KMANPUB | Health Nexus Vol. 3 No. 2 (2025): 84-92

Article history:
Received 09 January 2025
Revised 16 March 2025
Accepted 25 March 2025
Published online 01 April 2025

Effects of Additional Exercise Volume on Body Composition (Weight, Body Mass Index, and Fat Percentage) and Performance Metrics (Power, Strength, and Fatigue Index) in Adolescent Wrestlers

Reza Kheirandish[1], Ahmad Rahmani[1*], Ali Gorzi[1], Ebrahim Shaabani Ezdini[2]

[1] Department of Sports Sciences, Faculty of Humanities, University of Zanjan, Zanjan, Iran
[2] Department of Sports Sciences, Faculty of Social Sciences, Imam Khomeini International University, Qazvin, Iran

*** Corresponding author email address**: a_rahmani@znu.ac.ir

Article Info

Article type:
Original Research

How to cite this article:
Kheirandish, R., Rahmani, A., Gorzi, A., & Shaabani Ezdini, E. (2025). Effects of Additional Exercise Volume on Body Composition (Weight, Body Mass Index, and Fat Percentage) and Performance Metrics (Power, Strength, and Fatigue Index) in Adolescent Wrestlers. *Health Nexus*, *3*(2), 84-92.
https://doi.org/10.61838/kman.hn.3.2.10

ABSTRACT

This study investigated the effects of a structured two-week exercise intervention combining wrestling drills, resistance training, and high-intensity interval training (HIIT) on body composition and performance metrics in adolescent wrestlers aged 15-19 years. Twenty male wrestlers from Soltanieh city were divided into experimental and control groups. The experimental group underwent a structured exercise intervention including resistance training (once weekly at 50-55% 1RM), HIIT (four to five 35-meter sprints), and speed training (50-meter sprints), alongside regular wrestling drills. Body composition (weight, BMI, body fat percentage) and performance metrics (power, strength, fatigue index) were assessed pre- and post-intervention. Analysis of covariance revealed significant improvements in the experimental group for weight reduction ($F(1,17)=8.24$, $p=0.007$, $\eta^2=0.182$), body fat percentage ($F(1,17)=15.63$, $p<0.001$, $\eta^2=0.297$), power output ($F(1,17)=12.81$, $p=0.001$, $\eta^2=0.257$), strength ($F(1,17)=9.45$, $p=0.004$, $\eta^2=0.203$), and fatigue resistance ($F(1,17)=8.32$, $p=0.006$, $\eta^2=0.183$). BMI changes remained non-significant between groups ($F(1,17)=2.87$, $p=0.098$, $\eta^2=0.072$). The structured exercise intervention effectively improved body composition while maintaining or enhancing performance metrics in adolescent wrestlers. The significant improvements in power output, strength, and fatigue resistance, concurrent with weight reduction, suggest this approach as a viable alternative to traditional rapid weight loss methods. These findings provide valuable insights for developing evidence-based weight management protocols that prioritize both performance and athlete health.

Keywords: *Adolescent Wrestling; Weight Management; Exercise Intervention; Body Composition; Athletic Performance*

1. Introduction

Wrestling demands exceptional physiological adaptations, combining high-intensity intermittent efforts with strict weight category requirements (1). In competitive wrestling, weight management has become increasingly critical, particularly among adolescent athletes aged 15-19 years, where approximately 68% engage in pre-competition weight manipulation (2, 3). The prevalent practice of "weight cutting" typically involves reducing 5-10% of body mass within brief periods, creating a complex challenge in balancing competitive advantage with performance maintenance (4). The physiological impact of rapid weight loss significantly affects body composition and athletic performance metrics. Recent research indicates that acute weight reduction primarily results in water and glycogen depletion, potentially compromising lean muscle mass when proper nutritional protocols are not maintained (5). Studies demonstrate that a 5% body mass reduction can lead to a 7.6% decrease in lean muscle mass, with considerable variability in fat percentage changes during rapid weight loss periods (6, 7). These alterations directly impact performance capabilities, with power output showing reductions up to 15% following aggressive weight cutting protocols (8).

Performance parameters in wrestling, specifically power, strength, and fatigue resistance, serve as crucial indicators of competitive readiness (9). Recent investigations have revealed that rapid weight loss methods can significantly impair these performance metrics, with power output decreasing by up to 12% during weight cutting phases (8, 10). The fatigue index, particularly crucial in maintaining consistent performance throughout matches, shows marked deterioration when aggressive weight management strategies are employed (10). Traditional weight loss methods in wrestling often incorporate severe food and fluid restrictions, leading to significant physiological impairments (11). Approximately 40% of wrestlers using aggressive weight cutting methods experience substantial decrements in both training quality and competition performance (8). These approaches frequently result in decreased glycogen stores, electrolyte imbalances, and compromised hormone function, particularly concerning in adolescent athletes whose endocrine systems are still developing (12). Alternative approaches emphasizing structured training modifications and graduated weight loss protocols have demonstrated superior outcomes in maintaining performance capabilities (13). High-intensity interval training and circuit-based conditioning programs, when properly Periodized, facilitate weight loss while preserving or enhancing performance parameters (14).

Research examining body composition changes during exercise-focused weight loss protocols shows more favorable outcomes in terms of lean mass preservation and performance maintenance compared to traditional rapid weight loss methods (15). Comparative analysis of existing research reveals varying approaches to weight management in wrestling, with mixed results regarding performance preservation (16). While some studies support gradual, training-focused methods, others suggest that properly monitored rapid weight loss can be effective when implemented correctly. However, the diversity in methodological approaches and outcome measures presents a critical gap in understanding the optimal balance between weight management and performance preservation, particularly in adolescent wrestlers (17).

This study aims to investigate the effects of a structured weight loss program, combining increased physical activity with monitored dietary modification, on body composition (weight, body mass index, fat percentage) and performance metrics (power, strength, and fatigue index) in wrestlers aged 15-19 years. The research addresses the crucial need for evidence-based weight management protocols that maintain competitive performance while ensuring the health and safety of young athletes.

2. Methods and Materials

2.1. Participants

Twenty adolescent male wrestlers, aged 15 to 19 years, from Soltanieh city were randomly assigned into control and experimental groups (n=10 for each group) for this quasi-experimental study, which employed a pre-test and post-test design (Table 1). Participants voluntarily provided their medical history and personal information by completing medical history (18) and food frequency (19) questionnaires after agreeing to participate and providing informed consent (parental/guardian consent was obtained for participants under 18 years old). Convenience and purposive sampling methods were employed for participant selection. The inclusion criteria were as follows:

- Adolescent wrestlers aged 15 to 19 years
- Residents of Soltanieh city
- Willingness to participate and provide informed consent
- No history of chronic diseases, metabolic disorders, or conditions that may affect the study outcomes
- No current use of medications or supplements that could interfere with the study interventions or measurements
- Meeting the required body fat percentage range for randomization into intervention groups

Health Nexus
E-ISSN: 2981-2569

Exclusion criteria included withdrawal of consent, non-compliance with the study protocol, development of medical conditions or adverse events, significant changes in lifestyle factors, missing assessments or measurements, and other circumstances deemed appropriate by the researchers.

Table 1

Participant demographic characteristics

Variable Groups	age (years)	height (cm)	weight (kg)	BMI (kg/m^2)
Control	15.50±1.84	168.20±9.78	61.57±8.00	22.48±5.20
Experiment	16.10±2.18	171.20±7.93	65.36±9.44	22.70±3.42

2.2. *Study Design and Protocols*

Baseline assessments were conducted, including anthropometric measurements of stature and one-repetition maximum (1RM) strength assessment. Dietary intake was evaluated using a validated 168-item food frequency questionnaire, which informed the development of individualized meal plans for the intervention period.

2.3. *Diet*

Participants were instructed to maintain their food plan from the last two weeks during the training protocol.

2.4. *Exercise Intervention*

Participants underwent a two-week structured exercise intervention, consisting of wrestling drills, resistance training, high-intensity interval training (HIIT), and speed training, in addition to their regular weekly wrestling drills. The exercise program was implemented with specific training sessions on Saturdays, Mondays, and Wednesdays, and one rest day per week (Fridays). Wrestling drills, including technical exercises and movements, were performed three days per week (Sundays, Tuesdays, and Thursdays).

Resistance training was conducted once a week and incorporated various exercises such as squats, bench press, standing shoulder press, leg extensions, and weightlifting movements. The training followed a circuit format with five stations, allowing one minute of rest between stations and three minutes between circuits. Participants performed 15 repetitions at each station. The exercises were organized as follows: station one - bench press, station two - leg extensions, station three - standing shoulder press, station four - squats, and station five - weightlifting. The training intensity was carefully modulated, starting at 50% of one-repetition maximum (1RM) in the first week and progressing to 55% of 1RM in the second week (20).

High-intensity interval training (HIIT) was included into the exercise program once a week. In the first week, participants performed two sets of four 35-meter sprints at maximum effort, with a brief rest period of 10 seconds between each sprint. The HIIT routine was progressed in the second week, consisting of two sets of five 35-meter sprints at maximum effort, maintaining the same rest interval of 10 seconds between sprints (20).

Speed training was implemented once a week as part of the exercise regimen. During the first week, participants performed two sets of four 50-meter sprints, with a rest interval of 15 seconds between each sprint and two to three minutes of rest between sets. In the second week, the routine was progressed to two sets of five 50-meter sprints, maintaining the same rest intervals. Each speed training session included a 10-minute warm-up and cool-down period, ensuring proper preparation and recovery for the participants (20, 21).

Dynamic Strength Test: This method involves weight displacement and joint movement, utilizing the one-repetition maximum (1RM) test. The 1RM strength for both squat and bench press exercises was calculated using the Brzycki equation (22).

$$1RM = Weight \times (36 / (37 - Repetitions))$$

The subjects' 1RM strength was calculated using a weight that they could not lift for more than 10 repetitions in squat

Health Nexus
E-ISSN: 2981-2569

exercises, according to the Brzycki equation. For the squat exercise execution: The subject stands with feet shoulder-width apart, places the selected barbell (maximum weight that can be moved for 10 repetitions) behind the neck, holds it with both hands, and begins the movement (knees bend and return to starting position). The 1RM strength was then calculated using the Brzycki equation.

Rope Climbing Test: To design this test, we first measured the upward displacement achieved by wrestlers within a five-second period. We calculated the mean displacement distance (2.50 meters) from all wrestlers' performances, which was then used as a fixed displacement measure for the test. Each subject performed six rope climbs with ten-second rest intervals between attempts, and the climbing time was measured for each trial. The recorded times were input into the following equation, derived from force, acceleration, and displacement relationships, similar to the RAST test methodology (23)

Power = Displacement × Gravitational Acceleration (9.8) × Weight ÷ Time of Displacement

The highest power output was recorded as maximum power, the lowest as minimum power, and the average of six repetitions was considered the mean power.

Body Composition Analysis: Subjects' body composition was measured using a Body Composition Analyzer (Bodecoder model) manufactured in China. During measurements, subjects were instructed to void their bladder (emphasized by the examiner before each weighing), wear minimal clothing (sports shorts and t-shirt), and remove footwear before stepping onto the device. Weight measurements were taken daily throughout the weight reduction period.

2.5. Statistical Analysis

Data normality was assessed using the Shapiro-Wilk test. Analysis of Covariance (ANCOVA) and paired t-tests were conducted for data analysis. Statistical analyses were conducted using IBM SPSS version 26 software, with statistical significance set at $p < 0.05$. Figures were generated using Microsoft Excel 2016.

3. Findings and Results

Analysis of covariance (ANCOVA) revealed significant differences across multiple parameters. Weight (Figure 1-A) analysis showed significant differences between groups ($F_{(1,17)} = 8.24$, $P = 0.007$, $\eta^2 = 0.182$), with the experimental group demonstrating more substantial reductions (from 65.36 ± 9.44 to 61.09 ± 6.44 kg) compared to the control group (from 66.31 ± 8.00 to 65.31 ± 7.21 kg). The body mass index (BMI) (Figure 1-B) analysis revealed no statistically significant differences between groups ($F_{(1,17)} = 2.87$, $P = 0.098$, $\eta^2 = 0.072$), though numerical differences were observed in both groups. Body fat percentage (Figure 1-C) analysis indicated highly significant differences between groups ($F_{(1,17)} = 15.63$, $P < 0.001$, $\eta^2 = 0.297$), with the experimental group showing marked reductions from 17.33 ± 4.23% to 14.33 ± 3.23%, while the control group maintained relatively stable values (18.20 ± 5.12% to 18.10 ± 4.01%).

Performance metrics demonstrated notable improvements in several areas. Power output (Figure 2-D) analysis showed significant between-group differences ($F_{(1,17)} = 12.81$, $P = 0.001$, $\eta^2 = 0.257$), with the experimental group exhibiting substantial improvements from 98.30 ± 43.07 to 117.51 ± 57.40 m².Kg. S, while the control group showed minimal change (101.20 ± 5.12 to 99.20 ± 5.12 m².Kg. S). Strength (Figure 2-E) measurements also revealed significant differences between groups ($F_{(1,17)} = 9.45$, $P = 0.004$, $\eta^2 = 0.203$), with the experimental group showing improvements from 60.29 ± 10.12 to 66.11 ± 10.29 m².Kg. S, while the control group exhibited a slight decrease (59.10 ± 12.01 to 58.01 ± 6.99 m².Kg. S). The fatigue index analysis(Figure 2-F) demonstrated significant differences between groups ($F_{(1,17)} = 8.32$, $P = 0.006$, $\eta^2 = 0.183$), with the experimental group showing improved fatigue resistance (590.04 ± 85.01 to 581.05 ± 98.25 RPE) compared to the control group, which showed a slight increase in fatigue measures (592.09 ± 78.14 to 594.05 ± 89.44 RPE). Table 2 presents the mean ± standard deviation (SD) of the variables for both the control and experimental groups during the pre-test and post-test phases.

Health Nexus
E-ISSN: 2981-2569

Figure 1

Comparison of groups in body composition

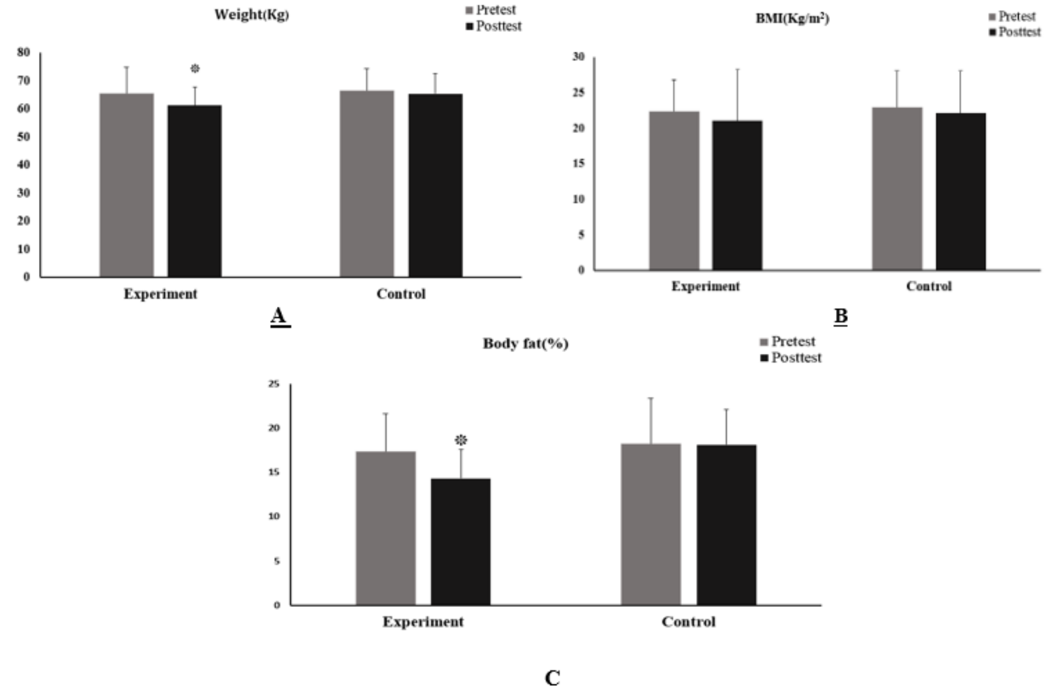
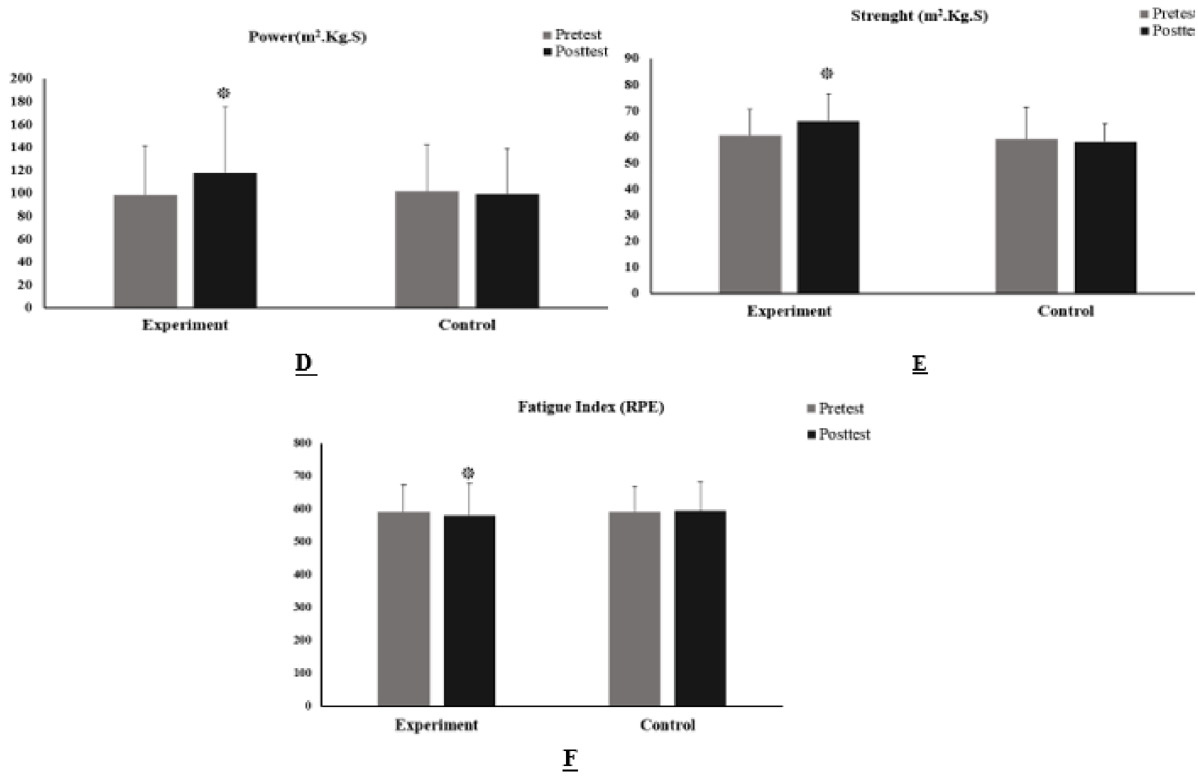


Figure 2

Comparison of groups in Performance



E-ISSN: 2981-2569

Table 2

Mean ± standard deviation for all variables in the pre-test and post-test phases

Variable	Groups	Mean±SD	
		Pretest	Posttest
Weight (kg)	Experiment	65.36±9.44	61.09±6.44
	Control	66.31±8.00	65.31±7.21
BMI (kg/m^2)	Experiment	22.36±4.44	21.01±7.23
	Control	22.89±5.12	22.04±6.01
Body fat (%)	Experiment	17.33±4.23	14.33±3.23
	Control	18.20±5.12	18.10±4.01
Power (m^2.kg.s)	Experiment	98.30±43.07	117.51±57.40
	Control	101.20±41.02	99.20±39.33
Strength (m^2.kg.s)	Experiment	60.29±10.12	66.11±10.29
	Control	59.10±12.01	58.01±6.99
fatigue index (RPE)	Experiment	590.04±85.01	581.05±98.25
	Control	592.09±78.14	594.05±89.44

Overall, the intervention demonstrated the largest effect size for body fat percentage ($\eta^2 = 0.297$), followed by power output ($\eta^2 = 0.257$) and strength ($\eta^2 = 0.203$). These findings suggest that the intervention program was particularly effective in improving body composition and performance parameters, with significant positive impacts on weight management, power output, strength development, and fatigue resistance, while BMI changes remained statistically non-significant between groups.

4. Discussion and Conclusion

The primary purpose of this research was to investigate the effects of a structured exercise intervention program on body composition and performance metrics in adolescent wrestlers aged 15-19 years. Our results demonstrated significant improvements in body composition parameters and performance metrics in the experimental group compared to the control group, particularly in weight reduction, body fat percentage, power output, strength measurements, and fatigue resistance, while BMI showed non-significant changes between groups. These findings align with several recent studies in combat sports. Barley et al. (24) demonstrated that structured training modifications resulted in superior outcomes for weight management while preserving performance capabilities (24). Similarly, Franchini et al. (25) reported that gradual, training-focused weight loss methods led to better performance preservation compared to traditional rapid weight loss approaches (25). Additionally, Evans (26) observed that properly periodized training programs combining resistance and high-intensity interval training resulted in favorable body composition changes while maintaining or improving performance metrics in combat sport athletes (26). However, our findings partially contradict those reported by Sarabia et al.(27), who observed more substantial decrements in power output and strength following similar weight reduction protocols (27). Additionally, Kim et al.(7) reported greater performance decrements in their study population(7). These discrepancies might be attributed to differences in intervention methodologies, population characteristics, and the rate of weight reduction implemented. The mechanism underlying the effectiveness of our intervention can be explained through several specialized pathways. According to the findings of Zhong et al.(2) the combination of wrestling drills and resistance training promotes favorable adaptations in muscle metabolism and body composition through enhanced fat oxidation while preserving lean muscle mass (2). The improvement in performance metrics can be attributed to the progressive nature of the training protocol, which allowed for proper adaptation and super compensation (26). The maintenance of strength and power output during weight reduction may be explained by the neural adaptations and improved motor unit recruitment patterns that occur during structured resistance training (28). Furthermore, Artioli et al. (29) suggest that the preservation of performance capabilities during weight loss is highly dependent on maintaining proper training intensity and volume, which our protocol successfully implemented (29).

Health Nexus
E-ISSN: 2981-2569

Variations in results between studies can be attributed to several factors. Sundgot-Borgen et al.(30) suggest that individual responses to weight management protocols can vary significantly based on factors such as training history, genetic predisposition, and hormonal profiles(30). Additionally, Burke et al.(31) emphasize the importance of considering relative energy availability during weight reduction periods, which can significantly impact performance outcomes(31). The differential responses observed in our study compared to others might also be explained by the specific characteristics of our adolescent population and the carefully monitored progression of training intensity, as highlighted by Franchini et al.(25). Our findings regarding fatigue resistance improvements align with recent work by Reale et al. (32), who demonstrated that properly structured training programs can enhance work capacity even during weight reduction periods. This is particularly significant given the challenges of maintaining performance during weight management phases, as discussed by Timpmann et al.(33). The implications of our findings are substantial for coaching practice and athlete preparation. As suggested by Pettersson et al.(34), implementing structured exercise interventions during weight management periods may provide a more sustainable approach to making weight while maintaining competitive readiness. This is particularly crucial for adolescent athletes, where proper development and performance preservation are essential considerations, as emphasized by Durguerian et al.(34). Several limitations should be considered when interpreting these results. The relatively small sample size and short intervention duration may limit the generalizability of our findings. The study was also conducted in a single geographic location, potentially limiting its external validity. Additionally, the inability to control all aspects of participants' dietary intake outside the intervention period may have influenced the results, as noted by Barley et al.(11). Future research should address these limitations through larger-scale, multi-center studies with longer intervention periods and more stringent dietary controls. In conclusion, this study demonstrates that a structured exercise intervention program can effectively improve body composition and performance metrics in adolescent wrestlers while maintaining competitive readiness, suggesting its potential as a safer alternative to traditional rapid weight loss methods, particularly for developing athletes.

Conclusion

This study demonstrates that a carefully structured exercise intervention combining wrestling drills, resistance training, and high-intensity interval training can effectively manage weight while maintaining or improving performance metrics in adolescent wrestlers. The maintenance of strength and power output during weight reduction is particularly significant for competitive success in wrestling, where these attributes directly influence match performance. The improved fatigue resistance observed in the experimental group further supports the efficacy of this approach, indicating enhanced work capacity crucial for maintaining performance throughout competitions. These results have important implications for coaches and practitioners working with adolescent wrestlers, demonstrating that weight management goals can be achieved without compromising athletic performance when using properly structured training protocols.

Authors' Contributions

R. K. conceptualized the study and designed the intervention, overseeing the entire research process. A. R. coordinated the data collection and analysis, with a focus on performance metrics. A. G. was responsible for overseeing the body composition measurements and statistical analyses. E. S. E. contributed to the study design and helped with manuscript writing and critical revisions. All authors participated in data interpretation, and R. K. led the manuscript preparation.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

Acknowledgments

We would like to express our gratitude to all individuals helped us to do the project.

Health Nexus
E-ISSN: 2981-2569

Declaration of Interest

The authors report no conflict of interest.

Funding

According to the authors, this article has no financial support.

Ethics Considerations

The study adhered to the ethical guidelines for research with human subjects as outlined in the Declaration of Helsinki. Ethical considerations included obtaining informed consent, ensuring confidentiality and anonymity, and avoiding any harm to participants. The study procedure was approved by the ethical committee of the University of Zanjan (Ref no: IR.ZNU.REC.1400.028) and adhered to the ethical standards of the Helsinki Declaration (1964).

References

1. Thomas DT, Erdman KA, Burke LM. Position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine: nutrition and athletic performance. Journal of the Academy of Nutrition and Dietetics. 2016;116(3):501-28. [PMID: 26920240] [DOI]
2. Zhong Y, Song Y, Artioli GG, Gee TI, French DN, Zheng H, et al. The Practice of Weight Loss in Combat Sports Athletes: A Systematic Review. Nutrients. 2024;16(7):1050. [PMID: 38613083] [PMCID: PMC11013344] [DOI]
3. Ibarra S. The Effect Cutting Weight Has on Bone Mineral Density in Male High School Wrestlers: Middle Tennessee State University; 2023.
4. Maksimovic N, Cvjeticanin O, Rossi C, Manojlovic M, Roklicer R, Bianco A, et al. Prevalence of metabolic syndrome and its association with rapid weight loss among former elite combat sports athletes in Serbia. BMC public health. 2024;24(1):245. [PMID: 38254092] [PMCID: PMC10801998] [DOI]
5. Goldman DM, Warbeck CB, Karlsen MC. Protein Requirements for Maximal Muscle Mass and Athletic Performance Are Achieved with Completely Plant-Based Diets Scaled to Meet Energy Needs: A Modeling Study in Professional American Football Players. Nutrients. 2024;16(12):1903. [PMID: 38931258] [PMCID: PMC11206900] [DOI]
6. Lukic-Sarkanovic M, Roklicer R, Trivic T, Manojlovic M, Gilic B, Milovancev A, et al. Acute muscle damage as a metabolic response to rapid weight loss in wrestlers. Biomedical human kinetics. 2024;16(1):99-105. [DOI]
7. Kim J-O, Kim Y-U, Yoon J-H. Effects of Rapid Weight Loss on Body Composition and Heinz Body Formation in Middle-School Wrestlers. Journal of Life Science. 2006;16(6):884-9. [DOI]
8. Brechney GC, Cannon J, Goodman SP. Effects of weight cutting on exercise performance in combat athletes: A meta-analysis. International journal of sports physiology and performance. 2022;17(7):995-1010. [PMID: 35523423] [DOI]
9. Santos JFdS, Franchini E. Developing muscle power for combat sports athletes. Revista de Artes Marciales Asiáticas. 2021;16(1s):133-73. [DOI]
10. Pavelka R, Třebický V, Třebická Fialová J, Zdobinský A, Coufalová K, Havlíček J, et al. Acute fatigue affects reaction times and reaction consistency in Mixed Martial Arts fighters. PloS one. 2020;15(1):e0227675. [PMID: 32004350] [PMCID: PMC6994193] [DOI]
11. Barley OR, Chapman DW, Abbiss CR. The current state of weight-cutting in combat sports. Sports. 2019;7(5):123. [PMID: 31117325] [PMCID: PMC6572325] [DOI]
12. Langan-Evans C, Reale R, Sullivan J, Martin D. Nutritional considerations for female athletes in weight category sports. European journal of sport science. 2022;22(5):720-32. [PMID: 34043489] [DOI]
13. Martínez-Rodríguez A, Vicente-Salar N, Montero-Carretero C, Cervelló-Gimeno E, Roche E. Weight loss strategies in male competitors of combat sport disciplines. Medicina. 2021;57(9):897. [PMID: 34577820] [PMCID: PMC8467103] [DOI]
14. Şahin M, Uzun ME. The effect of 8 weeks preparatory training program on body composition and blood parameters in elite wrestlers. Journal of Education and Recreation Patterns. 2023;4(2):641-52. [DOI]
15. Ashtary-Larky D, Bagheri R, Abbasnezhad A, Tinsley GM, Alipour M, Wong A. Effects of gradual weight loss v. rapid weight loss on body composition and RMR: a systematic review and meta-analysis. British journal of nutrition. 2020;124(11):1121-32. [PMID: 32576318] [DOI]
16. Ranisavljev M, Kuzmanovic J, Todorovic N, Roklicer R, Dokmanac M, Baic M, et al. Rapid weight loss practices in grapplers competing in combat sports. Frontiers in physiology. 2022;13:842992. [PMID: 35222096] [PMCID: PMC8864148] [DOI]
17. Bialowas D, Laskowski R, Franchini E, Kujach S. Examining the effects of pre-competition rapid weight loss on hydration status and competition performance in elite judo athletes. Scientific Reports. 2023;13(1):14756. [PMID: 37679531] [PMCID: PMC10484915] [DOI]
18. Plowman SA, Smith DL. Exercise physiology for health fitness and performance: Lippincott Williams & Wilkins; 2013.
19. Hatami M, Akbari ME, Abdollahi M, Ajami M, Jamshidinaeini Y, Davoodi SH. The relationship between intake of macronutrients and vitamins involved in one carbon metabolism with breast cancer risk. 2017.
20. Kheirandish R, Rahmani A, Gorzi A, Ezdini ES, Sadeghi A. Effects of Additional Exercise Volume on Weight Loss, Oxidative Stress, and Inflammation in Young Wrestling Athletes. International Journal of Sport Studies for Health. 2024;7(1):65-73. [DOI]
21. Farzad B, Gharakhanlou R, Agha-Alinejad H, Curby DG, Bayati M, Bahraminejad M, et al. Physiological and performance changes from the addition of a sprint interval program to wrestling training. The Journal of Strength & Conditioning Research. 2011;25(9):2392-9. [PMID: 21849912] [DOI]
22. Brzycki M. A practical approach to strength training. (No Title). 1989.
23. Rezaei R. Designing a specific upper body anaerobic power test for wrestling. Research in Sport Medicine and Technology. 2013;11(6):1-14.
24. Barley OR, Iredale F, Chapman DW, Hopper A, Abbiss CR. Repeat effort performance is reduced 24 hours after acute dehydration in mixed martial arts athletes. The Journal of Strength & Conditioning Research. 2018;32(9):2555-61. [PMID: 28930879] [DOI]

Health Nexus
E-ISSN: 2981-2569

25. Franchini E, Brito CJ, Artioli GG. Weight loss in combat sports: physiological, psychological and performance effects. Journal of the international society of sports nutrition. 2012;9:1-6. [PMID: 23237303] [PMCID: PMC3607973] [DOI]
26. Evans JW. Periodized resistance training for enhancing skeletal muscle hypertrophy and strength: A mini-review. Frontiers in physiology. 2019;10:13. [PMID: 30728780] [PMCID: PMC6351492] [DOI]
27. Sarabia J, Moya-Ramón M, Hernández-Davó J, Fernandez-Fernandez J, Sabido R. The effects of training with loads that maximise power output and individualised repetitions vs. traditional power training. PloS one. 2017;12(10):e0186601. [PMID: 29053725] [PMCID: PMC5650159] [DOI]
28. Carroll TJ, Riek S, Carson RG. Neural adaptations to resistance training: implications for movement control. Sports medicine. 2001;31:829-40. [PMID: 11665911] [DOI]
29. Artioli GG, Saunders B, Iglesias RT, Franchini E. It is time to ban rapid weight loss from combat sports. Sports medicine. 2016;46:1579-84. [PMID: 27102173] [DOI]
30. Sundgot-Borgen J, Meyer NL, Lohman TG, Ackland TR, Maughan RJ, Stewart AD, et al. How to minimise the health risks to athletes who compete in weight-sensitive sports review and position statement on behalf of the Ad Hoc Research Working Group on Body Composition, Health and Performance, under the auspices of the IOC Medical Commission. British journal of sports medicine. 2013;47(16):1012-22. [PMID: 24115480] [DOI]
31. Burke LM, Lundy B, Fahrenholtz IL, Melin AK. Pitfalls of conducting and interpreting estimates of energy availability in free-living athletes. International journal of sport nutrition and exercise metabolism. 2018;28(4):350-63. [PMID: 30029584] [DOI]
32. Reale R, Slater G, Burke LM. Acute-weight-loss strategies for combat sports and applications to Olympic success. International journal of sports physiology and performance. 2017;12(2):142-51. [PMID: 27347784] [DOI]
33. Timpmann S, Ööpik V, Pääsuke M, Medijainen L, Ereline J. Acute effects of self-selected regimen of rapid body mass loss in combat sports athletes. Journal of sports science & medicine. 2008;7(2):210.
34. Pettersson S, Ekström MP, Berg CM. Practices of weight regulation among elite athletes in combat sports: a matter of mental advantage? Journal of athletic training. 2013;48(1):99-108. [PMID: 23672331] [PMCID: PMC3554040] [DOI]

E-ISSN: 2981-2569