Fueling Performance Starts with Sleep

Joanna Fong-Isariyawongse, MD and
Kim Schwabenbauer, DHSc, MS, RD, CSSD

Athletes at all levels, including recreational, collegiate and professional, are susceptible to sleep deprivation due to demanding training schedules, frequent travel, psychological stress and daily obligations. These pressures are well documented to reduce sleep quality and duration, with known consequences for performance and injury risk.[1,2,3]

Appetite Hormone Dysregulation

Sleep plays a critical role in maintaining hormonal balance, particularly in the regulation of appetite. Sleep restriction consistently leads to an increase in ghrelin, a hunger-stimulating hormone produced by the stomach, and a decrease in leptin, a satiety hormone released from adipose tissue.[4,5] This hormonal shift promotes increased appetite and reduces post-meal satisfaction.[6]

Studies have shown that even short-term sleep restriction, such as one or two nights of insufficient sleep, can significantly raise ghrelin levels and lower leptin concentrations. This hormonal imbalance increases hunger and drives a stronger preference for calorie-dense foods.[4,5,6] These endocrine changes often emerge after just one night of restricted sleep and tend to worsen with ongoing sleep debt.[5]

Recent findings further support the rapid onset of these effects, with changes in hormone levels occurring by the following morning after sleep deprivation.[7,8] The American Heart Association has identified this disruption in appetite-regulating hormones as a key mechanism linking short sleep duration to increased energy intake and obesity risk.[9]

Altered Neural Reward Processing

Beyond hormonal disruptions, sleep deprivation also alters brain function in ways that increase vulnerability to poor dietary decisions. Neuroimaging research shows that sleep loss significantly impacts brain regions involved in both reward processing and self-regulation. Specifically, it heightens activation in the amygdala and nucleus accumbens, centers that process hedonic and motivational responses to food, while dampening activity in the prefrontal cortex, which is responsible for impulse control and decision-making.[10,11,12,13,14]

Additional evidence confirms that these changes can occur after just one night of restricted sleep.[12] Partial sleep deprivation has been associated with increased activation in both the nucleus accumbens and prefrontal cortex in response to food stimuli, reinforcing the link between sleep loss and heightened food cue reactivity.[13] Over time, chronic sleep restriction appears to intensify these effects, boosting the motivational value of calorie-dense foods and weakening the brain's cognitive control systems.

Following sleep restriction, individuals exhibit greater responsiveness to high-calorie food cues and a reduced ability to resist them. In research studies, participants rated high-calorie foods as more desirable after sleep deprivation, regardless of hunger, due to amplified reward center activity and diminished prefrontal inhibition.[10,12] These neural shifts make energy-dense foods more tempting and harder to resist.

Collectively, these alterations in neural processing bias athletes toward immediate gratification. As a result, it becomes more difficult to follow structured nutrition plans or achieve optimal body composition.

Impaired Glucose Metabolism

Short sleep duration has a well-documented negative impact on glucose metabolism and insulin sensitivity. Even brief periods of sleep restriction, such as 4–5 hours per night, can impair the body's ability to regulate blood sugar. Studies have shown that insufficient sleep reduces whole-body glucose uptake and slows glucose clearance, leading to elevated blood glucose levels and increased fat storage.

In the athletic population, such impairments could have important performance consequences. Disrupted glucose metabolism may reduce carbohydrate availability for contracting muscles, delay post-exercise recovery and hinder training adaptations. As a result, ensuring adequate and high-quality sleep should be considered a foundational strategy for metabolic health and performance.

For athletes, carbohydrates remain the primary fuel source, particularly during moderate- to high-intensity training. The American College of Sports Medicine emphasizes that carbohydrate intake should be individualized and periodized according to training demands—even in the context of sleep loss.[15,16] There is no evidence supporting routine carbohydrate restriction in sleep-deprived athletes. Instead, practitioners should focus on optimizing sleep quality while maintaining carbohydrate timing, quality and quantity to support performance and recovery.

Elevated Cortisol and Fat Accumulation

Sleep deprivation is closely linked to elevated secretion of cortisol, and elevated cortisol has multiple metabolic consequences. It promotes fat storage, particularly in the abdominal region, and interferes with muscle protein synthesis and energy regulation[17]. Chronically elevated cortisol contributes to visceral fat accumulation and reduced insulin sensitivity. Supporting this, data have shown a causal relationship between higher cortisol levels and reduced muscle strength and lean body mass, reinforcing its role in catabolic processes and muscle protein breakdown.[18,19]

Among athletes, persistently high cortisol levels can hinder recovery, slow lean mass development and increase the risk of injury. The American College of Sports Medicine and the American Medical Society for Sports Medicine have reported that chronic cortisol elevation, particularly in the context of overtraining, is associated with lower testosterone-to-cortisol ratios, diminished anabolic signaling and impaired musculoskeletal repair.[2] Sleep debt may further exacerbate injury risk by increasing catabolic activity and weakening tissue integrity.[20] Long-term cortisol elevation has also been observed in endurance athletes and is linked to adverse outcomes such as muscle loss and impaired recovery.[21]

Summary

Sleep is a critical regulator of the hormonal, metabolic and cognitive systems that shape nutritional outcomes and athletic performance. When sleep is insufficient, athletes experience disruptions in appetite-regulating hormones, stronger cravings for high-calorie foods, impaired glucose metabolism and elevated cortisol levels. These changes can undermine nutritional strategies, limit training adaptations and increase the risk of injury. Therefore, optimizing sleep should be considered a foundational pillar, alongside nutrition and training, for achieving peak performance and long-term athletic success.

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