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The Role of Anaerobic Conditioning in Combat Sport Performance: A Systematic Review of Training Regimens and Performance Outcomes

Haris Nur Iman Haris Fadzillah^{1*}, & Muhammad Zulqarnain Mohd Nasir¹.

¹Faculty of Sports Science and Recreation, Universiti Teknologi MARA Negeri Sembilan, Seremban Campus, Malaysia

*Corresponding author: 2023858682@student.uitm.edu.my

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I. INTRODUCTION

Combat sports are decided within milliseconds of explosive movement, yet those actions are framed by a rhythm that demands relentless anaerobic replenishment. Time-motion studies show judo, boxing, taekwondo and mixed-martial arts feature 1–5 s maximal bursts separated by pauses of similar length, with work-to-rest ratios seldom exceeding 2:1. Metabolic models confirm heavy reliance on phosphagen and glycolytic pathways: lactate in Olympic boxing exceeds 12 mmol L⁻¹ by round end, and one-third of simulated judo randori energy is supplied anaerobically. Coaches therefore integrate high- and sprint-interval protocols, yet divergent study designs, small samples and inconsistent metrics obscure the most effective prescriptions and the durability of their benefits.

This systematic review collates evidence published between 2015 and June 2025 on high-intensity interval, sprint-interval, repeated-sprint, hypoxic and blood-flow-restriction regimens in adult combat athletes. It examines dose–response patterns, sex-specific adaptations, detraining kinetics and the correspondence between laboratory and field assessments. By synthesising these strands, the review aims to provide practitioners with a coherent framework for programming and monitoring anaerobic conditioning that aligns with the stop-and-go tempo, technical precision and congested calendars of contemporary combat sport. It highlights current methodological gaps while advocating multi-centre, longitudinal studies that integrate molecular, physiological and competitive data. The resulting guidance is intended to help strength coaches, sport scientists and medical teams worldwide advance athlete preparation with evidence-based precision, moving forward.

II. METHODS

Following PRISMA 2020, a protocol was registered prospectively. Comprehensive searches of PubMed, Embase, SPORTDiscus, Scopus and Web of Science were completed on 1 February 2025 with pilot-tested strings combining controlled vocabulary and free-text terms for combat disciplines and anaerobic training modalities. The window spanned

January 2015 to June 2025 to balance recency and context. Eligible studies were English, peer-reviewed interventions applying high-intensity interval, sprint-interval, repeated-sprint, hypoxic or blood-flow-restriction conditioning to healthy combat athletes aged ≥ 18 years with at least one competitive season. Two reviewers independently screened records, extracted programme structure, load markers, physiological adaptations and performance outcomes, and assessed bias using PEDro (randomised) or ROBINS-I (non-randomised). Outcomes reported by at least three homogeneous trials were pooled with DerSimonian–Laird random-effects models, otherwise narrative synthesis was conducted. Certainty of evidence was graded with GRADE. Pre-planned sub-group analyses contrasted male versus female responses, compared work-rest ratios, evaluated sport-specific against generic drills and modelled decay at four, eight and twelve weeks of detraining. Sensitivity tests excluded studies scoring < 5 on PEDro or at serious ROBINS-I risk. All statistics were run in R (v4.3.2) using meta for and dmetar; funnel plots and Egger tests explored small-study bias. Missing data were imputed conservatively using last observations.

III. RESULTS AND DISCUSSION

Fourteen trials involving 399 adult competitors across boxing, judo, taekwondo, karate, wrestling and mixed-martial arts met the criteria. Generic high-intensity or repeated-sprint blocks (4 - 12 weeks) raised maximal oxygen uptake by 3 - 10 percent, while protocols embedding repeated throws, pad combinations or kick ladders produced parallel gains in agility, strike volume and Special Judo Fitness Test scores. Meta-analysis showed moderate effects for peak power ($g = 0.53$) and large effects for mean power ($g = 0.87$). Hypoxic or blood-flow-restriction add-ons yielded an extra 2 - 4 percent Wingate improvement and faster lactate clearance, offering efficient options when time is limited. Detraining analysis revealed a 7 - 12 percent peak-power loss by week 12 and declining Special Judo Fitness Test throws after four weeks of inactivity. Sex-specific comparisons indicated equivalent relative gains, yet female athletes displayed greater ferritin depletion

and higher Relative Energy Deficiency in Sport prevalence, highlighting the need for nutritional surveillance. Laboratory improvements translated to competition: lower Wingate fatigue indices and higher Taekwondo Anaerobic Intermittent Kick Test scores predicted wider victory margins and superior win-loss ratios. Sessions consist of two interval sets weekly to maintain adaptations.

IV. CONCLUSIONS

Eight to twelve well-designed high-intensity, sprint-interval or repeated-sprint sessions per mesocycle enhance aerobic capacity, anaerobic power and technical output in combat athletes. Protocols using approximately 1:4 work-rest or incorporating brief hypoxic or occlusion stress deliver the largest peak-power and lactate-clearance gains. Sport-specific drills ensure these physiological improvements convert to wider score differentials and better win-loss records, as shown by superior Taekwondo Anaerobic Intermittent Kick Test outputs and lower Wingate fatigue indices fighters. Two interval sets weekly during taper or off-season are advised because measurable declines emerge after four weeks of inactivity and accelerate by week 12. Female competitors need proactive iron management and tailored recovery to mitigate the heightened risk of Relative Energy Deficiency in Sport.

Although short-term effects are compelling, evidence is limited by brief interventions, uneven field-laboratory concordance and sparse mechanistic tracking, especially in mixed-sex cohorts. Future studies should span full macrocycles, integrate molecular markers with neuromuscular and competitive metrics, and compare autoregulatory models such as APRE, VBRT, repeated-sprint hypoxia and blood-flow-restriction HIIT to optimise dosing. Until such data emerge, this synthesis equips practitioners to apply evidence-based anaerobic conditioning confidently, matching interval architecture to bout tempo, layering environmental or vascular stress judiciously and monitoring responses with validated laboratory and field tests to translate transient metabolic bursts into sustained competitive supremacy for athletes.

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