



Advocating for Dietary Supplements as a Form of Neuromodulation in ADHD Management

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Opinion

Attention-Deficit/Hyperactivity Disorder (ADHD) is a neurodevelopmental condition characterized by persistent patterns of inattention, hyperactivity, and impulsivity that interfere with daily functioning. Affecting approximately 7% of children and persisting into adulthood for many, ADHD often involves imbalances in neurotransmitters like dopamine and norepinephrine. While traditional treatments such as stimulant medications and behavioral therapy remain staples, their side effects and limitations have spurred exploration into natural alternatives. Dietary supplements, including mushroom-based ones like lion's mane (*Hericium erinaceus*), reishi (*Ganoderma lucidum*), and turkey tail (*Trametes versicolor*), along with adjunctive brain foods such as omega-3 fatty acids, zinc, iron, magnesium, and B vitamins, have shown promising avenues. These supplements can influence neural activity, supporting the argument that they qualify as a form of neuromodulation for ADHD behavior change.

This essay advocates for recognizing dietary supplements as neuromodulation by examining broad definitions of the term, the mechanisms through which these supplements alter brain function, and emerging evidence of their efficacy in ADHD. Drawing from scientific literature, it posits that systemic chemical interventions like supplements fit within neuromodulation's expansive scope, challenging narrower views limited to devices or invasive methods. This perspective could expand research, regulatory frameworks, and clinical practices, positioning supplements as accessible, low-risk neuromodulatory tools.

Neuromodulation encompasses the alteration of neural activity to treat neurological or psychiatric conditions, broadly defined as the process by which neurons regulate others via chemical

messengers or therapeutic stimuli like electrical, magnetic, or chemical agents [3]. The International Neuromodulation Society defines therapeutic neuromodulation as “the alteration of nerve activity through targeted delivery of a stimulus, such as electrical stimulation or chemical agents, to specific neurological sites in the body” [4]. However, broader interpretations include any modulation of neural pathways, neurotransmitter release, or synaptic plasticity, even through systemic means [10]. This inclusive view supports classifying dietary supplements as chemical neuromodulators, as they deliver bioactive compounds that influence brain chemistry indirectly but effectively.

While examples like Deep Brain Stimulation (DBS) or Transcranial Magnetic Stimulation (TMS) represent precise, device-based neuromodulation—targeting areas like the subthalamic nucleus for Parkinson's or the prefrontal cortex for depression—chemical approaches via supplements align with the field's evolution. Supplements provide reversible, adjustable modulation without invasion, akin to pharmaceutical neuromodulation but with natural origins. Standard practice may prioritize technological methods, yet expanding to include dietary interventions democratizes access, especially for ADHD where neurotransmitter imbalances are key.

Mushroom supplements exemplify this neuromodulatory potential through bioactive compounds that directly impact brain function. Lion's mane promotes Nerve Growth Factor (NGF) production, fostering neuron repair and synaptic plasticity to enhance memory, focus, and cognitive speed—critical for ADHD [6,11]. A pilot study found that a single dose improved speed of performance on the Stroop task, with a trend toward reduced subjective stress after 28 days [2]. Another randomized trial

showed significant cognitive improvements, including prevention of deterioration on the Mini-Mental State Examination (MMSE), after 12 weeks of oral intake [9]. Reishi's polysaccharides modulate neurotransmitters, reducing anxiety and inflammation to indirectly support ADHD management. Turkey tail, with beta-glucans and antioxidants, combats oxidative stress, enhances neuroprotection, and bolsters the gut-brain axis, improving mood and clarity in ways that address ADHD comorbidities [1]. Combined, these mushrooms influence dopamine precursors and neural pathways systemically, qualifying as chemical neuromodulation under broad definitions.

Evidence from ADHD studies strengthens this argument. Rodent models show lion's mane enhancing working memory in ADHD-like states, while human trials demonstrate improvements in memory, reaction time, and stress reduction [2,9]. Turkey tail's mood benefits further suggest neuromodulatory effects on emotional regulation. Though large RCTs are needed, preliminary data indicate behavioral changes via neural modulation.

Adjunctive brain food supplements reinforce this neuromodulation framework, addressing deficiencies that exacerbate ADHD. Omega-3s (EPA/DHA) enhance brain membrane function, improving attention and reducing hyperactivity through neurotransmitter modulation, with meta-analyses showing modest but significant benefits, particularly in longer-term supplementation [7,8]. Zinc curbs impulsivity, iron optimizes dopamine synthesis, magnesium promotes relaxation, and B vitamins boost energy and focus. A randomized clinical trial demonstrated that broad-spectrum micronutrient supplementation led to greater global improvements in ADHD symptoms compared to placebo [5]. These act as chemical neuromodulators, supporting synaptic health and neural signaling when used adjunctively.

Analogies from other fields bolster this advocacy. In eating disorders, neuromodulation like TMS induces neuroplasticity, but nutritional therapies are increasingly integrated as complementary modulators. For obesity, orexin modulation via diet highlights supplements' neuromodulatory role. In ADHD, reviews show omega-3s and micronutrients improving symptoms, with herbal options like *Bacopa monnieri* reducing inattention—evidence of neuromodulation through nutrition.

In conclusion, dietary supplements like lion's mane, reishi, turkey tail, and brain foods such as omega-3s and zinc should be recognized as neuromodulation for ADHD, given their ability to modulate neural mechanisms—promoting NGF, reducing inflammation, and optimizing neurotransmitters. Though systemic, they align with chemical neuromodulation's broad definitions, offering safe, adjunctive benefits [3,10]. Future RCTs with

neuroimaging could solidify this, but current evidence advocates for their inclusion, enhancing ADHD treatment accessibility.

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Conflict of Interest

None.

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