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A BRIEF REVIEW OF ARTICLES ON THE STUDY OF MILITARY NUTRITION

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Abstract
This article presents an analysis of materials such as articles, scientific developments covered in the last 15 years on the results of some scientific studies related to the nutrition and health indicators of military personnel on various sites in the Internet system. The article presents the results of the study of the relationship between the level of health, changes in weight indicators, the decrease in working capacity and the amount of testosterone hormone in their bodies, and the existence of a relationship between the diet of military personnel and their health. Also, information about the immune function of military personnel and the relationship of infection with infectious diseases with their nutrition is reflected.

Keywords: technology, health, nutrition system, endurance, energy deficiency, hypogonadism, muscle mass fraction, strength, Army, Operational ration, nutrition, serious diseases.

Introduction

Methods:

PubMed, Google Scholar, CrossRef and Free PMC article databases were searched for September 2024. Search terms used were "nutrition and immune function", "stress and immune function", "obesity and immune function", "obesity and the military", "health", "food system", "resilience", "nutritional sciences", "energy deficiency", "muscular body mass", "skeletal muscle", "strength", "army", "operational rations", "nutrition", and "critical illness". The search criteria specified literature from the last 15 years from the search date and identified studies, reports, review articles and references in these sources relevant to the topic area.

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Summary of the review findings and accompanying discussion:

The study of scientific publications devoted to the nutrition of servicemen of different armies of foreign countries has shown that the research in this area was mainly conducted in the armies of such countries as the USA, Great Britain, Russia, France and Germany.

Authors Alyssa N. Varanoske et al (USA, 2022 y.) conducted research on "Testosterone undecanoate administration prevents fat-free body weight loss but not physical performance during simulated high-stress military operations"

According to the authors, male military personnel participating in stressful special operations experience decreased testosterone concentrations, muscle mass, and physical performance.

Special operations forces conducting prolonged, multi-stress military exercises and combat operations consist predominantly of men who often experience significant reductions in circulating testosterone below hypo gonadal concentrations (≤300 ng/dL or ≤10.4 nmol/L) [1], loss of muscle mass and reduced physical performance [2, 4]. These negative effects can manifest themselves during workouts lasting as little as 72 hours [3, 5] and are often attributed in part to the collective effects of sleep deprivation, increased exercise-induced energy expenditure, reduced energy intake (decreased appetite, time constraints and limited availability of food) and the resulting energy deficit (the percentage of energy intake required to establish energy balance and maintain body weight) on endogenous testosterone synthesis [6, 7].

The aim of this study was to test the effects of a single dose of testosterone undecanoate on body composition and military-relevant physical performance during a simulated military operation.

This study demonstrated that a single intramuscular dose of testosterone undecanoate (750 mg) administered to physically active men before a 20-day simulated high-stress military operation increased circulating total and free testosterone concentrations within normal physiological ranges and preserved fat-free mass. However, testosterone administration did not attenuate the decline in physical performance in several measures of power, strength, anaerobic or aerobic capacity.

Scientists Neil Hill et al (UK 2011) in their research "Military nutrition: maintaining health and repairing damaged tissues" analyzed scientific papers devoted to this problem.

According to the authors, food and nutrition are fundamental to military capability. Historical examples show that failure to provide armies with adequate nutrition inevitably leads to disaster. For example, scurvy caused the deaths of more sailors than enemy action in the eighteenth century. During Lord Anson's circumnavigation of the globe (1740-1744), 636 of the 961 sailors in his fleet died [8]. In 1753, the use of citrus fruits for the treatment and prevention of scurvy was recommended during round-the-world voyages [9]. In 1776, Captain James Cook wrote in the Philosophical Transactions of the Royal Society that the addition of malt, sauerkraut and wild celery to the diet, as well as the strict cleanliness and regular supply of fresh water on board, contributed to the fact that no crew member contracted scurvy during the 3-year voyage of the Resolution (1772-1775) [10].

More recently, nutrition during military operations has been the subject of research and investment. The challenges of feeding soldiers in austere environments are multifactorial [11], as seen during the Falklands War in 1982: 'During combat operations, the main source of food was either Arctic or 24-hour rations; a significant number of soldiers did not eat all their rations, resulting in weight loss and possible loss of effectiveness. Reasons for this failure ranged from

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“unappetizing” food, lack of time, the nature of operations and lack of potable water for cooking, especially Arctic rations.’ These issues remain a concern and have prompted ongoing research into military nutrition.

Recent evidence supports the view that wider societal trends towards weight gain and obesity are also prevalent in the armed forces and may adversely affect operational capability [12, 13]. However, in the more sedentary professional units of all three services physical activity can be relatively easily avoided unless the chain of command specifically monitors and authorizes the required levels of physical fitness in personnel. Problems relating to physical fitness and associated exercise and nutritional habits of recruits prior to military training are currently being addressed through a research collaboration between the RN and the Royal Air Force [14].

Inadequate nutrition can lead to poor physical and cognitive performance (e.g., inability to perform physical tasks, poor concentration and reduced alertness) [15, 16].

The authors highlight that, the UK Ministry of Defence actively supports healthy eating amongst military personnel through targeted educational lectures in phase 1 training, as well as through the publication of nutrition guides [17, 18] and educational DVDs [19].

On operations or military exercises, if field kitchens and fresh food are not available, UK military personnel are fed on Operational Rations Plans (ORP) provided by their command. ORP, as outlined in the UK Ministry of Defence's Nutrition Policy Statement [20], ‘is designed to sustain troops during operations and field exercises to preserve life, preserve physical and mental function, maintain mood and motivation, prevent fatigue and accelerate recovery.’ Responsibility for maintaining ORP lies with the Defance Food Services Team (DFST), part of Defence Equipment and Support, with scientific support from the Institute of Naval Medicine (INM), Alverstock, UK, and the Defence Science and Technology Laboratory, Porton Down, UK. Operational nutrition has been the subject of recent media and political attention [21, 22] and has implications not only for health but also for military effectiveness and morale. The aim of operational nutrition is ‘to provide a diet as close to normal as possible under all conditions’, and meals based mainly on ORP should be replaced with fresh rations after no more than 44 days (i.e. 14 days of combat and 30 days thereafter) [20].

According to the researchers, if all components of MCR are consumed, this would provide an average (across all options) energy intake of 4098 kcal, which includes 651 g carbohydrate, 130 g protein and 92 g fat. The energy and macronutrient profile of MCR has been analyzed [23] and the utility of MCR has been reviewed by INM [24] against military dietary reference values for ORP in hot climates [25].

The article points out that there is a lack of reliable evidence to support the nutritional adequacy of British rations in terms of sustaining combat effectiveness. There is no published literature investigating the change in body weight or body composition in soldiers consuming ORP compared to fresh rations, or whether ORP affects combat effectiveness. Work is currently underway to address this issue. The limited research available included a survey of users of old 24-hour GP ORP, from which it was concluded that between 25 and 55 per cent of 24-hour GP ORP was discarded immediately upon receipt, with snacks being the most commonly discarded, containing the most (43 per cent) energy [26, 27].

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Studies conducted in the United States in the 1980 y. reported conflicting evidence on whether American rations, called Meals Ready to Eat (MRE), resulted in body weight loss in operational field conditions [28]. In 1995, male soldiers participating in a 30-day field study during which they were provided only MRE rations lost 3.8 per cent of their body weight, compared to 1.2 percent body weight loss in soldiers fed hot, pan-cooked food (hydration status was unchanged) [29]. Dual X-ray absorptiometry (DEXA) and anthropometric measurements showed that body weight loss was almost entirely related to fat mass, which was associated with reduced carbohydrate intake, resulting in a net daily energy deficit of 600 kcal. However, it has been suggested that combat performance is not necessarily impaired in soldiers with a body weight loss of 3-6% consuming operational rations for more than 10 days [29]. Recent evidence suggests that providing food that can be easily snacked on throughout the day may improve physical activity during prolonged heavy workloads [30].

There is also growing evidence that caffeine can improve performance across a wide range of physical activities, as well as reduce fatigue and increase alertness [31]. Caffeine has been shown to improve running performance and maintain vigilance during an overnight field operation for US Special Forces personnel [32, 33] and to improve cognitive performance in sleep-deprived US Navy SEALs.

Authors Adrienne Hatch-McChesney and Tracy J. Smith (USA, 2023), in their article 'Nutrition, Immune Function, and Infectious Diseases in Military Personnel,' provide a review of research conducted on the impact of nutrition on immune function and the incidence of infectious diseases in US Army personnel.

In this paper, the authors point out that eating a diet that meets energy needs and provides essential nutrients promotes a healthy immune system, while both under- and over-nutrition are associated with immune dysfunction. Military personnel constitute a unique population that frequently encounters a multistress environment, which predisposes them to lower immunity. In addition, 49% and 22% of active US military personnel are classified as overweight and obese, respectively.

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In this paper, the authors point out that eating a diet that meets energy needs and provides essential nutrients promotes a healthy immune system, while both under- and over-nutrition are associated with immune dysfunction. Military personnel constitute a unique population that frequently encounters a multi-stress environment, which predisposes them to lower immunity. In addition, 49% and 22% of active US military personnel are classified as overweight and obese, respectively. [34, 35, 36, 37, 38, 39]. Maintaining immune competence in military personnel is particularly important as acute respiratory infections are a problem in the training environment and can result in the loss of up to 27,000 training days and 3,000 bed days for recruits annually [40]. In 2021, respiratory infections resulted in 8,466 bed days for hospitalized military personnel [41]. Susceptibility to respiratory infections increases in response to stressors associated with military

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service, during periods of high physical activity, increased exercise intensity and insufficient sleep [42, 43].

The association between nutrient status and susceptibility to infection is relevant to military personnel who are at risk for micronutrient immune stimulatory deficiencies during training or deployment in austere environments [44, 45, 46]. During military operations, warfighters often encounter conditions that favor the spread of pathogens (e.g. crowded living quarters), as well as periods of prolonged exercise, sleep deprivation and psychological stress, combined with insufficient energy intake, which increases the risk of infection in these circumstances [47, 48].

Stress hormones and humoral and cellular immune responses (i.e., two major mechanisms of immunity with an adaptive immune system) to military training are associated with vulnerability to gastric disease [49]. During deployment, infection from new pathogens to which humans are immunologically immune raises concerns about the transfer and spread of disease to outside populations or community members [50]. In addition, the emergence of the highly contagious SARS-CoV-2 (COVID-19) virus has jeopardized the health, readiness and lethality of military personnel [51, 52, 53]. The term 'lethality' is used in place of "lethality" to reflect the military context, referring to the ability to destroy the [54]. Rapid spread of the virus in cramped living quarters and the impact of short sleep duration on rates of hospitalization due to COVID-19 have been reported among military personnel [55, 56].

Changes in adipose tissue in response to overnutrition additionally contribute to susceptibility to infections due to chronic low-grade inflammation associated with changes in cytokine and hormone signalling [57]. Trends in the prevalence of overweight and obesity are increasing among military personnel in the United States [58, 59] and other countries [60, 61]. Subsequent behaviour from occupational stressors may be associated with overweight and obesity among military personnel, compromising readiness for service. This review will examine the influence of stressors relevant to military occupational demands on nutrition-related factors that modulate immune responses.

Thus, the scientific papers we have studied, devoted to the study of the effect of nutrition on the health of servicemen in different climatic and operational conditions, in different armies of foreign countries, provide different opinions and conclusions:

A single intramuscular dose of testosterone undecanoate (750 mg) administered to physically active men before a 20-day simulated high-stress military operation increased circulating total and free testosterone concentrations within normal physiological ranges and maintained FFM. However, testosterone administration did not attenuate the decline in physical performance in several measures of power, strength, anaerobic or aerobic capacity;

The UK Army's basic unit of ORP is the recently introduced Multi-Climate Ration (MCR), which replaced the previous 24-hour General Purpose (GP) ration. According to the researchers, if all components of the MCR are consumed, it will provide an average (across all options) energy intake of 4,098 kcal, which includes 651g of carbohydrates, 130g of protein and 92g of fat;

Optimal intake of energy, protein and micronutrients is key, as both under- and over-nutrition are associated with adverse health outcomes and risk of infectious diseases in military personnel;

The military work environment and occupational requirements expose military personnel to a high risk of infection, while at the same time jeopardizing nutritional status by limiting adequate dietary intake in certain scenarios;
Obesity is prevalent among military personnel, so the impact of body weight and nutritional status on warfighters' immune health and susceptibility to infectious diseases requires further study. Such efforts will better inform policies and interventions that mitigate the risk of disease and transmission.

Conclusions

Having reviewed some of the scientific literature, it can be concluded that considering nutritional status and prioritising efforts to optimise nutrient intake is one approach to reducing the burden of disease and improving military readiness.

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