

Dietary Supplements and Exertional Rhabdomyolysis in the Army

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The authors have no financial interests or relationships to disclose.

Acknowledgement

This work is sponsored by MSK3C, a collaboration between the Center for Health Services Research, Consortium for Health and Military Performance, and Musculoskeletal Injury Rehabilitation Research for Operational Readiness (Department of Neurology and Rehabilitation Medicine) at the Uniformed Services University (Award: HU00012320034), and the Department of War.

Background: Supplements

- Approximately 75% of service members use dietary supplements (DS) to either improve performance, prevent, or recover from injury
- Service member use of DS is greater than the average population, despite many safety concerns
- DS products that are considered high-risk by the Food and Drug Administration (FDA) are those marketed for:
 - Body building
 - Weight-loss
 - Sexual enhancement

In a 2024 study of 44 weight-loss DS sold around military bases, DS had:

- **Inaccurate labels (82%)**
- **Missing ingredients (61%)**
- **Hidden ingredients (36%)**
- **DoW-prohibited substances (9%)**
- **Excessive caffeine (≥ 350 mg; 48%)**
- **Questionable health claims (91%)**

Picture credit: Photo by Lance Cpl. Nikki Phongsisattanak. 2011. VIRIN: 110608-M-GL246-018

Background:

Rhabdomyolysis

- High risk DS may also contribute to **exertion-related injuries** such as rhabdomyolysis and heat injury
- Rhabdomyolysis is the rapid breakdown of skeletal muscle, with an extreme increase in circulating creatine kinase and myoglobin, and severe muscle pain
- Common triggers include trauma, infections, toxins, drugs, heat stress, physical exertion

O'Connor, F.G., Raleigh M., & Oh R. (2025) Clinical Practice Guideline for the Management of Exertional Rhabdomyolysis in Warfighters. Consortium for Health and Military Performance (CHAMP), Bethesda



Photo credit: U.S. Air Force photo by Airman 1st Class Elizabeth Davis. 2022. VIRIN: 220808-F-TX306-1055



Photo credit: U.S. Army photo by Spc. Mark Bowman. 2026. VIRIN: 260609-A-BF020-1005

Background: Purpose

- DS are cited as contributors in many rhabdomyolysis case studies and reviews
 - **But** there is minimal large-scale research into associations between DS use and rhabdomyolysis risk
- We investigated whether soldiers who endorse taking DS on their annual Periodic Health Assessment (PHA) were more likely to later have exertional rhabdomyolysis than soldiers who do not endorse taking them

Case Reports Linking Dietary Supplements to Rhabdomyolysis

Rhabdomyolysis associated with the nutritional supplement Hydroxycut. *Am J Health Syst Pharm* 2009.

Rhabdomyolysis associated with the use of a mislabeled "acai berry" dietary supplement. *Am J Med Sci* 2011.

Hydroxycut weight loss dietary supplements: a contributing factor in the development of exertional rhabdomyolysis in three U.S. Army soldiers. *Mil Med* 2013.

A case of rhabdomyolysis in the presence of multiple risk factors and dextroamphetamine use. *Am J Med Sci* 2013.

A case of paraspinal muscle rhabdomyolysis in a 22-Year-old male After ingesting a supplement containing higenamine. *Mil Med* 2015.

A remarkable case of rhabdomyolysis associated with ingestion of energy drink 'neon volt'. *J Community Hosp Intern Med Perspect* 2016.

Bodybuilding supplements leading to copper toxicity, encephalopathy, fulminant hepatic failure and rhabdomyolysis. *Am J Emerg Med* 2020.

Acute compartment syndrome in the setting of weight loss supplements and exercise-induced rhabdomyolysis. *Eur J Case Rep Intern Med* 2022.

Crushing muscles: A case study on rhabdomyolysis, renal failure, and compartment syndrome triggered by pre-workout supplement abuse. *Cureus* 2024.

Rhabdomyolysis associated with excess pine bark extract: A case report. *Cureus* 2025.

Exercise-induced rhabdomyolysis with supplements (Creatine, β -Alanine, Citrulline Malate, and β -Ecdysterone). *Cureus* 2026.

Rhabdomyolysis, acute kidney injury, and exudative retinal detachment associated with nonsteroidal anti-inflammatory drug and herbal product use: A case report. *J Clin Pract Res* 2026.

Methods: Retrospective Cohort

- Study was approved by Uniformed Services University IRB as research not involving human subjects
- Data accessed through Army Analytics Group's Person-Event Data Environment (PDE)
- We identified a cohort of 306,280 soldiers with
 - 1: A PHA between August 2021 and August 2022
 - 2: No evidence of rhabdomyolysis in the year prior to their PHA
- Soldiers were observed for up to one year, or until:
 - An incident of rhabdomyolysis (outcome event)
 - Military separation (censoring event)

Data Source	Variables
Defense Manpower Data Center	Demographics, career status, separations
Military Health System Data Repository*	Diagnoses
Periodic Health Assessment	Self-reported dietary supplement usage
*Based on BDE 2.4, which has been identified to be missing encounters starting ~2022.	



U.S. Air Force photo by Senior Airman Avery Litton, 182nd Airlift Wing. 2026. 260307-Z-OR724-1040

Methods: Exposures

- The PHA is an annual health readiness assessment
- Self-report portion asks about DS use “since your last periodic health assessment”
- Respondents select the frequency with which they used the DS (eg, monthly, daily, etc)
- We identified respondents who reported using DS at least once per month
- We analyzed three DS categories (right)
- These categories were analyzed individually, and combined into an any-DS use variable
- These DS items have limitations due to DS categorization and item-wording

DS Categories on the PHA

Muscle-building

Muscle Building/Testosterone Boosting Products (such as products that may contain pro-hormones, hormone boosters, hormone support, “legal steroids”, “anabolic”, deer velvet, “Andro”, anti-estrogen, estrogen blocker, DHEA, 7-Keto, IGF-1, growth hormone, Hydroxymethylbutyrate/HMB, or insulin releasing (factors))

Performance-enhancement

Performance Enhancers/Pre-Workout Products (such as Synephrine/Citrus Aurantium, bitter orange, Yohimbe/Yohimbine, or ephedra-free stimulants.....[additional examples listed])

Weight-loss

Weight Loss Products (such as...[examples listed]...green coffee bean extract, or products using marketing terms or phrases like “Ripped”, “Lipo”, “Heat”, “Cut”, or “Shred”)

Methods:

Outcome and Analyses

- Outcome: incident rhabdomyolysis
 - ICD-10 Codes: M62.82 (rhabdomyolysis); R82.1 (myoglobinuria)
 - Excluded cases with non-exertional triggers within two days before and seven days after the diagnosis (eg, poisoning, infections, acute trauma)
 - Case definition did not incorporate codes for external injury causes
- Covariates
 - Age, sex, race, pay grade
 - Body mass index from the year prior to the assessment
 - Physical fitness test score from the year prior to the assessment
 - Relative fitness test version
- Discrete time survival model with a complementary log-log link function
 - Hazard ratios (95% CI), unadjusted and adjusted

Table 1. Sample characteristics.	
	Overall (n=306,280)
Sex	
Female	16%
Male	84%
Body Mass Index	
< 25	22%
25-<30	32%
30-<35	10%
≥ 35	1%
Missing	34%
Fitness Quartile	
Q1 (Lowest)	19%
Q2	19%
Q3	19%
Q4 (Highest)	19%
Missing	23%

- Subjects were a median of 26 years old (interquartile range: 22, 32) and 84% were enlisted
- DS use rates:
 - Muscle-building: 6%
 - Weight-loss: 2%
 - Performance-enhancement: 3%
 - Any of the three categories: 9%

Table 2. Sample characteristics overall and based on DS endorsement.					
	Overall (n=306,280)	Endorsed DS Use			
		Muscle-Building (n=18,866, 6%)	Performance-Enhancing (n=5,837, 2%)	Weight-Loss (n=10,212, 3%)	Any (n=28,576, 9%)
Sex					
Female	16%	6%	16%	23%	13%
Male	84%	94%	84%	77%	87%
Body Mass Index					
< 25	22%	20%	17%	5%	16%
25-<30	32%	34%	35%	34%	34%
30-<35	10%	11%	14%	26%	15%
≥ 35	1%	1%	2%	4%	2%
Missing	34%	33%	32%	31%	32%
Fitness Quartile					
Q1 (Lowest)	19%	11%	18%	27%	17%
Q2	19%	18%	19%	20%	18%
Q3	19%	22%	19%	17%	20%
Q4 (Highest)	19%	28%	22%	13%	23%
Missing	23%	22%	23%	24%	23%

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Q3	19%	22%	19%	17%	20%
Q4 (Highest)	19%	28%	22%	13%	23%
Missing	23%	22%	23%	24%	23%

Results

- 445 cases of rhabdomyolysis (incident rate: 155 per 100,000 person-years)
- Most incidents occurred 6 months after the health assessment (interquartile range: 3, 9)
- Muscle-building and any-DS **were** associated with incidents of exertional rhabdomyolysis
 - Effect sizes were weak to moderate
- Of the 445 incident cases:
 - 9.2% had endorsed using a muscle-building DS
 - 4.0% had endorsed using a weight-loss DS
 - 2.2% had endorsed using a performance-enhancement DS
 - 12.1% had endorsed any-DS use

Table 3. Associations between DS use and incidents of rhabdomyolysis.

DS Usage	Hazard Ratios (95% CI)	
	Unadjusted	Adjusted
Muscle-Building	1.60 (1.16, 2.21)*	1.41 (1.06, 1.87)*
Weight-Loss	1.27 (0.79, 2.03)	1.37 (0.85, 2.21)
Performance Enhancement	1.33 (0.71, 2.48)	1.32 (0.70, 2.47)
Any DS Category	1.41 (1.06, 1.87)*	1.34 (1.01, 1.79)*

* $P < 0.05$.

Note. Unadjusted models only accounted for time at risk. Adjusted models controlled for age, sex, race, paygrade, physical fitness test, and body mass index.

Discussion

- Results indicated that muscle-building DS were weakly/moderately associated with risk for rhabdomyolysis
- Medications can likely increase risk for rhabdomyolysis by:
 - Disrupting calcium homeostasis
 - Causing dehydration
 - Disrupting thermoregulation
 - Stressing the kidneys



Photo credit: DOW photo by Ricardo J. Reyes. 2026. VIRIN: 260430-D-EC642-1210

Discussion: Risky DS

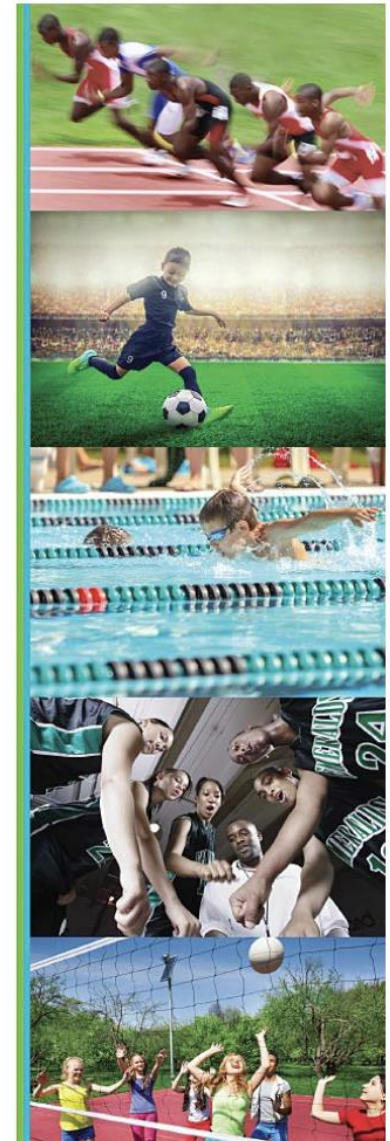
- It is standard practice to ask about DS use in the Pre-Participation Physical Exam (PPE)
- Most DS have intrinsic risks
 - Based on exercise experiments, DS such as creatine and herbals likely do *not* increase ER risk
 - Concerns can include extreme health claims, multiple ingredients/stimulants, and contaminated or adulterated products
 - It is challenging for SMs to distinguish between unsafe products and those with minimal risk

Harty PS, Cottet ML, Malloy JK, Kerkick CM. Nutritional and Supplementation Strategies to Prevent and Attenuate Exercise-Induced Muscle Damage: a Brief Review. *Sports Med Open*. 2019;5(1):1.

PPE PREPARTICIPATION PHYSICAL EVALUATION 5th Edition

American Academy of Family Physicians
American Academy of Pediatrics
American College of Sports Medicine
American Medical Society for Sports Medicine
American Orthopaedic Society for Sports Medicine
American Osteopathic Academy of Sports Medicine

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American Academy of Family Physicians, American Academy of Pediatrics, American College of Sports Medicine, American Medical Society for Sports Medicine, American Orthopaedic Society for Sports Medicine, American Osteopathic Academy of Sports Medicine. PPE: Preparticipation Physical Evaluation. 5th ed. American Academy of Pediatrics; 2019.

Discussion: Education is Key

DoD INSTRUCTION 6130.06

USE OF DIETARY SUPPLEMENTS IN THE DoD

Originating Component:	Office of the Under Secretary of Defense for Personnel and Readiness
Effective:	March 9, 2022
Releasability:	Cleared for public release. Available on the Directives Division Website at https://www.esd.whs.mil/DD/ .
Approved by:	Gilbert R. Cisneros, Jr., Under Secretary of Defense for Personnel and Readiness

Purpose: In accordance with the authority in DoD Directive 5124.02, this issuance:

- Establishes policy, assigns responsibilities, and provides procedures for dietary supplement education and use throughout the DoD.
- Establishes policy, assigns responsibilities, and prescribes procedures for administering the DoD Operation Supplement Safety (OPSS) Program and OPSS Advisory Board.



ARE YOU LOOKING FOR INFORMATION
ON DIETARY SUPPLEMENTS?
OPERATION SUPPLEMENT SAFETY CAN HELP!

Some of the tools and resources provided by OPSS include:

- DoD Prohibited List
- Evidence-based articles
- Handouts, guides, posters, and videos
- OPSS Scorecard
- Presentations and trainings



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Discussion: Limitations

- Important to consider types of DS and who uses them
 - Many potential confounders
 - Across the three DS categories, muscle-building DS was associated with being male and high-fitness levels
- DS questions on the PHA
 - Have outdated categories
 - Have confusing examples
 - Likely under-capture DS-use
- MDR data quality
- Rhabdomyolysis case definition and external cause coding



Photo credit: U.S. Air Force photo illustration/Airman 1st Class Daniel Brosam. VIRIN: 160922-F-DB969-022

Canham-Chervak M, Schuh-Renner A, Stahlman SL, Rappole C, Jones BH. External cause coding of injury encounters in the Military Health System among active component U.S. service members, 2016-2019. *MSMR*. 2025;32(2):2-9.

Knapik JJ, Steelman RA, Hoedebecke SS, Farina EK, Austin KG, Lieberman HR. A systematic review and meta-analysis on the prevalence of dietary supplement use by military personnel. *BMC Complement Altern Med*. 2014;14:143. Published 2014 May 2. doi:10.1186/1472-6882-14-143

Thank You

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