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Effects of Different Stress States on Athletes' Cognitive Function and the Underlying Neural Mechanisms

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INTRODUCTION & AIM

Athletes often face acute, chronic, or extreme stress that activates the sympathetic nervous system–hypothalamic–pituitary–adrenal axis and elevates cortisol and catecholamines. Short bursts may aid arousal, but prolonged activation undermines dorsolateral prefrontal cortex (DLPFC)-mediated attention, working memory, and executive control. Precisely how each stress type affects cognition and its neural basis remains unclear. To synthesise evidence (2000-2025) on how different stress states affect athletes' cognitive performance and to outline the associated neural mechanisms.

METHOD

Following PRISMA, we searched CNKI, PubMed, Web of Science, SPORTDiscus, and PsycINFO (Feb 2000-Feb 2025). Keywords combined "stress", "athletes", "cognitive/executive function", and "neural mechanism". From 1,253 hits, 46 studies met inclusion criteria (athlete sample; stress manipulation; cognitive or neural outcomes) and were qualitatively synthesised.

RESULTS & DISCUSSION

1) Acute stress impairs attentional allocation and decision speed in combative/team sports, increasing critical-moment errors; 2) fine-skill athletes (e.g., gymnastics, shooting) show reduced motor precision under acute stress; 3) chronic stress in endurance athletes slows processing and reaction times and heightens cognitive fatigue; 4) working memory and attentional control prove most vulnerable, with marked capacity loss in high-pressure settings; 5) High acute stress disrupts sustained attention, causing lapses; 6) prolonged chronic stress erodes executive functions—planning, flexibility—and raises impulsivity; 7) stress lowers response inhibition, increasing interference errors; 8) imaging: acute stress down-regulates DLPFC and up-regulates amygdala/anterior cingulate cortex activity; 9) Neurochemistry: elevated cortisol, norepinephrine, and dopamine weaken prefrontal control; 10) electroencephalography: diminished P300 amplitudes indicate reduced attentional resources; 11) psychological interventions (mindfulness, cognitive restructuring) ease anxiety and bolster attention/flexibility; 12) physiological techniques (breathing drills, progressive muscle relaxation) reduce heart rate and cortisol, improving adaptation; 13) transcranial direct current stimulation shows promise for restoring attentional control and decision-making under stress.

CONCLUSION

Stress-related neuroendocrine shifts weaken prefrontal control, eroding athletes' attention, working memory, and executive skills. Future studies should track long-term and individual effects and develop targeted, multi-modal countermeasures.

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