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Commentary on toxicological and pro-arrhythmic risks of high-caffeine beverages

Anna Vittoria Mattioli

University of Bologna – Alma Mater Studiorum, Department of Quality of Life Sciences, Bologna, Italy

Dear Editor,

I am writing in reference to your recently published article "What is more common in fatal caffeine intoxication – suicide or unintentional overdose?" (1) to discuss the toxicological and cardiovascular risks associated with the consumption of energy drinks, their potential to induce arrhythmia in particular. The mini-review referred to above underscores the dangers of excessive caffeine consumption but also highlights a broader public health issue: the underestimation of risks posed by energy drinks, especially in vulnerable populations. This issue warrants urgent attention due to their growing prevalence and serious health implications.

Energy drinks are frequently marketed as performance enhancers and cognitive boosters, appealing to adolescents, athletes, and overworked professionals. These beverages typically contain high concentrations of caffeine, often in combination with other stimulants like taurine, guarana, and ginseng (2–4). This combination creates a potent synergy, amplifying caffeine's physiological effects and leading to toxic outcomes even at doses that might otherwise be considered moderate. Common symptoms of overconsumption include tachycardia, hypertension, and arrhythmia, which can progress to life-threatening conditions such as ventricular fibrillation and sudden cardiac death (5–7).

The mechanisms underlying these effects are multifactorial (8, 9). Caffeine acts as an adenosine receptor antagonist, blocking the relaxing effects of adenosine and increasing intracellular calcium levels in myocardial cells. This mechanism heightens myocardial excitability and can lead to arrhythmia. In turn, taurine and guarana, which are common components of energy drinks, have stimulatory properties that may boost caffeine's effects on the cardiovascular system (10), especially in individuals exposed to dehydration, physical exertion, or suffering from underlying cardiac conditions.

Another critical factor are differences in caffeine metabolism among individuals, whose speed is greatly influenced by their genetic setup and liver enzyme activity. People with slower caffeine metabolism, such as children and some adults, are particularly vulnerable to its toxic effects even at lower doses. In addition, high-energy drink consumption often coincides with risky behaviours such as alcohol consumption or intense physical activity, which further increases the likelihood of adverse cardiovascular outcomes.

Given the widespread availability and aggressive marketing of energy drinks, especially among younger population, regulatory interventions are imperative. These beverages are often perceived as harmless, because they are available on supermarket shelves and associated with athletic performance and productivity. This underestimation is further encouraged by the absence of standardised labels specifying caffeine content and the absence of clear warnings about potential health risks.

Regulatory measures should include limiting caffeine content in energy drinks, mandatory labelling that clearly states stimulant levels, and age restrictions for consumption. Public education campaigns are also crucial to increase the awareness of health risks associated with excessive caffeine consumption, particularly from energy drinks. Healthcare providers should actively screen for energy drink consumption during patient evaluations, especially in those presenting with cardiovascular symptoms.

I commend the authors for shedding light on the fatal consequences of caffeine poisoning and support further research to explore the cardiovascular implications of energy drink consumption. Addressing these risks through both clinical awareness and policy changes is crucial to safeguarding public health.

Conflict of interests

None to declare.

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Corresponding author: Anna Vittoria Mattioli, University of Bologna – Alma Mater Studiorum, Department of Quality of Life Sciences, Via Irnerio 48, 40126 Bologna, Italy, E-mail: annavittoria.mattioli@unibo.it, ORCID: 0000-0003-1487-9530

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