

Efficacy and Safety of Protein Supplements for U.S. Armed Forces Personnel: Consensus Statement^{1–5}

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Abstract

To provide evidence-based guidance regarding the efficacy and safety of dietary protein supplement (PS) use by members of the U.S. Armed Forces, a panel of internationally recognized experts in the fields of protein metabolism and dietary supplement research was convened by the Department of Defense Center Alliance for Dietary Supplement Research and the U.S. Army Medical Research and Materiel Command. To develop a consensus statement, potential benefits, risks, and strategies to optimize military performance through PS use were considered in the context of specific warfighter populations and occupational demands. To maintain muscle mass, strength, and performance during periods of substantial metabolic demand and concomitant negative energy balance the panel recommended that warfighters consume 1.5–2.0 g · kg⁻¹ · d⁻¹ of protein. However, if metabolic demand is low, such as in garrison, protein intake should equal the current Military Dietary Reference Intake (0.8–1.5 g · kg⁻¹ · d⁻¹). Although PS use generally appears to be safe for healthy adults, warfighters should be educated on PS quality, given quality-control and contamination concerns with commercial dietary supplements. To achieve recommended protein intakes, the panel strongly urges consumption of high-quality protein-containing whole foods. However, when impractical, the use of PSs (20–25 g per serving or 0.25–0.3 g · kg⁻¹ per meal), particularly after periods of strenuous physical activity (e.g., military training, combat patrols, and exercise), is acceptable. The committee acknowledges the need for further study of protein requirements for extreme, military-specific environmental conditions and whether unique metabolic stressors associated with military service alter protein requirements for aging warfighters. *J. Nutr.* 143: 1811S–1814S, 2013.

Introduction

Protein supplements (PSs)⁹ are, after multivitamins, the most frequently consumed dietary supplement by U.S. military personnel, with recent estimates suggesting that the prevalence

of regular PS use by military personnel is nearly 20% or more in active-duty personnel (1). As such, in November of 2012, a group of internationally recognized subject matter experts (SMEs) in the fields of protein metabolism and dietary supplement research was convened by the Department of Defense Center Alliance for Dietary Supplements Research and the U.S. Army Medical Research and Materiel Command for a symposium that examined the efficacy and safety of PSs for U.S. Armed Forces personnel. The aim of the symposium was to evaluate the

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⁴ Consensus was based on recommendations, review, and agreement of all subject matter experts presenting at the 2012 Department of Defense Center Alliance for Dietary Supplements Research Symposium: Efficacy and Safety of Protein Supplements for U.S. Armed Forces Personnel.

⁵ The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the U.S. Army or the Department of Defense. Any citations 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.

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⁹ Abbreviations used: FFM, fat-free mass; PS, protein supplement; SME, subject matter expert.

current understanding of the efficacy and safety of PSs and determined whether warfighters¹⁰ would benefit by consuming dietary protein in excess of the current RDA ($0.8 \text{ g} \cdot \text{kg}^{-1} \cdot \text{d}^{-1}$). To initiate the symposium, the unique occupational demands of military service, current dietary protein research efforts in military nutrition, and the prevalence of PS use by warfighters were addressed by scientists from the Military Nutrition Division of the U.S. Army Research Institute of Environmental Medicine. Subsequently, SMEs presented and discussed the current evidence base regarding the efficacy of PSs, potential benefits or harm of consuming PSs, optimal nutrient timing strategies for dietary or supplemental protein consumption, recommendations for dietary protein intake for specific warfighter populations (e.g., occupation, deployment cycle, extreme conditions, aging), and concerns regarding the quality assurance of PSs used by warfighters.

A consensus statement was collaboratively developed by the SMEs who participated in this symposium. The objective of this consensus statement was to provide evidence-based, clear, and practical guidance to members of the U.S. Armed Forces. Recommendations from the panel may also be used to shape and develop military nutrition policy and for the formulation of combat rations.

Dietary Protein Recommendations for Warfighters: Efficacy of Supplemental Protein

During acute, sustained, or repeated periods of substantially elevated metabolic demand that can result in negative energy balance, the panel agreed that warfighters may benefit from consuming dietary protein at amounts that are approximately twice, and in some cases higher, than the current RDA for protein. The range for dietary protein intake by warfighter populations exposed to substantially increased metabolic demand recommended by the committee was $1.5\text{--}2.0 \text{ g} \cdot \text{kg}^{-1} \cdot \text{d}^{-1}$, which is slightly above the current MDRIs (military DRIs) (2) but consistent with current national protein recommendations for athletes and physically active adults (3). There is no available evidence in healthy adults that demonstrates a metabolic advantage of consuming dietary protein beyond $2.0 \text{ g} \cdot \text{kg}^{-1} \cdot \text{d}^{-1}$. The extent to which additional dietary protein may be beneficial for warfighters during periods of extreme physiological stress (e.g., severe energy deficit; sustained, high-intensity training; sleep deprivation) has not been determined.

The use of PSs should be intentional and strategic and may confer the following benefits: increasing lean body mass and skeletal muscle strength, maintaining body mass, attenuating the loss of fat-free mass (FFM) during energy deficit, and assisting with appetite control during periods of planned or unavoidable energy deficit and weight loss. Recommendations for PS use should take account of military training status, operational conditions, and deployment cycle phase (in garrison, predeployment training, deployment, and recovery/regeneration) given the vast discrepancies in energy expenditures between these operational scenarios. Recommendations should also consider the activity levels and mission requirements of different warfighter

populations, ranging from elite forces, combat arms, to combat service and combat service support.

When in garrison, the committee recommended that warfighters consume dietary protein at amounts consistent with the MDRIs ($0.8\text{--}1.5 \text{ g} \cdot \text{kg}^{-1} \cdot \text{d}^{-1}$) (2). During this period of the deployment cycle, supplemental protein may be used to promote recovery and maximize whole-body and muscle protein turnover responses to physical stress and military training. This recommendation is based on overwhelming experimental evidence demonstrating enhanced muscle protein synthesis and net protein balance when PSs are consumed before, during, or after a bout of resistance or endurance-type exercise (4–8). Although studies demonstrating metabolic advantages of PS consumption in the context of recovery from exercise have focused primarily on healthy men, sex-based differences in protein use (steady state branched-chain amino acid oxidation) may alter dietary protein requirements and, as a consequence, PS recommendations (9,10). Therefore, future studies are required to determine whether the unique metabolic demands associated with military training elicit similar sex-related differences in protein use and necessitate PS recommendations on the basis of sex.

The metabolic demand associated with predeployment, physical, and operational training also may warrant the use of PSs. For example, warfighters including U.S. Army Special Forces, Rangers, infantry, and Marines conducting dismounted combat training and simulated mountain warfare training often expend $3500\text{--}4600 \text{ kcal} \cdot \text{d}^{-1}$, and in certain circumstances they can expend up to $7000 \text{ kcal} \cdot \text{d}^{-1}$ (11–13). Consuming supplemental protein may optimize the whole-body and skeletal muscle metabolic responses to periods of intense physical training and preserve lean body mass by sustaining muscle protein balance, attenuating proteolysis, and promoting muscle protein accretion (4,7,8). Consuming a high-protein diet (supplemental or dietary) may also enhance bone health by attenuating bone turnover and increasing intestinal calcium absorption, if calcium intake is adequate (14–16). During repeated days and weeks of intense physical training and periods of training overload, supplemental protein may also mitigate the risk of injury and overtraining, although direct evidence for this is currently lacking (17). The committee suggested that dietary or supplemental protein intake be consumed in quantities of at least $0.25\text{--}0.3 \text{ g} \cdot \text{kg}^{-1}$ per meal or snack to maximize muscle protein anabolism (18) and to achieve a total daily intake of at least $1.5 \text{ g} \cdot \text{kg}^{-1} \cdot \text{d}^{-1}$ from multiple high-quality protein sources such as milk-based, soy, egg, and animal proteins.

Dietary Protein Recommendations for the Aging Warfighter

A relationship between dietary protein intake and age-related muscle loss (i.e., sarcopenia) has been observed (19). Dietary protein is critical for maintaining lean body mass with aging, because the anabolic sensitivity of skeletal muscle to protein-containing meals is blunted in aging (20,21). As such, aging adults likely require more dietary protein, particularly proteins rich in leucine, a branched-chain amino acid that regulates protein synthesis, to elicit a comparable skeletal muscle anabolic response to that seen in young adults (22–24). For most aging adults, it is recommended that protein intake be set at amounts of $1.2\text{--}1.5 \text{ g} \cdot \text{kg}^{-1} \cdot \text{d}^{-1}$ without increasing total energy intake and while remaining within the acceptable macronutrient distribution range (10–35% of total energy requirement from protein) (25–28). The committee recognizes that research on

¹⁰ The term “warfighter” is used by the U.S. Department of Defense to refer to any member of the U.S. Armed Forces. Warfighter is intended to be neutral regarding military service or branch, sex, and service status and replaces previously used terminology including “soldier,” “service member,” and “military personnel.”

age-related muscle loss and dietary protein requirements in aging adults may not be entirely applicable to an aging warfighter population who are not yet elderly but middle-aged (~25% of officers and 5% of enlisted personnel are >41 y of age and <1% of the active-duty military population are >50 y of age).

Safety Concerns for PS Use by Warfighters

Expert panels (Institute of Medicine and WHO) have concluded that there is no direct evidence that consuming high-protein diets or supplemental protein in large doses is detrimental to renal function (e.g., development of kidney disease or kidney stones) in healthy adults (25,29). Cross-sectional, longitudinal studies in healthy individuals consuming a high-protein diet reported healthy cardiometabolic profiles (30–32). Furthermore, there is no apparent relationship between dietary protein intake and deteriorating general health as defined by cardiovascular risk (33).

Warfighters should consider the quality of protein contained in the PSs being consumed and the potential for the product to be adulterated, given the quality-control concerns with the dietary supplement industry (34–36). Contamination of supplements with substances hazardous to health (e.g., heavy metals, fecal contaminants, and steroids) could result in adverse events and reductions in military readiness and could also result in positive drug tests: these outcomes have the potential to compromise national security should the warfighter be adversely affected during military training or combat operations. The committee recommends that the Department of Defense establish specific standards for the sale of products at military exchanges and that quality and safety guidelines be established for PSs sold to warfighters in military exchanges or on military facilities. Validated third-party certification of quality (i.e., verified label contents) and absence of contamination are necessary to minimize the potential impact on health, performance, national security, and military readiness. Military personnel should be educated regarding safety concerns associated with PSs. Furthermore, they should be advised that when a high-protein diet is appropriate, increased protein intake should be achieved by consumption of whole foods, and only when necessary, with PSs.

Recommendations for Type, Amount, and Form of PSs for Warfighters

The committee agreed that whole foods should be the first resource used to increase total dietary protein intake but recognizes that this is not always practical. Intact proteins that are high in essential amino acids, particularly the branched-chain amino acid leucine, such as milk, soy, egg, and animal proteins should be used to increase dietary protein intake (37). Supplemental protein should be evaluated on the basis of a protein quality rating that considers the essential amino acids, branched-chain amino acids, and leucine composition of the protein (38). In particular, consideration of the leucine content of the protein would be warranted when FFM accretion or retention is of paramount consideration. The timing of nutrient consumption, whether as food or a PS, should be considered when warfighters are in energy deficit or actively deployed and operating in a state of high energy expenditure. In such circumstances, warfighters should consume high-quality dietary protein or PSs in 20–25-g servings when feasible, particularly after strenuous exercise or prolonged training or combat patrols and before sleeping (39). Postexercise and presleep protein

snacks should be factored into the total daily energy intake to avoid overconsumption and possible gain of fat mass (40). When possible, particularly in austere, energy-deprived conditions, protein should be consumed not only with meals but also with snacks to ensure adequate provision of energy necessary for meeting the metabolic demands of the mission as well as the retention of FFM.

Recommendations for Further PS Research

The committee recommends further study on protein requirements during “real world” environmental stress and circumstances in which substantial disruption of the hypothalamic-pituitary-adrenal axis may occur, including periods of high levels of physical activity and inadequate energy intake. Specifically, studies are needed to determine the metabolic consequences of PSs or high-protein diets during exposures to challenging physical and psychological environments: extreme heat, high altitude, and cold. Further research should also be conducted to determine whether increased protein consumption has the potential to diminish inflammation associated with skeletal muscle damage.

The group consensus was that little is known with regard to the effect of extreme operational environments on whole-body and skeletal muscle protein metabolism and dietary protein requirements. To advance our current understanding of protein supplementation, the committee recommended that future research focus on evaluating the impact of increased protein consumption via the diet or through PSs during periods of extreme energy restriction in combination with high levels of energy expenditure, as well as the impact of protein supplementation during exposure to extreme environmental stress. Research is also needed to evaluate the effects of protein supplementation on middle-aged (≥ 41 –62 y of age) warfighters including the following: 1) to determine whether aging exacerbates the effects of severe operational stress and whether PSs are an effective countermeasure to the physiological consequences of aging, because mandatory retirement age is generally 62 y of age; 2) to determine if there is a benefit of higher protein intake in individuals who are in energy balance and the effects of protein supplementation with regard to healthy weight management in an aging population; and 3) to determine if protein enhances rehabilitation from age-related injury and immobility.

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