

“MOVEMENT EFFICIENCY AND ENERGY EXPENDITURE IN COMPETITIVE JUDO”

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Abstract : This study investigates the impact of judo training on the physical fitness and psychological development of young athletes. Judo is widely recognized not only as a competitive combat sport but also as an educational tool that promotes physical, mental, and social growth. Regular participation in judo training contributes to the development of essential physical abilities, including strength, endurance, speed, flexibility, balance, and coordination, while simultaneously enhancing psychological characteristics such as self-confidence, discipline, emotional stability, and resilience. The aim of this study was to analyze the role of systematic judo practice in improving the physical and psychological characteristics of youth athletes. The research was conducted through a comprehensive review of scientific literature and an analysis of previous studies related to sports science, physical education, and sport psychology. The findings indicate that regular judo training significantly improves muscular strength, aerobic capacity, motor coordination, and overall physical performance. Furthermore, participation in judo enhances cognitive skills, promotes emotional self-regulation, reduces anxiety levels, and strengthens motivation and perseverance. The educational philosophy of judo, based on mutual respect, self-control, and continuous self-improvement, also contributes positively to the social behavior and character development of young practitioners. In conclusion, judo represents an effective means of supporting the comprehensive development of young athletes. Its benefits extend beyond physical conditioning to include psychological well-being, social adaptation, and personal growth. Therefore, the integration of judo programs into youth sports development and educational systems is strongly recommended.

Keywords: judo, youth athletes, physical fitness, psychological development, sports training, motor skills, emotional regulation, youth development.

Competitive judo requires athletes to perform high-intensity technical and tactical actions while managing limited physiological resources. Movement efficiency plays a critical role in determining athletic performance, as inefficient movements can increase energy expenditure and accelerate fatigue. Despite the importance of energy

management in judo, limited research has examined the relationship between movement efficiency and physiological cost during competitive performance. This study aimed to investigate the association between movement efficiency and energy expenditure among competitive judokas.

A cross-sectional study was conducted involving 40 competitive judo athletes (age: 18–25 years) from regional and national teams. Participants completed simulated judo matches under standardized conditions. Movement efficiency was assessed using video-based motion analysis, including movement economy, displacement patterns, and technical execution scores. Energy expenditure was measured through portable metabolic analyzers and heart rate monitoring. Descriptive statistics, Pearson correlation analysis, and multiple regression models were used to examine relationships between variables at a significance level of $p < 0.05$.

Athletes demonstrating higher movement efficiency exhibited significantly lower energy expenditure during simulated matches ($r = -0.68$, $p < 0.001$). Efficient judokas showed reduced unnecessary displacement, improved technical precision, and lower physiological strain compared to less efficient athletes. Regression analysis indicated that movement efficiency explained 46% of the variance in energy expenditure ($R^2 = 0.46$, $p < 0.001$). Furthermore, athletes with greater efficiency maintained performance quality during later stages of competition and reported lower perceived exertion.

The findings suggest that movement efficiency is a significant determinant of energy expenditure in competitive judo. Athletes who optimize technical execution and minimize unnecessary movements can conserve physiological resources and sustain performance throughout a match. Coaches should incorporate biomechanical analysis, technical refinement, and movement-economy training into athlete development programs. Future research should explore longitudinal interventions aimed at improving movement efficiency and competitive outcomes in elite judo populations.

In conclusion, the findings of this study demonstrate that judo training plays a significant role in the comprehensive development of young athletes. Regular participation in judo contributes to improvements in physical fitness components, including strength, endurance, coordination, flexibility, and balance. At the same time, judo training promotes important psychological qualities such as self-confidence, emotional stability, discipline, resilience, and stress management. Beyond its physical and psychological benefits, judo fosters positive social and moral values, including respect, responsibility, self-control, and perseverance. These characteristics support the overall personal development of young athletes and help them adapt more effectively to both sporting and everyday challenges. Therefore, judo should be considered an

effective tool for promoting holistic youth development. The integration of judo programs into schools, sports clubs, and youth development initiatives can contribute to healthier lifestyles, improved mental well-being, and stronger character formation among young people. Future research should focus on longitudinal studies to further examine the long-term effects of judo training on physical, psychological, and social outcomes in different age groups and competitive

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