# Caffeine, Energy Beverage Consumption, Fitness, and Sleep in U.S. Army Aviation Personnel

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**BACKGROUND:** Caffeine-containing products and dietary supplements are widely used by military populations, but little is known about their use by aviation personnel. This study assessed self-reported sleep, fitness, work-schedules, and caffeine/energy drink use.

**METHODS:** A standardized survey was conducted in person by study personnel using tablet computers. A total of 188 aircrew members from the Combat Aviation Brigade at Fort Campbell, KY, participated in the survey. Focus groups were conducted with a subset of 47 subjects.

**RESULTS:** The majority of subjects reported their physical fitness, health, and diets were good. They reported sleeping about 6 h per day and stated they needed additional sleep to feel fully rested. Their caffeine consumption averaged 346 $\pm$ 23 mg $\cdot$ d$^{-1}$ with most derived from coffee (139 $\pm$ 12 mg $\cdot$ d$^{-1}$) and energy drinks (110 $\pm$ 13 mg $\cdot$ d$^{-1}$). About half (55%) of participants used energy drinks at least once per week and they consumed greater amounts of caffeine than nonusers. Focus group data indicated crewmembers primarily consumed energy drinks to enhance performance degraded by variations in work schedules and lack of sufficient sleep. Participants expressed a desire for additional education on diets and energy drinks as well as on aeromedical policies governing energy drink and supplement use.

**CONCLUSIONS:** Caffeinated products, including coffee and energy drinks, are routinely used by Army aircrews to increase alertness. Aircrew personnel consider them generally safe, but would like to receive education about these beverages, other dietary issues, and Army policies governing their use in aircrew.

**KEYWORDS:** pilots, energy drinks, supplements, aircrew, Army regulations, fatigue, alertness.

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Caffeine is used by more than 80% of U.S. adults and it enhances a variety of mental functions, including alertness, vigilance, attention, and reaction time; as well as physical characteristics such as stamina, muscle endurance, and muscle strength.[24] A recent comprehensive evidence-based review concluded caffeine use in moderate doses was safe.[38] In military personnel, caffeine mitigates the negative impact of long duty periods, sleep deprivation, and operational stress; and due to its effectiveness, caffeinated chewing gum and other products have been added to some military rations.[15,16,22] In general, over 80% of U.S. Army soldiers, 84% of U.S. Air Force personnel, and 87% of Navy and Marine Corps service members regularly consume at least moderate amounts of caffeine.[18,19,21]

Use of caffeine within the military aviation sector has not been comprehensively examined, but a small sample of deployed Air Force F-15 aircrew members reported that 86.2% used caffeine while deployed,[13] and a recent assessment of caffeine use in Naval aviation candidates found that 86.4% frequently consumed caffeinated coffee.[30] Of the respondents, 92% stated they consumed their caffeine in the form of "coffee or beverages with coffee."

In the United States, adults consume most of their caffeine in the form of coffee, but energy drinks and energy shots have

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become an increasingly popular source of caffeine over the past decade, especially in young men, college athletes, and military personnel.[12,21,32] These drinks typically contain anywhere from 50 to 505 mg of caffeine per container in addition to various combinations of taurine, glucuronolactone, vitamins, herbal extracts, proprietary blends, and/or amino acids. They are frequently promoted for their ability to boost mental alertness and improve physical stamina.[14,28] In the general population, approximately two-thirds of energy drink consumers are 13–35 yr old and about 30% of young people consume these drinks on a regular basis.[1] Up to 80% of college athletes report using energy beverages to potentially enhance their performance.[7,33] In the military, where 72% of active-duty enlisted and 36% of active-duty officers are under 31 yr of age,[10] 30–50% of personnel consume energy beverages at least once per week or state they have consumed them "within the past month."[2] These products are commonly used with the expectation they will improve mental alertness and enhance mental and physical endurance.[32]

As with overall caffeine consumption, the prevalence of energy drink and energy shot use among rated aviators (civil or military) has not been assessed, but a 2016 study of naval aviation candidates found that 79% had consumed energy beverages within the last year and 36% of those had used energy beverages within the last 30 d.[29] The majority of these aviator trainees (67%) indicated they used the beverages to enhance mental alertness and a small subset (12%) consumed them to increase physical endurance.

The present study was conducted to explore patterns of caffeine and energy product use within U.S. Army aviation personnel; to examine the demographic, dietary, fitness, sleep, and work factors that could affect consumption of caffeinated and energy-enhancing products; to consider the potential impact of these products on both the health and safety of these personnel; and to gauge potential uncertainties among aircrew members over whether they are authorized or prohibited from using these products under current Army aeromedical policies. This was accomplished by the administration of a well-validated survey previously used in studies of military personnel and the conduct of semistructured, in-depth focus-group interviews with a subset of survey subjects.[9]

## METHODS

### Subjects

The standardized survey was administered to 188 aircrew members from the Combat Aviation Brigade at Fort Campbell, KY, in June 2016 following an initial briefing and after obtaining subject consent. A subset of 47 participants was subsequently selected and invited to participate in a focus group session to gather more detailed information. The study was reviewed and approved by the Human Use Review Committee of the U.S. Army Research Institute of Environmental Medicine.

### Survey

The survey was administered onsite, under the supervision of study personnel. It required approximately 40 min to complete. It consisted of a modified version of a survey previously administered to U.S. Army,[21] Air Force,[3] and Coast Guard[4] personnel as well as a sample of students at five U.S. universities.[20] For a complete description of the core survey contents and validation procedures, see Caldwell et al.[9] The version used for this study included 67 questions, many of which focused on types of supplements used, frequency of use, reason for use, and money spent on these products. Caffeine consumption was comprehensively assessed based on product serving sizes and frequency of use as described in Lieberman et al.[21]

The survey also included questions regarding use of sports drinks, sports bars or gels, and meal replacement beverages. These products are not considered to be dietary supplements for regulatory purposes as specified in the Dietary Supplement Health and Education Act of 1994.[11] The survey assessed the reasons respondents reported using each product from a list that included: no reason, habitual use, maintain alertness, improve physical performance, improve workouts, cope with long duty schedules, cope with shift schedule changes, reduce fatigue, like the taste, to reduce pain, to hydrate, and other.

Key sociodemographic and lifestyle factors were assessed, including sex, age, race/ethnicity, family income, aerobic exercise duration, strength training, whether the respondent was attempting to gain or lose weight, and his/her overall fitness level. Many of these factors are predictors of dietary supplement and caffeine use.[5,12,19]

Aviation-specific items included: queries on primary aircraft flown; duty position onboard the aircraft; flight hours; typical duty characteristics (i.e., duration of flights, duty hours); sleep habits; sleep quality/sufficiency; and experiences with fatigue. In addition, the survey focused on opinions regarding energy drink availability and acceptability as well as reasons for energy-product use.

Self-reported height and weight were collected so that body mass index (BMI, $kg \cdot m^{-2}$) could be calculated. In accordance with standard definitions, individuals with BMI $< 18.5$ were categorized as underweight, those with a BMI 18.5 to 24.9 were categorized as normal weight, individuals with a BMI 25.0 to 29.9 were categorized as overweight, and those with a BMI 30.0 were classified as obese.[27] Respondents' eating styles (weight loss, vegetarian/vegan, low salt/sodium, weight gain, cholesterol lowering, high protein, low fat, high carbohydrates, low carbohydrate, none of these apply, and other) and reasons for exercise (to increase muscle mass, for strength or aerobic competition, and/or stress relief) also were assessed.

After completion of the survey, a subset of subjects was assigned to focus groups on the basis of rank, officer/enlisted, gender, and users/nonusers of dietary supplements. These sessions were conducted as described below. Participants' statements regarding energy drink use were considered in light of possible concerns about compliance with current aeromedical policies.

Focus groups lasted approximately 90 min. At the start of each session, participants were briefed on the focus group purpose and ground rules, including: 1) introduction of study personnel; 2) explanation of focus group format; 3) explanation of the use of recordings; 4) respect of participant opinions and privacy; and 5) confidentiality of participant identities. Additionally, participants were informed at the outset of each focus group encounter that: 1) there are aeromedical policies which may prohibit/restrict personnel on flight status from using a variety of supplements (possibly including energy drinks); 2) study staff would refrain from directly inquiring about the use of potentially prohibited/restricted supplements; 3) participants should avoid making statements that could inadvertently or intentionally be interpreted or construed by other group members as an admission of a policy violation; and 4) participants should respect the privacy and confidentiality of other focus group members.

Each focus group followed a general script outline of predetermined topics. The script outline addressed: 1) definitions of dietary supplements; 2) use of dietary supplements and decision making; 3) desired effects and/or benefits of supplement use on health and performance, etc.; 4) confidence in perceived safety and efficacy of supplements; 5) awareness/perceptions of information related to dietary supplements; 6) potential for effective guidance and education on dietary supplements; and 7) rationale and type of energy drink use permitted during flight duty or while on flight status.

### Procedure

Electronic surveys were administered using Samsung® Series 7 Slate tablets (Samsung Electronics Co., Ltd, Suwon, South Korea). Prior to data analysis, individual supplements and supplement types were grouped into standardized categories.[3,21] Those that could not be placed in an identifiable category were termed "other."

Focus groups were recorded using audio recorders. Verbal responses on the recordings were transcribed verbatim into an electronic text format. The identities of individual participants were not recorded.

### Statistical Analysis

Descriptive statistics, including means, standard deviations, and proportions were computed from the survey responses of the subjects. Questionnaire datasets were managed and analyzed using SPSS (Statistical Package for the Social Sciences ver. 21 or most current, IBM, Armonk, NY, USA) and Microsoft Excel 2007.

The verbal responses from the focus groups were coded for discussion categories, patterns, and themes. The major categories in each discussion were further defined by coded subcategories. Focus-group verbatim transcripts were managed and analyzed using Microsoft Word 2007 (Microsoft) and NVivo 10 (QSR International). For the present report, direct quotes from participants have been omitted, but the essence of the various individual comments on topics of importance is summarized.

## RESULTS

### Demographic Factors

The majority (94%) of subjects ($N = 188$) served in combat arms and on average served on 1.96 ± 0.13 deployments lasting for an average total of 23.13 ± 1.57 mo. Of the subjects, 52% were enlisted, 48% officers, 82% male, 18% female, 2.0% were Special Forces qualified, and 88% were non-Hispanic. Mean ± SE age was 30.38 ± 0.48 yr (**Table I**). Of the participants, 60% reported to be on flight status; 54% were pilots, 9.0% indicated they were standardization instruction pilots, 8.0% stated they were instructor pilots, 5.0% said they were maintenance test pilots, 1.0% were instrument examiners, and 23% of the sample indicated they were nonrated crew. Primary aircraft were designated as: AH-64E (Apache; 19.0%); UH-60M (13.8%); UH-60A/L (Blackhawk; 8.5%); UH-72 (Lakota; 7.4%); AH-64D (Apache; 7.4%); OH-58D (1.0%); RQ-7B (1.0%); and air traffic control (0.5%). The aircrews' average (mean ± SE) years in service was 8.99 ± 0.47 yr and total career flight time was 1272.33 ± 96.24 h.

### Lifestyle Factors

Subjects reported their fitness levels as follows: 17.0% rated it as excellent; 67.6% good; 14.4% fair; and 1.1% poor. They reported that their Army Physical Fitness Test (APFT) scores (total points generally range from 180 to 300) were ≥ 300 points for 6.9% subjects, 290–299 points for 7.4%, 240–289 points for 61.2%, 180–239 points for 22.3%, and below 180 points for 0.5%. They reported their reasons for exercise as: 64.9% for stress relief; 60.6% for APFT preparation; 55.3% for health reasons; 47.9% for weight loss; 38.8% for fun; 6.4% to prepare for an aerobic competition; and 2.7% to prepare for strength competition. A small percentage (2.7%) said they exercised because it was physician directed and 1.1% said they did not exercise.

Approximately one-third of the sample (29.3%) reported being in excellent general health, 63.8% in good health, and 6.9% in fair health. The average BMI was 26.41 ± 0.25 with 30.1% normal weight, 55.9% overweight, and 14.0% in the obese category. A small percentage (8%) reported having been enrolled in the Army weight control program at one or more point during their career. Half of the participants (51.6%) indicated they were trying to lose weight, 6.4% were trying to gain weight, and 27.7% were trying to maintain bodyweight. The specific diet categories indicated by subjects were: 44.7% high protein, 35.1% weight loss, 23.9% low carbohydrates, 16.0% low fat, 13.8% low sodium, and 31.9% of the respondents did not select any particular diet category.

Subjects reported sleeping an average of 6.57 ± 0.09 h per 24-h period while in the garrison (home) environment. Sleep in the field (or when deployed) reportedly averaged 6.15 ± 0.11 h per 24-h period. The subjects reported on average they needed 7.22 ± 0.11 h of sleep to feel fully rested. In home and/or garrison environment, sleep quality was rated as excellent by 12.8%, good by 41.0%, fair by 31.9%, and poor by 14.4% of the participants. In the field or deployed environment, excellent (6.4%) and good (23.9%) ratings for sleep quality declined by

**Table I.** Caffeine and Sources of Caffeinated Beverages Among U.S. Army Aviation Personnel Based on Demographic and Lifestyle Factors ($N = 188$).

| | *N* | % | ANY CAFFEINE | COFFEE | HOT TEA | TEA-CONTAINING BEVERAGES | COLA | OTHER SODA | ENERGY DRINK | ENERGY SHOT | GUM, CANDY, OR MEDS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TOTAL | 188 | 100% | 346 ± 23 | 139 ± 12 | 6 ± 1 | 40 ± 7 | 18 ± 2 | 11 ± 3 | 110 ± 13 | 5 ± 1 | 16 ± 6 |
| Gender | | | | | | | | | | | * |
| Male | 155 | 82% | 341 ± 25 | 130 ± 12 | 6 ± 2 | 44 ± 8 | 19 ± 2 | 11 ± 3 | 116 ± 15 | 6 ± 1 | 9 ± 3 |
| Female | 33 | 18% | 369 ± 56 | 184 ± 39 | 8 ± 3 | 21 ± 7 | 13 ± 4 | 8 ± 4 | 80 ± 22 | 3 ± 1 | 51 ± 33 |
| Age Group | | | | ** | | | | | | | |
| Age 18-24 | 35 | 19% | 295 ± 56 | 56 ± 17 | 7 ± 3 | 55 ± 18 | 11 ± 3 | 6 ± 2 | 120 ± 33 | 3 ± 1 | 38 ± 30 |
| Age 25-29 | 59 | 31% | 322 ± 40 | 132 ± 21 | 9 ± 4 | 37 ± 14 | 14 ± 3 | 15 ± 8 | 104 ± 18 | 5 ± 1 | 6 ± 3 |
| Age 30-40 | 73 | 39% | 413 ± 38 | 181 ± 23 | 4 ± 1 | 37 ± 9 | 22 ± 4 | 11 ± 3 | 134 ± 25 | 8 ± 3 | 16 ± 7 |
| Age 40+ | 21 | 11% | 264 ± 39 | 152 ± 29 | 3 ± 2 | 38 ± 19 | 21 ± 7 | 7 ± 5 | 28 ± 9 | 3 ± 2 | 10 ± 9 |
| Education Level | | | | | | | | | ** | | |
| High School (HS)/Some HS | 35 | 19% | 385 ± 64 | 92 ± 23 | 5 ± 3 | 65 ± 24 | 18 ± 4 | 23 ± 13 | 176 ± 34 | 3 ± 1 | 3 ± 1 |
| Some College/AA | 94 | 50% | 369 ± 34 | 145 ± 20 | 7 ± 2 | 38 ± 8 | 18 ± 3 | 12 ± 3 | 125 ± 21 | 6 ± 2 | 19 ± 11 |
| Bachelors/Graduate | 59 | 31% | 284 ± 28 | 157 ± 19 | 6 ± 2 | 30 ± 9 | 16 ± 3 | 2 ± 1 | 47 ± 10 | 6 ± 2 | 20 ± 9 |
| Race | | | | * | ** | | | | | | ** |
| White/Caucasian, non-Hispanic. | 138 | 73% | 347 ± 25 | 144 ± 14 | 4 ± 1 | 39 ± 7 | 19 ± 2 | 12 ± 4 | 113 ± 16 | 6 ± 1 | 11 ± 4 |
| Black/African American, non-Hispanic. | 14 | 7% | 209 ± 68 | 23 ± 13 | 12 ± 7 | 60 ± 27 | 18 ± 6 | 21 ± 10 | 70 ± 38 | 1 ± 1 | 4 ± 3 |
| Hispanic or Latino | 23 | 12% | 367 ± 80 | 178 ± 45 | 5 ± 2 | 38 ± 18 | 8 ± 3 | 2 ± 1 | 125 ± 38 | 5 ± 2 | 5 ± 3 |
| Other Race | 13 | 7% | 442 ± 106 | 145 ± 38 | 25 ± 15 | 41 ± 35 | 16 ± 7 | 5 ± 3 | 96 ± 32 | 5 ± 3 | 109 ± 82 |
| Rank Group | | | | | | | | | ** | * | |
| Junior Enlisted Rank | 49 | 26% | 360 ± 56 | 107 ± 24 | 10 ± 5 | 54 ± 18 | 13 ± 3 | 9 ± 3 | 135 ± 27 | 5 ± 2 | 27 ± 22 |
| Senior Enlisted Rank | 49 | 26% | 399 ± 47 | 127 ± 24 | 6 ± 2 | 44 ± 13 | 20 ± 4 | 22 ± 10 | 170 ± 33 | 2 ± 1 | 8 ± 3 |
| Junior Officer Rank | 51 | 27% | 292 ± 33 | 159 ± 28 | 3 ± 1 | 26 ± 9 | 14 ± 3 | 5 ± 4 | 58 ± 15 | 10 ± 4 | 16 ± 9 |
| Senior Officer Rank | 39 | 21% | 330 ± 41 | 169 ± 20 | 4 ± 1 | 37 ± 12 | 25 ± 5 | 7 ± 3 | 72 ± 20 | 4 ± 1 | 13 ± 7 |
| Army Aircrew Flight Status | | | | | ** | | | * | | * | |
| Aircrew Member on Flight Status | 112 | 60% | 310 ± 24 | 140 ± 15 | 5 ± 1 | 27 ± 6 | 19 ± 3 | 6 ± 2 | 93 ± 14 | 7 ± 2 | 14 ± 5 |
| Non-Aircrew Member | 76 | 40% | 399 ± 43 | 139 ± 22 | 8 ± 3 | 61 ± 14 | 15 ± 3 | 18 ± 7 | 135 ± 25 | 3 ± 1 | 20 ± 14 |
| Special Forces Qualified | | | | | | | | | | | |
| Special Forces Qualified | 3 | 2% | 397 ± 171 | 170 ± 85 | 2 ± 2 | 124 ± 124 | 47 ± 24 | 1 ± 1 | 51 ± 41 | 0 ± 0 | 3 ± 3 |
| Not Special Forces Qualified | 185 | 98% | 345 ± 23 | 139 ± 13 | 6 ± 1 | 39 ± 7 | 17 ± 2 | 11 ± 3 | 111 ± 13 | 6 ± 1 | 16 ± 7 |
| Marital Status | | | ** | | | | | | * | | |
| Single never married | 35 | 19% | 244 ± 32 | 82 ± 23 | 12 ± 6 | 39 ± 14 | 16 ± 4 | 7 ± 2 | 79 ± 17 | 3 ± 1 | 6 ± 3 |
| Married | 134 | 71% | 389 ± 30 | 154 ± 16 | 5 ± 1 | 45 ± 9 | 18 ± 2 | 12 ± 4 | 127 ± 17 | 6 ± 1 | 21 ± 9 |
| Not married (Widowed/Divorced) | 16 | 9% | 200 ± 26 | 121 ± 29 | 3 ± 1 | 5 ± 2 | 17 ± 7 | 8 ± 7 | 37 ± 17 | 8 ± 5 | 2 ± 1 |
| Living with partner | 3 | 2% | 379 ± 36 | 247 ± 93 | 1 ± 1 | 31 ± 31 | 0 ± 0 | 0 ± 0 | 99 ± 77 | 0 ± 0 | 0 ± 0 |
| BMI Group | | | * | | * | | | | | | |
| 18.5–24.9 | 56 | 30% | 404 ± 49 | 170 ± 28 | 10 ± 4 | 67 ± 18 | 17 ± 4 | 8 ± 4 | 101 ± 23 | 4 ± 1 | 27 ± 19 |
| 25–29.9 | 104 | 56% | 347 ± 29 | 136 ± 16 | 4 ± 1 | 29 ± 6 | 18 ± 2 | 13 ± 5 | 126 ± 19 | 7 ± 2 | 13 ± 5 |
| ≥30 | 26 | 14% | 222 ± 33 | 94 ± 19 | 6 ± 3 | 24 ± 8 | 16 ± 5 | 8 ± 5 | 66 ± 22 | 2 ± 2 | 6 ± 4 |
| Overall Fitness Level | | | | | | | * | | | | |
| Excellent Fitness | 32 | 17% | 316 ± 67 | 154 ± 29 | 5 ± 2 | 40 ± 24 | 8 ± 2 | 7 ± 5 | 52 ± 15 | 8 ± 3 | 42 ± 33 |

**Table I,** *Continued.*

| | *N* | % | ANY CAFFEINE | COFFEE | HOT TEA | TEA-CONTAINING BEVERAGES | COLA | OTHER SODA | ENERGY DRINK | ENERGY SHOT | GUM, CANDY, OR MEDS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Good Fitness | 127 | 68% | 336 ± 25 | 139 ± 15 | 4 ± 1 | 34 ± 6 | 17 ± 2 | 11 ± 4 | 114 ± 17 | 5 ± 1 | 10 ± 4 |
| Fair Fitness | 27 | 14% | 422 ± 66 | 126 ± 36 | 14 ± 7 | 70 ± 21 | 31 ± 7 | 15 ± 8 | 148 ± 37 | 4 ± 2 | 15 ± 8 |
| Poor Fitness | 2 | 1% | 403 ± 301 | 92 ± 53 | 8 ± 6 | 47 ± 46 | 10 ± 10 | 0 ± 0 | 246 ± 187 | 0 ± 0 | 0 ± 0 |
| Duration Aerobic Exercise | | | | | | | | | | | |
| 0–60 min aerobic exercise/wk | 3 | 2% | 204 ± 23 | 101 ± 52 | 3 ± 2 | 60 ± 41 | 7 ± 5 | 18 ± 18 | 13 ± 6 | 2 ± 2 | 1 ± 1 |
| 61–314 min aerobic exercise/wk | 22 | 12% | 364 ± 68 | 126 ± 33 | 2 ± 1 | 41 ± 20 | 27 ± 7 | 11 ± 8 | 143 ± 40 | 3 ± 2 | 11 ± 6 |
| 315–464 min aerobic exercise/wk | 10 | 5% | 310 ± 102 | 222 ± 103 | 8 ± 7 | 13 ± 5 | 10 ± 5 | 13 ± 11 | 35 ± 25 | 4 ± 2 | 5 ± 3 |
| 465 or more min aerobic exercise/wk | 153 | 81% | 348 ± 25 | 137 ± 13 | 7 ± 2 | 42 ± 8 | 17 ± 2 | 10 ± 3 | 112 ± 15 | 6 ± 1 | 18 ± 8 |
| Weekly Strength Training | | | | | | | | | | | |
| No weekly weight-training | 19 | 10% | 383 ± 86 | 186 ± 51 | 1 ± 1 | 78 ± 25 | 16 ± 6 | 6 ± 2 | 91 ± 45 | 2 ± 1 | 3 ± 2 |
| Weekly weight-training | 169 | 90% | 341 ± 23 | 134 ± 13 | 7 ± 2 | 36 ± 7 | 18 ± 2 | 11 ± 3 | 112 ± 13 | 6 ± 1 | 18 ± 7 |
| | | | ** | | | | | * | * | | |
| Use of Tobacco Products | | | | | | | | | | | |
| No tobacco use past year | 126 | 67% | 304 ± 27 | 129 ± 14 | 5 ± 1 | 38 ± 8 | 17 ± 2 | 7 ± 2 | 92 ± 14 | 4 ± 1 | 13 ± 5 |
| Tobacco use past year | 62 | 33% | 430 ± 39 | 160 ± 24 | 9 ± 4 | 45 ± 11 | 19 ± 4 | 19 ± 8 | 147 ± 26 | 8 ± 3 | 24 ± 17 |

Mean ± Standard Error; $^{*}P < 0.05$, $^{**}P < 0.01$.

almost half with increased ratings for fair (48.4%) and poor (21.3%) sleep quality. When respondents were asked about the extent to which they ever felt so drowsy that they might fall asleep during flying, 21.4% indicated they never felt drowsy, 35.7% said they were rarely drowsy, 42.0% said they were sometimes drowsy, and 0.9% indicated they often were drowsy. Participants indicated feeling drowsy as though they might fall asleep 1.22 ± 0.7 times and that they actually fell asleep on duty 1.95 ± 0.44 times during their flying history. Typical flying time was reported as 8.16 ± 1.52 h/wk and typical on-duty nonflying time reported was 51.11 ± 1.51 h/wk. Average length of a typical flight was 3.26 ± 0.11 h. Half (50%) of the participants reported evening (17:01–23:00) as the time during which the majority of their flying took place, 38.4% indicated daytime (06:00–17:00), and 11.6% said the majority was during the night (23:00–06:00).

The majority of study participants (94%) consumed some type of caffeinated beverage or product on a weekly basis and 64.5% of study participants reported using caffeine daily. Overall consumption of caffeine for the entire study sample ($N$ = 188) was 345.69 ± 22.69 mg · d$^{-1}$. Sources of caffeine were stated as coffee products (139.26 ± 12.38 mg · d$^{-1}$); energy drinks (109.98 ± 12.90 mg · d$^{-1}$); tea products (46.42 ± 6.84 mg · d$^{-1}$); cola products (17.55 ± 1.95 mg · d$^{-1}$); caffeinated gum, candy, or medications (16.28 ± 6.42 mg · d$^{-1}$); other non-cola sodas (10.78 ± 2.90 mg · d$^{-1}$); and energy shots (5.44 ± 1.14 mg · d$^{-1}$). **Fig. 1** shows the distribution of study participants by caffeine consumption. No significant difference in caffeine intake was noted based on gender, but participants 30–40 yr of age consumed more caffeine compared to other age groups. Senior enlisted personnel consumed more caffeine than other rank categories and they consumed most of their caffeine from energy drinks, whereas senior officers consumed most of their caffeine in the form of coffee. Flight status had little impact on caffeine consumption (Table I).

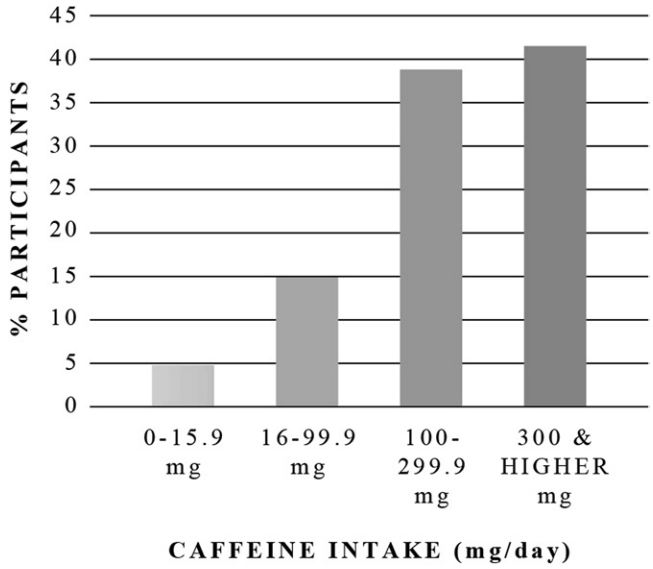


**Fig. 1.** Daily consumption of caffeine in milligrams by U.S. Army aircrew personnel ($N$ = 188).

Energy drinks accounted for 30% of total daily caffeine intake and 55.3% of subjects reported using energy drinks or energy shots at least once per week. Approximately 20% indicated they used energy drinks on a daily basis and 46% consumed them before flying.

Participants' responses to questions regarding the need to develop and approve an energy drink specifically designed for military personnel are provided in **Fig. 2**, and reasons for the use of a new energy drink are summarized in **Fig. 3**. Of the participants, 45% were willing to use an energy drink developed and approved by the Army, 32% were unsure, and 23% would not use it. Participants were asked about the best time to consume an energy drink and responses were: during duty hours (76.6%), during flight duty (54.3%), before flight duty (51.6%), during nonduty hours (44.1%), and after flight duty (37.8%). More than half (61%) of aircrew personnel consumed energy drinks without the approval of the flight surgeon, and 46% consumed them before a flight or while flying without seeking approval of their flight surgeon. About 10% of the sample reported side effects such as rapid heart rate after using energy drinks and energy shots. With respect to stimulant use in general, only 11 (6%) of the 188 participants indicated they had at some point been prescribed stimulants under operational conditions, and 82% indicated that these stimulants helped them maintain their alertness.

### Focus Group Results

Focus group sessions provided in-depth information on energy drink-related topics, and this information was grouped into major themes for the ease of discussion: job duties and schedules; energy drink use; safety concerns; and attitudes regarding education on the energy drink policy.

The study participants indicated their work schedules were unpredictable, as would be expected for aviation crews. Pilots noted their shift schedules disrupted their sleep/rest cycles, they participated in fatiguing long flights, and were assigned many additional duties when not flying. Ground crew reported working physically demanding, unpredictable, long duty days, while senior officers reported more predictable schedules that involved less flight time. Pilots noted their high degree of responsibility in terms of mission safety, but maintenance personnel highlighted their stress in terms of pressure to ensure aircraft readiness for mission success. Some crewmembers indicated they were sometimes "short-handed," and their duty schedules often shifted between days and nights with little recuperation time between.

Attitudes toward use of energy drinks were consistent across the ranks and that energy drinks are generally accepted as part of the aircrew community unless they are abused. Respondents acknowledged aviators used these drinks in part because they were convenient, but that such usage was either marginally approved or not approved at all. They generally felt the benefits of commercial energy drinks outweighed the risks, especially when deployed. Use of energy drinks was higher when deployed. Senior officers observed these drinks were most often used by younger soldiers, in part to make up for a poor diet in an environment where healthy food alternatives were less accessible than unhealthy ones. They also indicated knowledge regarding the importance of good dietary habits appeared to be lacking. Some respondents said they thought energy drinks

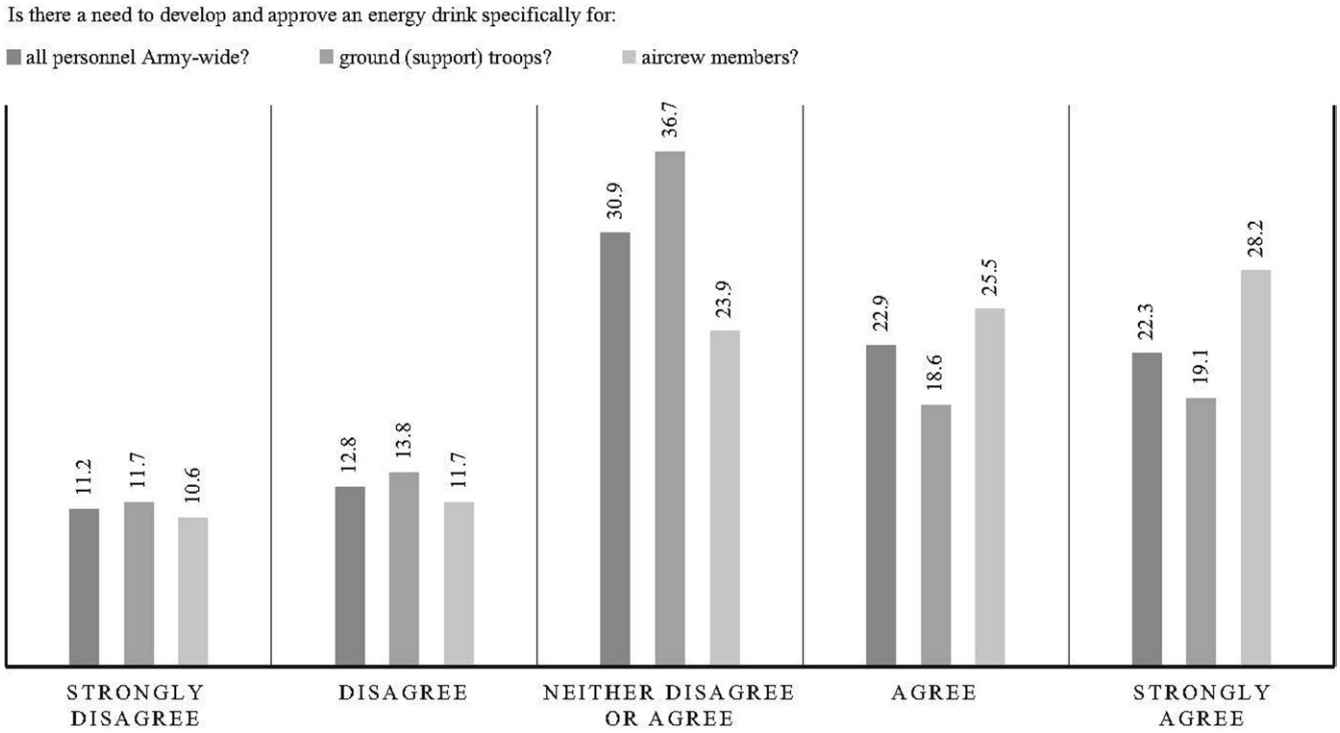


**Fig. 2.** Opinions of U.S. Army aircrew members on development of a new military energy drink ($N = 188$).

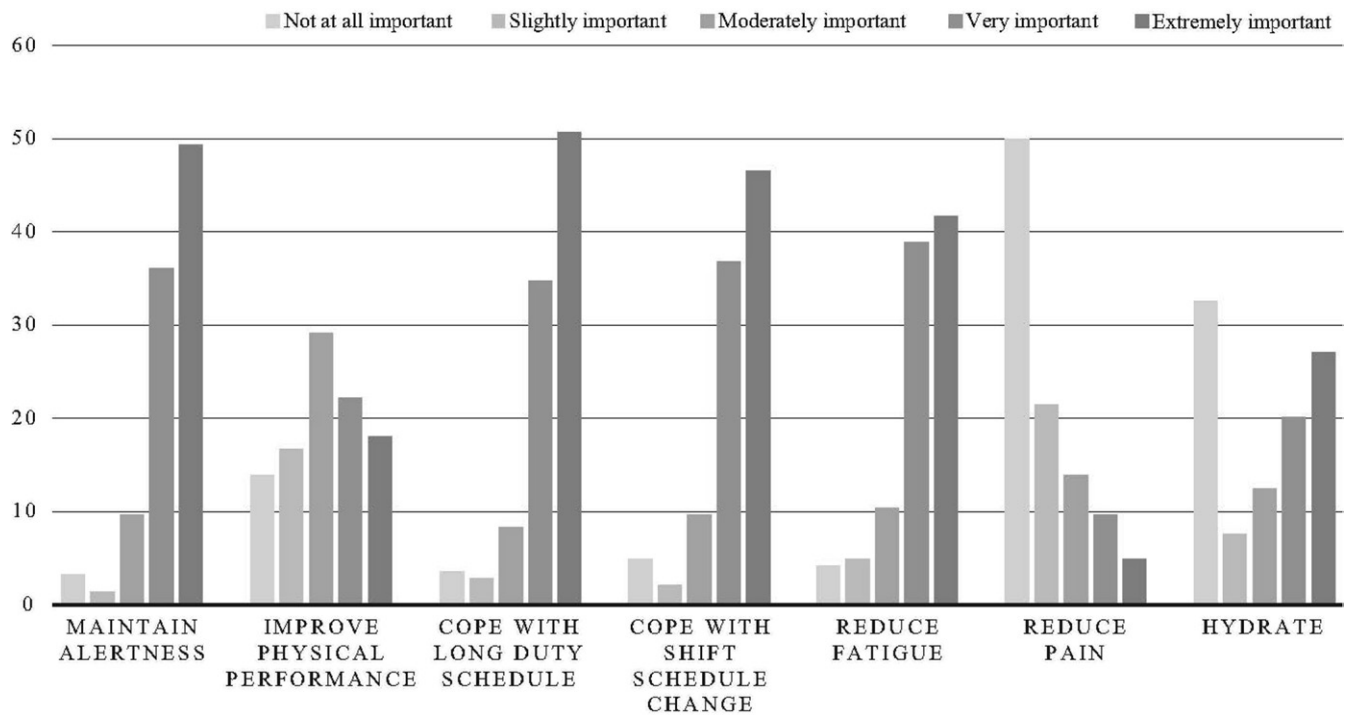


**Fig. 3.** Reported reasons for use of a new military energy drink by U.S. Army aircrew members ($N = 188$).

might be consumed more for their sugar content and the supposed "sugar high" than for the caffeine, and that health-conscious troops were less likely to rely on these beverages than their less health-minded counterparts, who tended to frequent the mess hall or fast food establishments. Others said energy drinks were less likely to be used when personnel had adequate sleep opportunities and took advantage of these opportunities, as opposed to staying up and playing computer games, but it was also noted that some aviators drink them for taste rather than the stimulant effect.

When asked about the need for an Army-approved energy drink, some users felt it would be worthwhile to develop an effective, healthy, low volume, and easy-to-use energy drink to support their unique requirements. Aircrew personnel would consider use of an Army approved energy drink if it could enhance mental acuity and focus to manage high cognitive workload, including visual, auditory, and split-second decision making. They stated mental exhaustion in the cockpit was different from physical exhaustion when not flying. There was a preference for commercially available vs. Army-issued products. Participants indicated they each respond differently to various energy drinks and were skeptical the Army could develop a single product that would meet everyone's needs. Participants who used energy drinks indicated they tested them prior to using them during flight to be aware of the effects, dosing, and timing of optimal use.

Flight crews reported energy drinks were useful for dealing with fatigue and acknowledged their use was a cultural norm, but they also indicated that misuse of energy drinks could be a liability in terms of, for example, a crewmember becoming unable to perform duties due to side effects, thus placing the entire crew at risk. For maintenance crews, over-reliance on energy drinks was thought to possibly result in an inability to focus. All study participants, regardless of their flight status, were concerned with dehydration associated with energy drink use as they thought many soldiers were consuming the drinks in place of water. Study participants also were concerned with other negative effects of energy drinks and the potential for addiction to these drinks or caffeine in general, and/or the possibility of withdrawal effects when the drinks were not available. Flight crewmembers were concerned about exhaustion and "crashing" after energy drink and caffeine use. They felt that even if personnel used energy drinks outside of the 12-h window prior to flight, they still might suffer from disrupted or insufficient pre-mission sleep as a result.

The majority of participants were receptive to education and training on food, nutrition, and safety concerns related to energy drinks, as well as relevant aeromedical policies regarding energy drink and supplement use, and they believed this should occur early in a soldier's career. While flight crews apparently were, to some extent, aware of relevant aeromedical policies potentially governing the use of these products, ground crews indicated they did not receive any aeromedical policy training.

The focus group findings noted widespread use of energy drinks among Army aircrew members and that these drinks were used for a variety of reasons, including coping with fluctuations in shifts/schedules and dealing with high cognitive workload and suboptimal sleep-rest cycles. The widespread availability of a large variety of energy drinks was cited as a reason for their use, as well as their lack of knowledge about dietary issues in general and the fact that healthy options often were not available. Participants observed a need for the Army to provide

clearer guidance on policies regarding use of energy drinks and other supplements as well as a need to provide training on lifestyle behaviors (sleep, activity, and nutrition) early in a soldier's military career.

## DISCUSSION

Based on our review of the literature, the present study appears to be the first to examine caffeine and energy drink use among a group of U.S. Army aircrew. Sleep and other factors were also assessed. A total of 188 crewmembers from a combat aviation brigade were surveyed, 76% were pilots and approximately 23% were nonpilots. Of the respondents, 47 participated in focus groups to expand on their written responses. Most subjects reported they were in good health and physically fit. The majority (94%) were in combat units.

When asked about their sleep, respondents reported obtaining an average of only 6.57 h of sleep per day while in garrison, and even less when deployed (6.15 h/d). In both environments, the amount of sleep obtained was substantially less than the 7.2 h respondents thought they needed to feel fully rested. It is also far less than the 8 h on average required for optimal cognitive performance.[6] Self-ratings of sleep quality were somewhat positive in garrison/home as nearly 54% of the sample thought their sleep was excellent or good in this context, whereas only 30% said they slept as well while deployed. The daily amount and quality of sleep reported by the present sample was less than the 6.9 h per workday reported by the general U.S. adult population, most of whom are not engaged in activities as dangerous as aircraft operations.[26] The preferred amount of sleep by aircrew members was similar to preferences of civilians (7.2 h for aircrew members vs. 7.3 h per night for civilian adults). The self-reported sleep quality while at home/in garrison was similar to that of the general population, with 54% of the current sample vs. 52% of civilian adults rating their sleep as excellent, very good, or good. The reduced sleep duration and sleep quality reported by aircrew members while deployed was expected given the environmental and psychological challenges experienced by military personnel in operational contexts.[34] Given the indications of insufficient nightly sleep either at home or when deployed, it was not surprising that fatigue from insufficient sleep was frequently noted in focus group comments. This finding is consistent with the findings of other aviation studies, indicating that pilot fatigue is a significant problem due to unpredictable work hours, long duty periods, circadian disruptions, and insufficient sleep opportunities.[8]

The aviators surveyed in this study used more caffeine than most other military[17,19,21] and civilian populations[12,23] surveyed with the exception of combat arms soldiers serving in Afghanistan.[25] The military population with the highest reported caffeine use (over 400 $mg \cdot d^{-1}$) is combat arms soldiers serving in Afghanistan during periods of active combat operations. These soldiers appear to use caffeine in various forms, often including energy drinks, to reduce the inevitable degradation in physical and cognitive function associated with intense combat operations, including frequent night operations.[25] Most of these soldiers reported sleeping less than 6 h/d.[25] It appears that aviators also use caffeine to prevent the degradation in cognitive performance invariably associated with the intense nature of their occupation and their restricted sleep.

The reported extent of aircrew fatigue explains in part why more than half of the respondents in the present investigation (65%) acknowledged using caffeinated products on a daily basis while 94% used caffeine at least weekly. It also explains why their daily consumption of 346 $mg \cdot d^{-1}$ was somewhat higher than the 285 $mg \cdot d^{-1}$ consumed by U.S. Army soldiers not serving as aircrew members[21] and higher than the 211 $mg \cdot d^{-1}$ typically consumed by caffeine-using U.S. adults,[12] the 212 $mg \cdot d^{-1}$ consumed by U.S. Air Force personnel in general,[18] or the 226 $mg \cdot d^{-1}$ consumed by Navy and Marine personnel in general.[19] Acute caffeine consumption improves various aspects of cognitive function, including alertness as well as increasing physiological arousal.[24] Previous reports have linked caffeine consumption to fatigue management in aviation candidates as well as in combat units in Afghanistan.[25,31] Furthermore, in the focus groups the primary reason aviators reported using energy drinks was for performance enhancement. Thus, aircrew members surveyed in the present study were using caffeine to cope, at least in part, with the adverse effects of sleep restriction, shift work, and highly variable work/rest schedules.

With regard to energy drink consumption, 55% of the sample reported using energy beverages at least once per week. This is higher than the 38% found from a survey of a diverse sample of 827 military personnel conducted by Stephens et al.[32] and the 39.3% rate reported from a survey of 975 active duty Army personnel.[21] It appears that "seeking caffeine for performance enhancement" was a primary rationale for energy drink consumption in this sample of aircrew members, and this makes sense given that aviators are well-known to face a high level of occupational fatigue as a matter of routine.[8] According to the present findings, aircrew personnel seem in general to be taking calculated risks to support mission needs with regard to the consumption of energy drinks. However, it is also the case that energy drinks are often being consumed more for their convenience, taste, sugar content, or to simply make up for the lack of available healthy dietary alternatives, rather than (or in addition to) their stimulant effects. Nonetheless, given energy beverages are often specifically marketed to young men as products that will improve energy, promote athletic performance, increase stamina, and improve concentration,[32] it is likely that fatigue management was a primary reason for energy drink consumption in our sample of aviation personnel.

In summary, caffeinated products, including energy drinks, are routinely consumed by Army aircrews to cope with fatigue. Given the use of energy drinks throughout American society, it appears that their consumption is part of an accepted "cultural norm" in the military aviation community, and aircrew members consider the use of energy beverages safe if they are not over-used or "abused." However, there appears to be uncertainty regarding the degree to which consumption of dietary supplements (including energy drinks) by personnel on flight status is permissible under current Army aeromedical

policies.[36] This policy states that "all aircrew and those applying for any form of aviation or aeromedical training will report the use of any form of dietary supplement to their flight surgeon." Therefore, it would appear that aircrew personnel are required to obtain an official waiver from a flight surgeon or the governing aeromedical activity prior to using any supplements. However, 60% of the aircrew members surveyed in this study stated they did not seek flight surgeon approval prior to energy drink use. Perhaps this is because personnel are unclear about whether or not energy drinks are in fact considered to be a form of dietary supplement or because they are uncertain about aeromedical policies governing the use of supplements in general and energy drinks in particular.

The policies of the other services appear to be somewhat more straightforward than those of the U.S. Army. The U.S. Navy Aeromedical Reference and Waiver Guide,[37] for instance, states that: "Energy beverages and derivatives (shots, gels, gum, chews, inhalers, nasal sprays, etc.) are not authorized for use by personnel on flight status who are actively performing duties in an aircraft… and personnel consuming [these beverages] should be grounded for at least 24 hours before resuming flight duties," and U.S. Air Force Instruction 48-123 says that "dietary, herbal, and nutritional supplements can only be used with the approval of a flight surgeon… and the flight surgeon should consider aeromedical implications of the supplement as well as the probability the supplement will actually enhance performance."[35] It would appear Army policy regarding the allowable use of commercial sports, energy, and protein products while on flight status, and better education on the importance of dietary factors in general for health, well-being, and performance should be provided to aviators.

This study provided data regarding the demographic, lifestyle, and caffeine sources and use among U.S. Army aircrew personnel. Like soldiers in combat units in Afghanistan, aircrew personnel use caffeine, in part, to reduce fatigue during missions.[25] Use of caffeinated beverages in aircrew personnel varied based on age and military rank, with coffee as the major source of caffeine among officers and older age groups and energy drinks as the major source of caffeine for enlisted personnel and younger age groups. Focus groups demonstrated the underlying factors for selecting energy drinks were occupational demands, unpredictable schedules, poor access to nutritious foods or beverages, convenience, habits established during deployments, and unclear aeromedical policies. Aircrew personnel indicated willingness to take potential risks associated with energy drinks to support the flying mission and they indicated they often try various energy drinks before using them during flight to determine the optimal dosing and timing of energy drinks. But they also expressed a desire to learn more about energy drinks, aeromedical policies, and safe nutritional strategies to overcome fatigue and improve job performance. Early education for aviators on lifestyle (sleep and activity), nutrition, energy drinks, and aeromedical policies, along with conditions/environment to translate knowledge to behaviors, will help ensure aircrew personnel are able to maintain a high level of performance for military operations and provide long-term health benefits.

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