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Topic: Elucidate the Effect of High-Altitude Hypoxia on Vitamin D and associated Molecules and its Relation to Hypoxia-Induced Thrombosis.

Findings

This study offers a comprehensive assessment of the interplay between high-altitude exposure and vitamin D status, incorporating physiological, genetic, and lifestyle dimensions among high-altitude natives (HNs) and lowlanders (LLs) in Ladakh. The major findings are summarized below:

Prevalence of Vitamin D Deficiency

A high prevalence of vitamin D deficiency was observed in both HNs and LLs, with LLs showing a significantly greater deficiency rate. The lower median serum 25(OH)D levels in LLs compared to HNs indicate a possible adaptive physiological mechanism in long-term high-altitude residents that helps maintain higher vitamin D levels despite environmental limitations.

Influence of Age and Gender

Among HNs, vitamin D levels increased with age and were generally higher in males. Conversely, LLs exhibited higher vitamin D levels predominantly in middle-aged individuals and females. These patterns suggest a population-specific variation influenced by demographic factors, indicating the need for age- and gender-tailored strategies to combat deficiency.

Role of Lifestyle Factors

Behavioral factors such as smoking and alcohol consumption demonstrated varied effects on vitamin D levels across groups. These findings underscore the importance of integrating behavioral health considerations when planning interventions to improve vitamin D status, especially in populations with diverse cultural practices.

Genetic Associations

Significant associations were found between polymorphisms in the vitamin D binding protein (DBP) gene—particularly rs4588 and rs7041—and both vitamin D and DBP levels. HNs showed higher 25(OH)D and DBP levels, along with distinct allele and genotype distributions compared to LLs. These genetic differences suggest that genotype-specific approaches may enhance the efficacy of vitamin D supplementation strategies in high-altitude populations.

Hematological and Biochemical Differences

Marked differences in hematological and biochemical parameters were noted between LLs and HNs. LLs exhibited elevated white blood cell counts and platelet indices, while HNs demonstrated variations in red blood cell indices and metabolic parameters. These findings reflect complex systemic adaptations required for high-altitude acclimatization.

Vitamin D and Systemic Physiology

Vitamin D levels were significantly associated with several hematological and biochemical markers, including those related to liver and kidney function. These associations support the pleiotropic role of vitamin D beyond calcium and bone metabolism, emphasizing its relevance in systemic health maintenance.

Thrombosis Risk and Vitamin D Deficiency

Thrombotic patients residing at high altitude were found to have significantly lower vitamin D levels alongside elevated inflammatory and coagulation markers. Additionally, upregulation of NLRP3 inflammasome-associated molecules was observed in these individuals, suggesting a potential mechanistic link between vitamin D deficiency and increased thrombosis risk in hypoxic environments.