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PARACETAMOL INGESTION AND ITS INFLUENCE ON EXERCISE PERFORMANCE: A META-ANALYSIS OF RANDOMIZED CONTROLLED TRIAL

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ABSTRACT

Paracetamol, a widely used analgesic, has garnered attention for its potential role in modulating exercise performance. Despite its established efficacy in pain relief, its ergogenic effects remain unclear, with conflicting evidence across various exercise modalities. The influence of paracetamol on performance markers, particularly in aerobic and anaerobic domains, is not fully understood. This meta-analysis aims to systematically assess the effects of paracetamol ingestion on exercise performance, with a specific focus on distinguishing its impact across different exercise types and intensities. A comprehensive literature search was conducted across multiple electronic databases, including PubMed, Web of Science, Cinahl, and SPORTDiscus, up to October 2022. Studies were selected based on predefined inclusion criteria, focusing on randomized controlled trials (RCTs) assessing paracetamol's effects on aerobic and anaerobic exercise outcomes. Mean differences were pooled using fixed- or random-effects models, depending on heterogeneity levels, and subgroup analyses were performed to evaluate the moderating effects of exercise type and intensity. A total of 18 studies involving 231 participants met the eligibility criteria and were included in the meta-analysis. The pooled data revealed a trending but non-significant enhancement in overall exercise performance following paracetamol ingestion (SMD = 0.12; 95% CI: -0.01, 0.26; p = 0.07). Subgroup analysis suggested a more pronounced, though still non-significant, effect in aerobic endurance tasks (SMD = 0.12; 95% CI: -0.07, 0.28; p = 0.23) compared to anaerobic activities (SMD = 0.15; 95% CI: -0.06, 0.37; p = 0.17). Notably, paracetamol appeared more effective in moderate-intensity exercise conditions, while high-intensity tasks exhibited minimal improvements. The findings suggest that the analgesic properties of paracetamol may reduce perceived exertion and delay fatigue, particularly in endurance-based activities. However, no significant impact was observed on maximal oxygen uptake ($V\dot{O}_{2max}$). While paracetamol ingestion exhibits potential as an ergogenic aid, particularly in endurance-based exercise, the evidence remains inconclusive. The findings highlight the need for further research to clarify paracetamol's role in optimizing performance under different training conditions. Future studies should focus on the dose-response relationship, long-term effects, and potential variations across diverse athletic populations to better understand its practical application in sports performance.

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CHAPTER 1
INTRODUCTION

1.1 Research Background

Fatigue during exercise is a complex phenomenon arising from impairments in multiple physiological systems and compromises exercise performance. The complexity of resolving the mechanisms that underpin exercise-induced fatigue is exemplified by the fact that fatigue development is influenced by various factors including, but not limited to, age, gender, type/mode of exercise duration and intensity, as well as environmental conditions (Enoka & Duchateau, 2008). The study of fatigue in human activities has been interesting for over a century. Peripheral fatigue refers to causes of fatigue outside the central nervous system through processes distal to the neuromuscular junction. Central fatigue relates to grounds located within the central nervous system, with loss of contractile force occurring through processes proximal to the neuromuscular junction (within the brain, spinal nerves, and motor neurons). Whereas peripheral fatigue occurs via processes outside of the central nervous system, unsurprisingly, central fatigue proposes that the origin of fatigue is located within the central nervous system, with a loss of muscle force occurring through processes proximal to the neuromuscular junction (Phillips, 2015). For example, a pharmacological ergogenic aid such as caffeine or the amphetamines may exert its ergogenic effect through a number of mechanisms (Mcdaniel et al., 2010), with particular mention of the, consequently enhancing the adenosine receptors in the central nervous system, enhancing the attention, concentration and alertness, and ultimately, reducing the perception of fatigue during exercise (Cormano et al., 2019).

Any training regimen, mechanical aid, dietary or pharmaceutical strategy, or psychological tactic that can increase exercise capacity and training adaptations is called an ergogenic aid (Porrini & Del Bo', 2016). Accordingly, a pharmacological ergogenic aid is a food supplement consumed orally and contains a nutrient to enhance diet. These supplements improve athletic performance without adversely affecting users (Vicente Salar et al., 2020). The consumption of pharmacological ergogenic aid has been increasing in recent years around the world with sales of global dietary supplements growing 6.1% in 2017, and this has led to a great variety of research intending to