Low energy availability (LEA) and bone health

For those involved in strenuous training programmes, it is often difficult to match dietary energy intake to exercise energy expenditure. The consequences of failing to do so, particularly if occurring consistently over time, could be quite severe for bone health, something that has been documented in clinical populations, particularly in those with anorexia nervosa or other eating disorders, where altered bone metabolism, low bone mineral density and increased fracture risk have been reported. In athletic populations, the potential negative bone health outcomes arising from LEA have been described by the Female and Male Athlete Triads and the Relative Energy Deficiency in Sport models. Research attempting to examine how LEA directly influences bone has tended to examine changes in bone (re)modelling marker concentrations either acutely or over periods of LEA lasting between 3 and 5 days. These studies have generally shown that LEA reduces the circulating concentrations of markers of bone formation, with a more severe LEA also increasing the circulating concentrations of bone resorption markers. Although these short term studies tend to support an effect of LEA on bone, it is hard to determine how important this might be for longer-term bone health, given that the effects are relatively small and transient and it is unclear whether changes in these markers can predict longer-term alternations to bone mass, microarchitecture or bone stress injury risk in athletes. The evidence relating to the effects of LEA on bone outcomes in athletes largely comes from cross-sectional studies. Whilst cross-sectional studies can be useful in the generation of hypotheses and in informing further study designs, the major issue is that they cannot establish a cause-and-effect relationship or provide information on how outcomes and behaviours might change over time. As such, the evidence base relating to the effects of LEA on bone health might not be as clear as one might imagine, especially given the difficulties in a) measuring energy availability, b) determining the bone health of athletes, c) isolating effects of LEA from other factors (i.e., exercise factors, nutrient availability, sleep, illness), and d) determining the extent to which short-term periods of LEA and adaptations to bone relate to longer-term problems for bone health. This talk will discuss where information might point towards an effect of LEA on bone and where the evidence might be lacking, which will then underpin some thoughts around future research directions.