Zinc, Bone Health and Skeletal Adaptation in Sport: A Neglected Nutrient with Persistent Evidence Gaps?

Zinc is an essential trace mineral involved in numerous physiological processes relevant to sport and exercise, yet it receives comparatively little attention relative to nutrients such as protein, calcium, vitamin D and iron. As a component or regulator of enzymes and cellular pathways, zinc contributes to cellular growth, protein synthesis, tissue repair, immune function and bone metabolism. Despite these important biological roles, the relevance of zinc to athlete health, skeletal adaptation and performance remains incompletely understood. This presentation will examine the current evidence surrounding zinc in sport and exercise, with a particular focus upon bone health and skeletal adaptation. Bone is a dynamic tissue that continuously remodels in response to mechanical loading, nutritional status and hormonal influences. Zinc has been shown to play a role in osteoblast function, collagen synthesis and mineralisation, with experimental studies suggesting that zinc availability may influence pathways involved in bone formation and turnover. Observational studies in non–athletic populations have reported associations between inadequate zinc intake or status and poorer measures of bone health. The extent to which these findings translate to physically active populations remains unclear, however, and direct evidence linking zinc status with skeletal adaptation to training is limited. The potential importance of zinc may be greatest in athletes exposed to prolonged periods of high training load or dietary restriction. Such circumstances may reduce overall micronutrient intake and increase the risk of nutritional inadequacies. The prevalence of suboptimal zinc status in athletic populations is uncertain, however, largely because the assessment of zinc status remains a significant challenge. Commonly used biomarkers, including plasma and serum zinc concentrations, are influenced by factors such as recent food intake, inflammation, hydration status and exercise, limiting their utility for the identification of marginal deficiency. Beyond bone health, zinc has been implicated in processes relevant to exercise recovery and adaptation, including protein turnover, antioxidant defence and the regulation of inflammatory responses. While these mechanisms provide biological plausibility for a role in training adaptation, evidence from athlete–focused intervention studies remains limited. Consequently, there is insufficient evidence to determine whether zinc supplementation provides meaningful benefits for performance, recovery or adaptation in individuals who are not deficient. This presentation will critically evaluate the available evidence linking zinc with bone metabolism, athlete health and exercise adaptation, while considering practical implications for dietary assessment and nutritional practice. Attention will be given to the challenges of identifying inadequate zinc status and determining who may benefit most from intervention. The session will conclude by highlighting key research priorities, including the need for well–designed

prospective studies investigating relationships between zinc nutrition, bone health and responses to training. Overall, zinc represents a neglected nutrient within sport and exercise science that is biologically important and mechanistically intriguing yet characterised by substantial uncertainty regarding its direct relevance for athlete outcomes and the effectiveness of nutritional strategies.