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ENERGY DRINKS: ENERGY BOOSTER OR LIFETIME REDUCER

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Energy drink consumption has increased sharply in recent years. Despite widespread marketing portraying these beverages as beneficial, many consumers remain unaware of the risks associated with their key ingredients. This report examines the physiological effects of caffeine, taurine, and L-carnitine, and evaluates both the short-term benefits and the health risks of excessive consumption.

When consumed in moderate amounts, caffeine increases concentration, reduces reaction time, increased physical performance, temporary mood improvement. Paraxanthine, the primary hepatic metabolite of caffeine, accounts for approximately 70% of caffeine's metabolic products (Jäger et al., 2024). It has a shorter half-life than caffeine and is cleared more rapidly. Paraxanthine inhibits phosphodiesterase 9 (PDE9), thereby potentiating nitric oxide neurotransmission and enhancing cognition and memory. It also elevates brain-derived neurotrophic factor (BDNF), supporting neuroplasticity (Yoo et al., 2024). Compared to caffeine, it is associated with fewer anxiogenic effects and a reduced post-stimulant decline in alertness. Taurine and L-carnitine support metabolic activity and energy production (Constantino et al., 2023).

Excessive caffeine intake can lead to physiological dependence, cardiovascular strain, blood glucose instability, sleep disturbance, anxiety, and in extreme cases, seizures (Nadeem et al., 2020). Energy drinks elevations in blood pressure and heart rate that pose particular risk to individuals with pre-existing cardiac conditions (Vargiu et al., 2021). High doses of taurine and L-carnitine may cause gastrointestinal disturbances, renal strain. Adverse effects are potentiated when caffeine co-occurs with taurine or L-carnitine at elevated concentrations. Caffeine, as a non-selective adenosine receptor antagonist, may also affect bone metabolism: antagonism of A2A/A28 receptors can inhibit osteoblast activity and promote osteoclastic resorption, though the net effect is dose-dependent and receptor-subtype-specific. Caffeine effects on the bone through derangement of calcium metabolism, alteration of vitamin D responses (Berman et al., 2022). Notably, a 2025 study in young adults found that even low-frequency energy drink consumption was associated with poorer bone tissue quality compared to non-consumers (Sulis et al., 2025). Many energy drinks contain high amounts of sugar, which contributes to weight gain, dental problems, and significantly increases the risk of developing type 2 diabetes and metabolic syndrome over time.

In conclusion, energy drinks provide a temporary increase in alertness and physical endurance; however, their regular or excessive use carries significant physiological risks, particularly for adolescents whose nervous systems are still maturing. Reducing intake, maintaining adequate hydration, sufficient sleep, physical activity, and a balanced diet are recommended strategies for mitigating dependence and protecting long-term health.