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The Role of Nutrition in Enhancing Physical Performance and Preventing Injuries in Military Activities: A Literature Review

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Abstract: This literature review examines the role of nutrition in enhancing physical performance and preventing injuries in military activities. Optimal physical fitness is crucial in military settings, where personnel are regularly exposed to extreme physical demands, including intense training, combat operations, and harsh environmental conditions. Proper nutrition plays a pivotal role in maintaining energy, enhancing muscle recovery, and preventing injuries. Key macronutrients—carbohydrates, proteins, and fats—are essential for sustaining endurance, repairing muscles, and providing steady energy, particularly during prolonged operations. Additionally, micronutrients like vitamins D, calcium, magnesium, and potassium support bone and muscle health, while antioxidants (e.g., vitamins C, E, and zinc) reduce inflammation and accelerate recovery. The review also highlights the significance of hydration and the need for personalized nutrition strategies tailored to the unique demands of military personnel. Studies emphasize that nutrition interventions not only optimize physical performance but also mitigate injury risks and improve recovery, especially in cases of traumatic injuries such as brain trauma. The review suggests that military-specific nutrition guidelines are necessary to enhance readiness and resilience in soldiers. Furthermore, targeted dietary supplementation may help prevent deficiencies and improve overall health. In conclusion, the review underscores the critical role of evidence-based nutrition strategies in maintaining the physical and mental well-being of military personnel, ultimately supporting long-term operational readiness. Further research is recommended to refine these strategies and their application in military contexts.

Keywords: Nutrition; Physical Performance; Injury Prevention; Military

Introduction

In the military context, optimal physical performance is crucial to meeting the challenges that require endurance, strength, and agility (Hajji et al., 2021; Nindl et al., 2018; Vaara et al., 2022). Intense physical training, extreme field conditions, and various high-risk missions demand that soldiers remain in peak condition at all times (Oktadinata et al., 2024; Saharullah et al., 2024). Therefore, a comprehensive approach to enhancing physical performance is essential, with one of the key factors being nutrition (Lasri et al., 2024). Proper nutrition not only supports physical performance enhancement but also plays a critical role in injury prevention, recovery after strenuous activity, and maintaining overall physical resilience in the face of various environmental and operational threats (Purwanto & Ockta, 2024).

The importance of nutrition in supporting physical activity has been widely recognized in sports and health fields (Budiman & Ockta, 2024). In the military context, where physical and mental stress is significantly higher, a deeper understanding of the relationship between nutrition and physical performance becomes an essential need that cannot be overlooked. Military personnel are often faced with situations requiring maximum physical strength, high endurance, and the ability to recover quickly after strenuous physical tasks. Therefore, choosing the right nutrition plays a vital role in their ability to face these challenges.

Several studies have shown that inadequate nutrition—whether in the form of macronutrients (carbohydrates, proteins, and fats) or micronutrients

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(vitamins and minerals)—can impair performance and increase the risk of injury (Russell et al., 2019). For example, a deficiency in carbohydrates can reduce endurance, while inadequate protein intake can hinder muscle recovery after intense training or physical tasks. Micronutrients like vitamin D, calcium, and magnesium also play a significant role in maintaining bone and muscle health, and their deficiency may lead to compromised physical performance and an increased risk of injury (Hughes et al., 2019). To help soldiers remain in optimal condition, it is crucial to understand how proper dietary patterns can support both performance and injury prevention. Therefore, research on the role of nutrition in enhancing physical performance and preventing injuries among military personnel needs to be further explored. Additionally, understanding how the body responds to intense physical training and how optimal recovery can be achieved through proper nutrition is vital for its application in military routines (Worth & Cave, 2018).

Proper nutrition helps the body maintain the energy reserves required during intense physical activity. Carbohydrates, for instance, are the primary source of energy for the body during intense military training or operations, stored as glycogen in the muscles and liver. When the body requires immediate energy, the carbohydrates consumed are converted into glucose, which is used by cells as a fuel source. Therefore, adequate carbohydrate intake is essential for maintaining physical performance, enhancing endurance, and speeding up recovery (Elbin et al., 2023). Protein also plays a critical role in muscle recovery and the repair of body tissues. After strenuous physical activity, the body undergoes microtears in muscle fibers. Protein aids in repairing this damage and encourages the growth of stronger muscle tissue. Sufficient protein intake for military personnel is vital to prevent excessive muscle fatigue and expedite recovery processes. Furthermore, fats are also an essential energy source, especially in situations where carbohydrate stores are depleted, such as during prolonged combat or extended physical training sessions.

Injury is a common risk in military activities due to the heavy training loads, uncomfortable equipment, and often challenging terrain. One factor that can help prevent injury is a balanced intake of nutrients. For example, deficiencies in calcium and vitamin D can increase the risk of bone fractures and musculoskeletal injuries (Givens et al., 2023). Vitamin D plays a crucial role in the absorption of calcium and in maintaining bone strength. Additionally, magnesium and potassium help maintain electrolyte balance in the body, supporting muscle function and preventing cramps, which could lead to injury. Studies also suggest that antioxidants found in food, such as vitamins C, E, and zinc, can help reduce inflammation after intense physical activity, thus accelerating muscle and tissue recovery. By strengthening the immune system through proper nutrition, soldiers can minimize the risk of infections or more serious injuries.

This literature review aims to explore the relationship between nutrition, physical performance, and injury prevention within the context of military activities. The review will cover various studies discussing the role of both macronutrients and micronutrients in supporting optimal physical performance, as well as how proper nutrition can help minimize the risk of injury and accelerate recovery. By doing so, this review seeks to provide deeper insights into the importance of proper dietary planning for military personnel and its practical implications for military training and operational readiness. Overall, the implementation of appropriate nutrition strategies in training and operational readiness programs for military personnel is critical to achieving optimal physical performance and preventing injuries. Therefore, a more comprehensive understanding of the role of nutrition in supporting physical activity and preventing injuries is expected to contribute positively to enhancing the competitiveness and safety of soldiers. This literature review will discuss various aspects of nutrition that support both performance and injury prevention, providing a foundation for the development of effective nutrition programs in military environment.

Method

This study uses a literature review to explore the role of nutrition in enhancing physical performance and preventing injuries in military activities. Articles were sourced from databases such as Scopus, PubMed, and Google Scholar, using keywords like "nutrition," "physical performance," "injury prevention," and "military.". The goal is to synthesize findings and offer evidence-based nutritional strategies to optimize performance and health while reducing injury risks. For more details, see the figure 1.

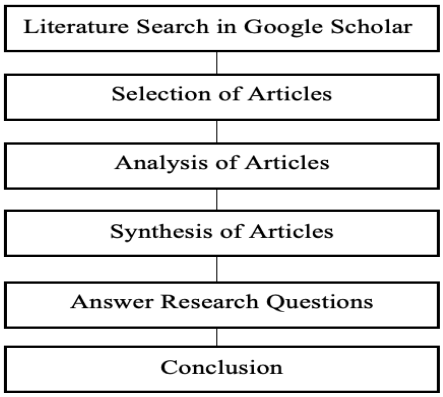

Figure 1. Research flowchart

Results and Discussion

The table below summarizes key findings from the literature review on the role of nutrition in enhancing

physical performance and preventing injuries in military activities. It includes the Author, Topic, and Results of various studies examining how different nutritional strategies impact endurance, strength, recovery, and injury prevention in military personnel. It offers valuable insights into effective nutrition practices, serving as a useful reference for military personnel, nutritionists, and trainers.

Table 1. Summary of Data Descriptions

Author	Topic	Results
(Howard et al., 2021)	Telomere shortening and accelerated aging in US military veterans.	The study found that individuals with prior military service had a mean telomere length of 5821.7 base pairs, which was 225.8 base pairs shorter than those without military service. After adjusting for demographic, socioeconomic, and behavioral variables, men with military service had a mean telomere length that was 47.2 base pairs shorter, while no significant difference was observed in women. The interaction between military service and race/ethnicity was not significant for either sex, suggesting that military service may contribute to accelerated aging due to health-damaging exposures.
(Gonzalez et al., 2022)	International society of sports nutrition position stand: tactical athlete nutrition.	The study emphasizes the need for tailored nutritional guidelines for tactical athletes, highlighting the importance of adequate fueling and hydration to enhance health and performance. It identifies gaps in current research and calls for further investigation into the specific dietary needs of these populations to optimize their readiness and reduce injury risks.
(Yu et al., 2019)	Reduced neuroinflammation and improved functional recovery after traumatic brain injury by prophylactic diet supplementation in mice.	The study found that prophylactic diets enriched with fruits and vegetables improved neuromotor function, reduced lesion volume, and decreased inflammation in mice after traumatic brain injury (TBI). These diets also increased neuronal density in the hippocampus, suggesting protective effects against TBI.
(Givens et al., 2023)	Characterization of Female US Marine Recruits: Workload, Caloric Expenditure, Fitness, Injury Rates, and Menstrual Cycle Disruption during Bootcamp.	The study revealed that female recruits expended an average of 3096 kcal daily and walked 11 miles, with 35% sustaining injuries during boot camp. Additionally, 85% of those not on birth control experienced menstrual cycle dysfunction, indicating significant health impacts from intense training.
(Elbin et al., 2023)	Targeted multidomain intervention for complex mTBI: protocol for a multisite randomized controlled trial in military-age civilians.	The study's results are not explicitly detailed in the provided contexts. However, it aims to determine the effectiveness of a targeted multidomain (T-MD) intervention compared to usual care for military-aged civilians with complex mTBI. The outcomes will be assessed through a randomized controlled trial design.

This literature review examines the role of nutrition in enhancing physical performance and preventing injuries within the context of military activities. As the studies reveal, optimal nutrition is vital for maintaining physical fitness, preventing injury, and ensuring long-term health in military personnel. This discussion highlights key findings from the reviewed studies and discusses their implications for military nutrition strategies.

The studies included in this review underline the importance of a tailored, comprehensive approach to nutrition in military settings. Military personnel often face highly demanding physical conditions, from intense training regimens to combat operations, which require sustained energy, muscle strength, endurance, and quick recovery. Therefore, a proper nutritional foundation is essential for maintaining peak physical performance and mitigating the risk of injury. One of the key findings from the literature is the significant relationship between nutrition and physical performance in military personnel. Gonzalez et al. (2022) emphasize the importance of fueling and hydration for tactical athletes, recognizing the unique demands faced by military personnel. The study calls for the development of nutritional guidelines specifically designed for these populations to improve readiness and minimize injury risks. In line with this, several studies have demonstrated the critical role of macronutrients—carbohydrates, proteins, and fats—in sustaining energy levels and promoting muscle recovery, all of which directly contribute to enhanced performance. Carbohydrates serve as the primary source of energy during high-intensity activities, ensuring that military personnel can sustain prolonged physical efforts. Proteins are essential for repairing muscle fibers damaged during strenuous physical activity, while fats provide a steady energy source for extended operations, particularly when carbohydrate stores are depleted.

The need for proper hydration is another crucial aspect that several studies have highlighted. Gonzalez et al. (2022) and Givens et al. (2023) underline the importance of maintaining adequate fluid intake to

support optimal performance and prevent dehydration, which can impair physical function and increase the risk of heat-related injuries. Soldiers working in extreme environmental conditions—such as hot or humid climates—are especially vulnerable to dehydration, which can severely impact physical performance and recovery. Ensuring proper hydration protocols alongside nutritional strategies can significantly enhance military readiness and prevent performance declines due to dehydration.

The reviewed studies also stress the role of macronutrients in preventing injuries. Proper nutrition helps the body maintain muscle strength and function, reducing the likelihood of overuse injuries, muscle fatigue, and joint problems. Howard et al. (2021) discuss the long-term impact of military service on veterans' health, showing that nutritional interventions could help mitigate some of the physiological wear and tear experienced during active duty. By addressing nutritional deficiencies and ensuring an adequate intake of key nutrients, the body's ability to cope with the physical stress of military activities is enhanced, thereby reducing the risk of injury. A particular focus of the studies is the role of micronutrients, including vitamins D, calcium, magnesium, and potassium, in maintaining bone and muscle health. Gonzalez et al. (2022) suggest that tactical athletes are at risk of developing bone stress fractures and musculoskeletal injuries if their intake of these critical micronutrients is insufficient. Vitamin D is essential for calcium absorption and bone mineralization, while magnesium and potassium help regulate muscle function, including contraction and relaxation, thereby reducing the likelihood of muscle cramps, strains, and other soft-tissue injuries. This is especially important for military personnel who are often engaged in high-impact activities and repetitive movements that can lead to overuse injuries.

Furthermore, antioxidants—such as vitamins C, E, and zinc—have been shown to play a crucial role in reducing inflammation and aiding muscle recovery. Studies suggest that post-exercise inflammation, if not managed properly, can lead to chronic injuries. Gonzalez et al. (2022) point out that adequate intake of antioxidants can help mitigate oxidative stress and muscle inflammation, which in turn supports faster recovery and reduces the chances of prolonged injury. Another critical aspect of nutrition in military personnel is its effect on recovery and cognitive function. The study by Yu et al. (2019) explores the impact of a prophylactic diet on recovery from traumatic brain injury (TBI), showing that diets rich in fruits and vegetables can significantly reduce neuroinflammation and improve functional recovery. Given the high incidence of TBIs in military environments, especially in combat situations, this finding highlights the potential of dietary interventions to not only support physical recovery but also enhance cognitive resilience. Nutrition rich in neuroprotective nutrients can help mitigate the long-term effects of brain injuries, improving both mental and physical recovery after traumatic events.

Moreover, Givens et al. (2023) discuss the specific challenges faced by female military recruits, who often experience menstrual cycle disruptions and a higher injury rate during intense training. The study suggests that addressing nutritional needs during such critical times, such as ensuring adequate iron intake to counteract the increased risk of anemia, could reduce menstrual dysfunction and improve physical endurance. Iron deficiency is a common concern among female soldiers, and its resolution through targeted nutritional interventions could contribute to overall better health outcomes and performance.

The findings from the studies reviewed have important implications for developing effective nutrition strategies for military personnel. First, it is clear that a personalized approach to nutrition is necessary. As Gonzalez et al. (2022) highlight, military personnel, especially those in tactical roles, have unique nutritional needs that differ from the general population. Tailored nutrition plans that consider individual energy expenditure, physical demands, and environmental conditions should be developed and implemented to optimize performance and prevent injuries. Additionally, the role of dietary supplementation cannot be overlooked. Given the high physical demands of military life, supplementation with specific nutrients like vitamin D, magnesium, and omega-3 fatty acids may help prevent nutrient deficiencies that could impair performance and increase the risk of injury. Further research is needed to identify the most effective supplementation strategies for military personnel, especially those deployed in extreme conditions where food sources may be limited. Finally, hydration protocols must be integrated into daily training and operational routines. Military operations often take place in harsh environments where dehydration is a significant risk. A strategic approach to hydration—considering not only water intake but also electrolyte balance—can prevent heat-related illnesses and ensure sustained performance during physically demanding tasks.

This literature review underscores the critical role that nutrition plays in supporting physical performance, preventing injuries, and promoting recovery among military personnel. The studies reviewed highlight the need for comprehensive, evidence-based nutrition strategies that address the specific demands of military training and operations. By optimizing nutrition, military personnel can enhance their physical capabilities, reduce the risk of injury, and maintain long-term health and readiness. As military environments evolve and the physical demands on soldiers increase, the development of personalized nutrition plans and hydration protocols will become increasingly important to ensuring the well-being and operational effectiveness of military forces worldwide.

Conclusion

This literature review highlights the essential role of nutrition in enhancing physical performance and preventing injuries in military activities. Proper intake of macronutrients and micronutrients, along with adequate hydration, is crucial for sustaining energy, supporting recovery, and reducing injury risks. Tailored nutritional strategies are needed to meet the specific demands of military personnel, ensuring optimal performance and long-term health. The findings emphasize the importance of personalized nutrition plans and highlight the need for continued research to develop effective dietary interventions that enhance military readiness and resilience in challenging environments.

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Author Contributions

Ahmadi conceptualized the study, provided overall direction, and supervised the research. He was responsible for drafting the introduction and conclusion sections of the manuscript. Willadi Rasyid contributed to the methodology, selecting relevant studies and databases, and conducted data analysis. He also played a key role in drafting the methodology section and contributed to the results and discussion. Wilda Welis assisted in the literature search and synthesis, focusing on the impact of nutrition on injury prevention and physical performance. She contributed significantly to the writing of the discussion and results sections. Aldo Naza Putra and Yovhandra Ockta supported the drafting of the results and discussion sections by summarizing key findings from the selected studies and contributed to the structuring and formatting of the final manuscript.

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Conflict of Interest

The content of this article does not create a conflict of interest.

References

Budiman, I. A., & Ockta, Y. (2024). Nutritional Strategies for Maintaining Optimal Hemoglobin Levels in Soccer Players : A Review of Health Implications. *Jurnal Penelitian Pendidikan IPA*, *10*(8), 580–587. https://doi.org/10.29303/jppipa.v10i8.9103

Elbin, R. J., Trbovich, A., Womble, M. N., Mucha, A., Fedor, S., Stephenson, K., Holland, C., Dollar, C., Sparto, P., Durfee, K., Patterson, C. G., Smith, C. N., Huppert, T. J., Okonkwo, D. O., Collins, M. W., & Kontos, A. P. (2023). Targeted multidomain intervention for complex mTBI: protocol for a multisite randomized controlled trial in military-age civilians. *Frontiers in Neurology*, *14*(June), 1–9. https://doi.org/10.3389/fneur.2023.1085662

Givens, A. C., Bernards, J. R., & Kelly, K. R. (2023). Characterization of Female US Marine Recruits: Workload, Caloric Expenditure, Fitness, Injury Rates, and Menstrual Cycle Disruption during Bootcamp. *Nutrients*, *15*(7). https://doi.org/10.3390/nu15071639

Gonzalez, D. E., McAllister, M. J., Waldman, H. S., Ferrando, A. A., Joyce, J., Barringer, N. D., Dawes, J. J., Kieffer, A. J., Harvey, T., Kerksick, C. M., Stout, J. R., Ziegenfuss, T. N., Zapp, A., Tartar, J. L., Heileson, J. L., VanDusseldorp, T. A., Kalman, D. S., Campbell, B. I., Antonio, J., & Kreider, R. B. (2022). International society of sports nutrition position stand: tactical athlete nutrition. *Journal of the International Society of Sports Nutrition*, *19*(1), 267–315. https://doi.org/10.1080/15502783.2022.2086017

Hajji, J., Bettayeb, A., Fekih, S., Guerchi, M., Bragazzi, N., Azaiez, F., & Elloumi, A. (2021). The Coping Strategies Used by Young Tunisian Athletes in Individual and Collective Sports. *Psychiatry International*, *2*(3), 277–286. https://doi.org/10.3390/psychiatryint2030021

Howard, J. T., Janak, J. C., Santos-Lozada, A. R., McEvilla, S., Ansley, S. D., Walker, L. E., Spiro, A., & Stewart, I. J. (2021). Telomere shortening and accelerated aging in US military veterans. *International Journal of Environmental Research and Public Health*, *18*(4), 1–13. https://doi.org/10.3390/ijerph18041743

Hughes, J. M., Foulis, S. A., Taylor, K. M., Guerriere, K. I., Walker, L. A., Hand, A. F., Popp, K. L., Gaffney-Stomberg, E., Heaton, K. J., Sharp, M. A., Grier, T. L., Hauret, K. G., Jones, B. H., Bouxsein, M. L., McClung, J. P., Matheny, R. W., & Proctor, S. P. (2019). A prospective field study of U.S. Army trainees to identify the physiological bases and key factors influencing musculoskeletal injuries: A study protocol. *BMC Musculoskeletal Disorders*, *20*(1), 1–7. https://doi.org/10.1186/s12891-019-2634-9

Lasri, R. R., Sin, T. H., Welis, W., Handayani, S. G., & Raibowo, S. (2024). Nutritional Status and Gross Motor Skills : Study of children in coastal areas. *Jurnal Penelitian Pendidikan IPA*, *10*, 546–551. https://doi.org/10.29303/jppipa.v10iSpecialIssue.8660

Nindl, B. C., Billing, D. C., Drain, J. R., Beckner, M. E., Greeves, J., Groeller, H., Teien, H. K., Marcora, S., Moffitt, A., Reilly, T., Taylor, N. A. S., Young, A. J., & Friedl, K. E. (2018). Perspectives on resilience for military readiness and preparedness: Report of an

international military physiology roundtable. *Journal of Science and Medicine in Sport*, *21*(11), 1116–1124. https://doi.org/10.1016/j.jsams.2018.05.005

Oktadinata, A., Prabowo, B. Y., Daya, W. J., Diana, F., Nugraha, U., Melinda, & Ockta, Y. (2024). Motivation And Physical Activity: Correlation Study On Extracurricular Sports Of High School Students. *Journal of Education, Teaching, and Learning*, *9*(1), 25–39.

Purwanto, S., & Ockta, Y. (2024). Sports Nutrition and Gross Motor Skill Development in Youth Athletes : A Literature Review. *Jurnal Penelitian Pendidikan IPA*, *10*(8), 572–579. https://doi.org/10.29303/jppipa.v10i8.8991

Russell, D. W., Kazman, J., & Russell, C. A. (2019). Body Composition and Physical Fitness Tests Among US Army Soldiers: A Comparison of the Active and Reserve Components. *Public Health Reports*, *134*(5), 502–513. https://doi.org/10.1177/0033354919867069

Saharullah, Wahyudin, Idrus, N. A., & Ockta, Y. (2024). Application of combination of physical training methods to improve the aerobic capacity of football players. *Sport TK*, *13*, 1–8. https://doi.org/10.6018/sportk.637341

Vaara, J. P., Groeller, H., Drain, J., Kyröläinen, H., Pihlainen, K., Ojanen, T., Connaboy, C., Santtila, M., Agostinelli, P., & Nindl, B. C. (2022). Physical training considerations for optimizing performance in essential military tasks. *European Journal of Sport Science*, *22*(1), 43–57. https://doi.org/10.1080/17461391.2021.1930193

Worth, A. J., & Cave, N. J. (2018). A veterinary perspective on preventing injuries and other problems that shorten the life of working dogs. *Revue Scientifique et Technique (International Office of Epizootics)*, *37*(1), 161–169. https://doi.org/10.20506/rst.37.1.2749

Yu, J., Zhu, H., Taheri, S., Monday, W., Perry, S., & Kindy, M. S. (2019). Reduced neuroinflammation and improved functional recovery after traumatic brain injury by prophylactic diet supplementation in mice. *Nutrients*, *11*(2). https://doi.org/10.3390/nu11020299