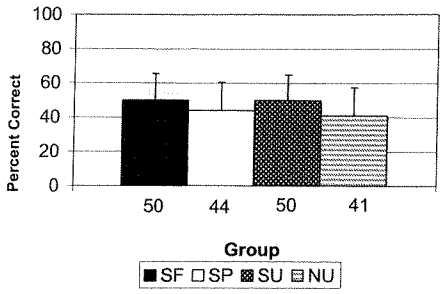

Fig. 1. NK scores.

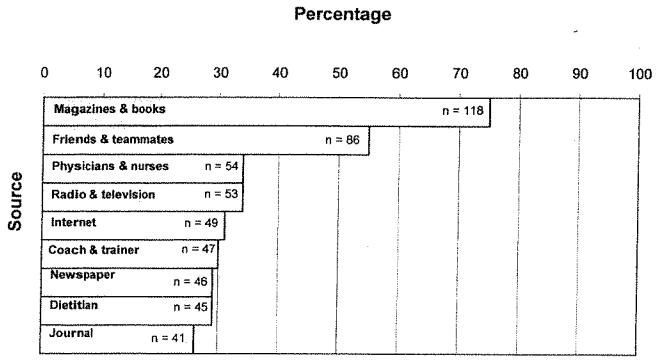

Fig. 2. Most common nutrition information sources used by the soldier.

Most frequently reported nutrition information sources for all soldiers were magazines/books, friends, and teammates (Fig. 2). SF were less likely than SP to report using the Internet (27 vs. 45%, respectively, $p \leq 0.05$), physician/nurse (26 vs. 61%, respectively, $p \leq 0.001$), and coach/trainer (24 vs. 50%, respectively, $p \leq 0.01$) for nutrition information sources. The only significant difference between SU and NU was that SU used magazines/books more than NU (79 vs. 52%, respectively, $p \leq 0.05$).

The mean scores of the five NK subtopics are presented in Table IV. Soldiers performed best on fluid and hydration questions with 82% answering at least one-half of the questions correctly; only 38% of soldiers answered one-half of the prior event meal questions correctly.

Discussion

Supplement Use

SF represent a unique military population and exhibit some behaviors similar to those of competitive athletes. A higher proportion of soldiers used supplements than previously reported in athletes.[1] SUs exercised more frequently and had greater NK than NU, whereas in previous studies, predictors of SU have been age, education greater than 12 years, higher income, and positive lifestyle factors such as exercise.[10–12] Overall, SU chose supplements such as multivitamins, sports bars/drinks, and vitamin C, which are widely regarded as safe and may be beneficial to meet their physical training needs. These supplements are similar to choices reported previously by elite military personnel and athletes.[1,2,13]

TABLE IV

PERCENT CORRECT NK SCORE FOR ALL SOLDIERS

Subtopics[a]	Minimum	Maximum	Mean ± SD
Fluid and hydration (8)	0	100	60.8 ± 20.6
General nutrition information (25)	8	84	50.2 ± 17.0
Special dietary concerns (11)	0	91	45.7 ± 19.3
Nutrient supplementation (4)	0	100	42.3 ± 23.9
Prior event meal (6)	0	83	34.4 ± 20.4

$N = 157$.

[a] Number of questions per subtopic.

SF in this study are graduates of the U.S. Army SF training school, where there was a lower incidence (64%) of supplement use than observed in the present study (90%).[2] The difference between SF students and SF-qualified soldiers may reflect an increase in use over time, because the SF student study was conducted in 1997–1998.[2] Additionally, there may be a trend in the SF culture that as SF students become SF qualified, more of them become SU. Consistent with this explanation, supplement use among the elite U.S. Navy SEALs (78%) was similar to the incidence we observed in SF.[13] Because there was a significant difference between SF and SP and from previously cited rates of supplement use, it appears that Special Operations Forces (e.g., SF and Navy SEALs) use supplements more often than other soldiers and athletes.[2,14]

Nutrition Knowledge

There is limited data available on military populations' NK. A report on over 3,000 Navy sailors found they responded correctly to approximately 40 to 65% of nutrition questions.[7,8] In comparison, NK studies of college athletes found they responded correctly approximately 34 to 52% of the time.[15,16] Previous research has not demonstrated a positive correlation between supplement use and NK;[11,17] however, in this study, NK was a predictor of supplement use, and SU had significantly higher NK than NU.

There is confusion about the role of protein in performance in this population, similar to a prior study of athletes.[18] Many soldiers (65%) incorrectly believe that for short-term athletic events, energy comes from amino acids. Whereas only 22% of soldiers reported using protein supplements and the amounts consumed are unknown, it is troubling that most soldiers do not understand the function of the supplements they use. Of concern is that if soldiers are consuming large amounts of protein supplements, it will increase their already elevated fluid needs during training. Additionally, the safety and efficacy of consuming individual amino acids has not yet been proven in research studies of adequately nourished humans.[19]

Fifty-eight percent of SF and SP responded that vitamins provide energy. These soldiers may be misled into assuming their energy intake will be provided by a vitamin supplement. An energy deficit may result in muscle mass loss, increased fatigue, injury, and illness,[4] all of which would be detrimental to performance and mission success.

The beneficial effects of most supplements used by those who are well-nourished are not known; however, multivitamin supplementation by individuals who lack certain vitamins or minerals in their diet is certainly warranted. The use of carbohydrate supplementation in the form of drinks, bars, or gels is advocated for those with high-energy needs, such as the SF. These results suggest that in general, these soldiers are often consuming appropriate supplements for their health and per-

formance. It is encouraging that a high percentage of soldiers will take supplements if they were found to be beneficial to their health or job performance.

In a nationwide survey by the American Dietetic Association,[20] 92% of respondents agreed that "registered dietitians, nutritionists, and doctors are people's most-valued sources of nutrition information"; however, primary sources reported for nutrition information were television and magazines. Similarly, in this study, only a small number of soldiers sought out these professionals for nutrition information. Because NK in this study was low, combined with obtaining nutrition information from nonprofessional sources, the Department of Defense medical professionals must bridge the gap to proper nutrition by directing soldiers to easy to read nutritionally sound magazines. Other efforts could include briefings to command personnel on proper nutrition, as word-of-mouth nutrition information is often obtained through friends and colleagues. Nutrition education for SF, some of the most active soldiers in the military, could significantly enhance their health, physical training, and ultimately mission success. Realizing that most soldiers may not seek qualified medical personnel such as dietitians to obtain information is a barrier that military dietitians must overcome to ensure soldiers' NK and subsequent eating behaviors are healthy.

Acknowledgments

We thank Susan McGraw for assistance with data analyses and Carol Baker-Fulco for support on-site during data collection. This work was supported by the U.S. Army Medical Research and Materiel Command.

References

1. Sobal J, Marquart LF: Vitamin/mineral supplement use among athletes: a review of the literature. Int J Sport Nutr 1994; 4: 320–34.
2. Arsenault J, Kennedy J: Dietary supplement use in U.S. Army Special Operations candidates. Milit Med 1999; 164: 495–501.
3. Blendon RJ, DesRoches CM, Benson JM, Brodie M, Altman DE: Americans' views on the use and regulation of dietary supplements. Arch Intern Med 2001; 161: 805–10.
4. Sports supplement dangers. Consumer Reports. Available at http://www.consumerreports.org/main/detail.jsp?CONTENT%3%Ecnt_id=59279&FOL; accessed June 21, 2002.
5. Bedgood BL, Tuck MB: Nutrition knowledge of high school athletic coaches in Texas. J Am Diet Assoc 1983; 83: 672–4, 677.
6. Jacobson BH, Sobonya C, Ransone J: Nutrition practices and knowledge of college varsity athletes: a follow-up. J Strength Cond Res 2001; 15: 63–8.
7. Conway TL, Hervig LK, Vickers RRJ: Nutrition knowledge among Navy recruits. J Am Diet Assoc 1989; 89: 1624–8.
8. Trent LK: Nutrition knowledge of active duty Navy personnel. J Am Diet Assoc 1992; 92: 724–8.
9. Daniel W: The χ^2 distribution and the analysis of frequencies. In Biostatistics: A Foundation for Analysis in the Health Sciences, pp 503–65. New York, John Wiley and Sons, 1995.
10. Koplan JP, Annest JL, Layde PM, Rubin GL: Nutrient intake and supplementation in the United States (NHANES II). Am J Public Health 1986; 76: 287–9.
11. Greger JL: Dietary supplement use: consumer characteristics and interests. J Nutr 2001; 131: 1339S–43S.
12. Bathalon GP, McGraw SM, Hennessy LD, Barko WF, Creedon JF, Lieberman HR: Comparison of reported nutritional supplement intake in two army populations. J Am Diet Assoc 2000; 100: A102.
13. Schneider K, Hervig LK, Prusaczyk WK, Goforth HW: Use of supplements by U. S. Navy SEALS. Med Sci Sports Exerc 1998; 30: S60.
14. Sobal J, Marquart LF: Vitamin/mineral supplement use among high school athletes. Adolescence 1994; 29: 835–43.
15. Barr SI: Nutrition knowledge of female varsity athletes and university students. J Am Diet Assoc 1987; 87: 1660–4.
16. Jonnalagadda SS, Rosenbloom CA, Skinner RD: Dietary practices, attitudes, and physiological status of collegiate freshman football players. J Strength Cond Res 2001; 15: 507–13.
17. Nehila JH: Consumers' knowledge and use of vitamin and mineral supplements. J Am Diet Assoc 1999; 99: A96.
18. Rosenbloom CA, Jonnalagadda SS, Skinner RD: Nutrition knowledge of collegiate athletes in a Division I National Collegiate Athletic Association Institution. J Am Diet Assoc 2002; 102: 418–20.
19. Lemon PW: Effects of exercise on dietary protein requirements. Int J Sport Nutr 1998; 8: 426–47.
20. Nutrition and you: trends 2000: ADA's Public Relations Team. J Am Diet Assoc 2000; 100: 626–7.