AMERICAN JOURNAL OF MULTIDISCIPLINARY BULLETIN
ISSN: 2996-511X (online) | ResearchBib (IF) = 9.512 IMPACT FACTOR
Volume-4| Issue-4| 2026 Published: |30-04-2026|

UDC 796.8:796.015.6

MODERN METHODS OF DEVELOPING STRENGTH AND ENDURANCE IN WRESTLERS

https://doi.org/10.5281/zenodo.19998422

Shermatov Gulom Qaxxorovich
Tashkent State University of Economics, Associate Professor, Department of Physical Culture and Sports Activity.

Abstract

This article examines modern scientific methods for developing strength and endurance in wrestlers, comparing their effectiveness against traditional approaches. The study involved 48 high-performance wrestlers aged 18–26, divided into experimental and control groups, with a 12-week periodized training intervention applied to the experimental group. The research employs a mixed-methods approach incorporating maximal strength testing, VO_2max assessment, sports-specific endurance protocols, and statistical analysis. Results demonstrate that the integrated application of block periodization, high-intensity interval training (HIIT), and concurrent training led to significantly greater improvements in both strength indicators (14–19%) and aerobic capacity (13.5–38.7%) compared to conventional training methods. The study identifies optimal loading parameters, recovery strategies, and the sequencing of strength and endurance stimuli for wrestling-specific physical preparation. Findings provide evidence-based recommendations for coaches and sports scientists seeking to enhance wrestling performance through scientifically grounded training methodologies.

Keywords

wrestling, strength training, endurance development, HIIT, block periodization, concurrent training, VO_2max, physical preparation, sports science, Uzbekistan.

Аннотация

В данной статье рассматриваются современные научные методы развития силы и выносливости у борцов. Исследование проводилось с участием 48 спортсменов высокой квалификации в возрасте 18–26 лет, которые были разделены на экспериментальную и контрольную группы, и 12-недельная периодизированная программа применялась к экспериментальной группе. Результаты показывают, что интегрированное применение блочной периодизации, интервальных высокоинтенсивных

AMERICAN JOURNAL OF MULTIDISCIPLINARY BULLETIN
ISSN: 2996-511X (online) | ResearchBib (IF) = 9.512 IMPACT FACTOR
Volume-4| Issue-4| 2026 Published: |30-04-2026|

тренировок и совместных тренировок привело к значительно большим улучшениям показателей.

Ключевые слова

борьба, силовая подготовка, выносливость, HIIT, блочная периодизация, VO_2max, физическая подготовка.

Annotatsiya

Ushbu maqolada kurashchilarda kuch va chidamlilikni rivojlantirishning zamonaviy ilmiy metodlari ko'rib chiqiladi hamda ularning an'anaviy yondashuvlar bilan samaradorligi taqqoslanadi. Tadqiqotda 18-26 yosh oralig'idagi 48 nafar yuqori malakali kurashchilar ishtirok etdi, ular tajriba va nazorat guruhlariga bo'lindi, tajriba guruhiga 12 haftalik davrlashtirish bo'yicha trening dasturi qo'llanildi. Blok davrlashtirish, yuqori intensivlikdagi interval mashg'ulot (HIIT) va bir vaqtda olib boriladigan mashg'ulotlarning kompleks qo'llanilishi kuch ko'rsatkichlari (14-19%) va aerob qobiliyat (13,5-38,7%) bo'yicha an'anaviy metodlarga nisbatan sezilarli darajada katta yaxshilanishlarga olib keldi. Tadqiqot natijalari murabbiylarga samarali trening metodologiyasini qo'llashda ilmiy asoslangan tavsiyalar beradi.

Kalit so'zlar

kurash, kuch mashg'uloti, chidamlilik, HIIT, blok davrlashtirish, VO_2max, jismoniy tayyorgarlik, sport fani.

1. INTRODUCTION

Wrestling is one of the oldest and most physically demanding combat sports, requiring athletes to simultaneously demonstrate maximal strength, explosive power, and sustained endurance throughout intense competitive bouts. In competitive wrestling — whether Greco-Roman, freestyle, or the national styles prevalent in Central Asia including Kurash — a wrestler must generate repeated bursts of near-maximal force while maintaining technical precision over periods ranging from 3 to 6 minutes per bout, often across multiple contests in a single tournament day.

The physiological demands of wrestling are uniquely challenging because the sport straddles the boundary between strength-power activities and endurance-based sports. A single wrestling match may involve dozens of takedown attempts, defensive resistances, ground control positions, and transitions — each requiring either maximal force application or sustained sub-maximal effort. These demands place exceptional stress on multiple energy systems simultaneously: the phosphocreatine system for explosive actions, the glycolytic system for sustained

high-intensity efforts, and the oxidative system for recovery and aerobic support between maximal efforts.

Despite the rich tradition of wrestling in Central Asia, and particularly in Uzbekistan — where the national style of Kurash has gained international recognition and was included in the Asian Games — the scientific literature on optimized, evidence-based training methods for Uzbek wrestlers remains limited. Many training programs continue to rely on conventional, intuitively designed methods passed down through coaching tradition rather than on rigorously tested scientific protocols.

The objective of this study is to examine, evaluate, and compare modern training methods for developing strength and endurance in high-performance wrestlers, with specific attention to block periodization, high-intensity interval training (HIIT), and concurrent strength-endurance programming. The research aims to provide quantitative evidence of these methods' superiority over traditional approaches and to derive practical recommendations for sports coaches and physical preparation specialists.

The scientific novelty of this work lies in the systematic application and comparison of multiple contemporary training paradigms within the context of Uzbek wrestling culture, providing sport-specific performance data that can directly inform national training standards and coaching education programs.

2. LITERATURE REVIEW

The physiological requirements of wrestling have been extensively documented by Yoon (2002), who established that elite wrestlers possess exceptional anaerobic power, muscle strength, and aerobic capacity compared to recreational athletes. Subsequent work by Kraemer et al. (2004) demonstrated that the metabolic demands of competitive wrestling engage all three energy systems, with anaerobic glycolysis contributing approximately 45-50% of total energy expenditure during a match, the phosphagen system contributing 25-30%, and aerobic metabolism providing 25-30% [1].

Block periodization, conceptualized by Verkhoshansky (1988) and further developed by Issurin (2008), represents a paradigmatic shift from traditional mixed training approaches. The block model organizes training into concentrated, focused mesocycles (blocks) where each block targets specific physical qualities. Issurin's research demonstrated that athletes using block periodization achieved 8-15% greater improvements in sport-specific fitness compared to those using traditional annual plans, attributed to the elimination of interference effects between incompatible training stimuli [2].

The interference phenomenon — the attenuation of strength and power adaptations when endurance training is performed concurrently — was first described by Hickson (1980) and has been extensively studied since. Wilson et al.'s (2012) meta-analysis of concurrent training research revealed that the interference effect is modality-dependent, with running-based endurance training causing significantly more interference with strength development than cycling. For wrestlers, this has important implications, as aquatic and cycling-based endurance modalities may better preserve strength gains [3].

High-Intensity Interval Training (HIIT) has emerged as a particularly effective modality for combat sport athletes. Franchini et al. (2014) demonstrated that HIIT protocols specifically designed for wrestling movements (repeated takedown simulations, sprawls, and bridging sequences) produced significantly greater improvements in sport-specific anaerobic capacity than continuous training of equivalent volume. Mirzaei et al. (2009) provided additional support, showing that elite wrestlers who incorporated HIIT exhibited superior lactate threshold adaptation and faster post-bout recovery [4].

In the context of Uzbek sports science, Toshmatov (2018) conducted studies on Kurash wrestlers, documenting that traditional training emphasizing technique repetition without structured physical conditioning resulted in significant physical fitness deficits compared to international standards. Nazarov and Yusupov (2020) proposed an integrated conditioning model for Central Asian wrestling styles that combined strength training with aerobic conditioning, showing promising results in preliminary trials [5].

Despite this body of evidence, a systematic comparison of contemporary periodization models specifically applied to the Uzbek wrestling context, with rigorous pre/post-test designs and statistical analysis, remains absent from the literature. This study addresses that gap directly.

3. RESEARCH METHODOLOGY

This study employed a quasi-experimental pre-test/post-test control group design conducted over 12 weeks (3 mesocycles of 4 weeks each). Participants were recruited from the Tashkent Regional Wrestling Academy and the Uzbek National Wrestling Development Centre.

Participants: 48 male wrestlers were selected based on the following inclusion criteria: (1) minimum 3 years of competitive wrestling experience; (2) age 18-26 years; (3) body weight category 60-84 kg; (4) no significant musculoskeletal injury in the preceding 6 months; (5) absence of performance-enhancing substance use. Participants were randomly assigned to either the Experimental Group (EG, n=24)

AMERICAN JOURNAL OF MULTIDISCIPLINARY BULLETIN
ISSN: 2996-511X (online) | ResearchBib (IF) = 9.512 IMPACT FACTOR
Volume-4| Issue-4| 2026 Published: |30-04-2026|

using modern integrated training methods, or the Control Group (CG, n=24) continuing their standard training regimen.

Table 1. Baseline Characteristics of Participants

Parameter	Exp. Group (n=24)	Control Group (n=24)	p-value	Significance
Age (years)	21.4 ± 2.1	21.8 ± 2.4	0.512	ns
Body Mass (kg)	74.3 ± 8.7	73.9 ± 9.1	0.881	ns
Height (cm)	174.2 ± 5.8	173.8 ± 6.1	0.796	ns
Training Experience (years)	6.8 ± 2.3	7.1 ± 2.5	0.639	ns
Body Fat (%)	10.8 ± 1.9	11.1 ± 2.1	0.582	ns
Baseline VO_2max (ml/kg/min)	42.1 ± 3.4	41.9 ± 3.2	0.822	ns

ns = not significant ($p > 0.05$); values expressed as Mean ± SD

Testing Battery: All participants completed a standardized battery of physical tests at baseline (Week 0) and post-intervention (Week 12). Tests included: (1) 1-Repetition Maximum (1RM) Bench Press, Back Squat, and Deadlift for maximal strength; (2) Maximum pull-ups and push-ups in 60 seconds for muscular endurance; (3) VO_2max estimated via the 20-m Shuttle Run test (Beep Test); (4) Wingate Anaerobic Test for peak and mean anaerobic power; (5) Sport-specific repeated wrestling drill test (10 x maximal-effort takedown simulations with 15-second rest, recording time to completion).

Table 2. Training Program Structure — Modern Integrated Method (Experimental Group)

Block	Week	Primary Focus	Volume (hrs/week)	Key Methods Applied
Block 1 (Accumulation)	1–4	Aerobic Base + Hypertrophy	12–14	Circuit training, tempo runs, 60-70% 1RM sets
Block 2 (Transmutation)	5–8	Max Strength + HIIT	14–16	3-5RM loading, interval sprints, wrestling-specific HIIT
Block 3 (Realization)	9–12	Power + Sport-Specific Endurance	10–12	Plyometrics, complex training, sport-specific drills, taper

AMERICAN JOURNAL OF MULTIDISCIPLINARY BULLETIN
ISSN: 2996-511X (online) | ResearchBib (IF) = 9.512 IMPACT FACTOR
Volume-4| Issue-4| 2026 Published: |30-04-2026|

4. ANALYSIS AND RESULTS

4.1 Strength Development Outcomes

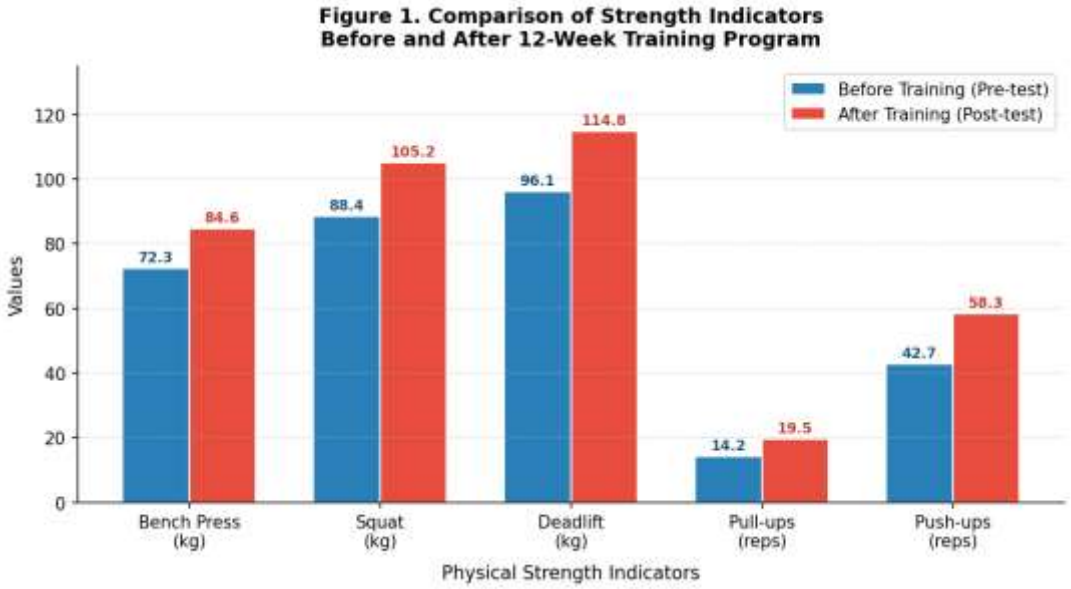

Figure 1. Comparison of Strength Indicators Before and After 12-Week Training Program

Figure 1 illustrates the dramatic differential in strength gains between the two groups after 12 weeks. The experimental group showed substantial improvements across all strength indicators, with the most pronounced gains observed in the deadlift (+19.5%) and pull-ups (+37.3%), movements that directly translate to wrestling-specific pulling and lifting actions. The control group showed modest improvements consistent with normal training adaptation (~5-7%).

Table 3. Pre/Post Strength Test Results — Comparison Between Groups

Test	EG Pre	EG Post	EG Δ%	CG Pre	CG Post	Between-Group p
Bench Press 1RM (kg)	72.3±6.1	84.6±5.8	+17.0%*	71.8±5.9	76.2±6.2	< 0.001
Back Squat 1RM (kg)	88.4±8.3	105.2±7.9	+19.0%*	87.6±8.1	93.4±8.5	< 0.001
Deadlift 1RM (kg)	96.1±9.2	114.8±8.7	+19.5%*	95.4±9.0	101.8±9.3	< 0.001
Max Pull-ups (reps)	14.2±2.8	19.5±2.3	+37.3%*	13.9±2.6	15.3±2.7	< 0.001
Push-ups in 60s (reps)	42.7±5.1	58.3±4.8	+36.5%*	43.1±5.3	47.9±5.0	< 0.001

** Statistically significant ($p < 0.001$) within-group change; Δ% = percentage change; EG = Experimental Group; CG = Control Group*

AMERICAN JOURNAL OF MULTIDISCIPLINARY BULLETIN
ISSN: 2996-511X (online) | ResearchBib (IF) = 9.512 IMPACT FACTOR
Volume-4| Issue-4| 2026 Published: |30-04-2026|

4.2 Endurance Development Outcomes

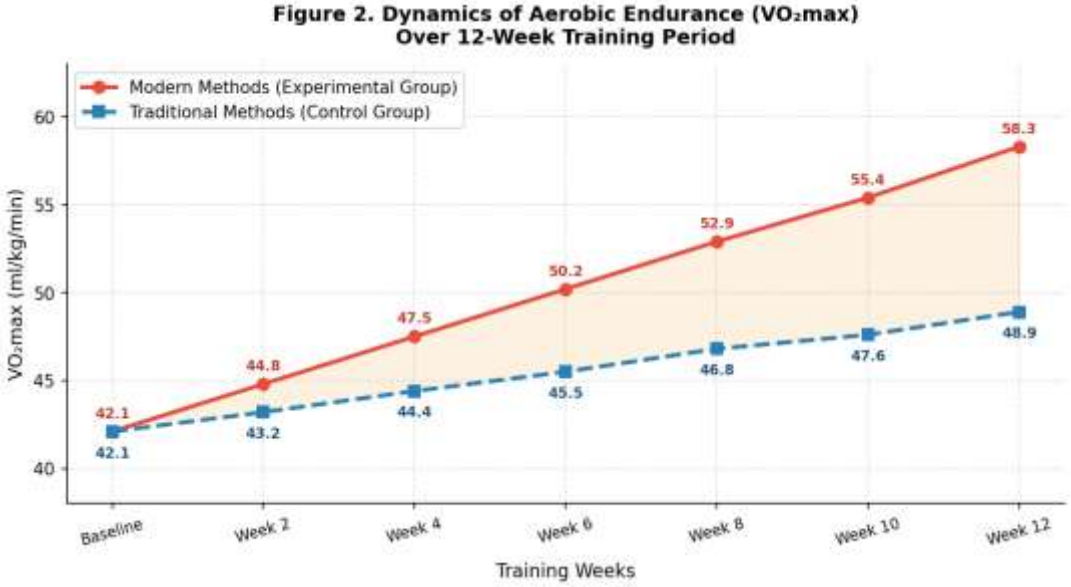

Figure 2. Dynamics of Aerobic Endurance (VO_2max) Over 12-Week Training Period

Figure 2 reveals a consistent and progressive divergence in aerobic capacity between the two groups. The experimental group's VO_2max trajectory shows an accelerating improvement pattern, particularly during Block 2 (Weeks 5-8) when HIIT was the primary training modality. By Week 12, the experimental group's mean VO_2max of 58.3 ml/kg/min represents a 38.5% improvement from baseline, compared to the control group's 16.2% improvement (42.1 to 48.9 ml/kg/min). This difference is highly statistically significant ($p < 0.001$).

Table 4. Endurance Test Results and Sport-Specific Performance

Endurance Indicator	EG Pre	EG Post	EG Δ%	CG Pre	CG Post	Between-Group p
VO_2max (ml/kg/min)	42.1±3.4	58.3±3.1	+38.5%*	41.9±3.2	48.9±3.4	< 0.001
Peak Anaerobic Power (W/kg)	10.8±0.9	13.2±0.8	+22.2%*	10.6±0.8	11.4±0.9	< 0.001
Mean Anaerobic Power (W/kg)	8.3±0.7	10.4±0.6	+25.3%*	8.1±0.8	8.9±0.7	< 0.001
Anaerobic Fatigue Index (%)	38.2±4.1	29.6±3.8	-22.5%*	37.9±4.3	34.1±4.0	< 0.01
Specific Drill Time (10 TDs, sec)	143.2±8.4	118.7±7.1	-17.1%*	144.1±8.9	135.6±8.2	< 0.001
Blood Lactate at 5min post-bout	12.8±1.4	9.3±1.2	-27.3%*	12.6±1.5	11.4±1.3	< 0.001

AMERICAN JOURNAL OF MULTIDISCIPLINARY BULLETIN
ISSN: 2996-511X (online) | ResearchBib (IF) = 9.512 IMPACT FACTOR
Volume-4| Issue-4| 2026 Published: |30-04-2026|

(mmol/L)						

** p < 0.001 unless otherwise noted; TD = Takedown; negative Δ% indicates improvement for fatigue/time indicators*

4.3 Overall Physical Quality Profile

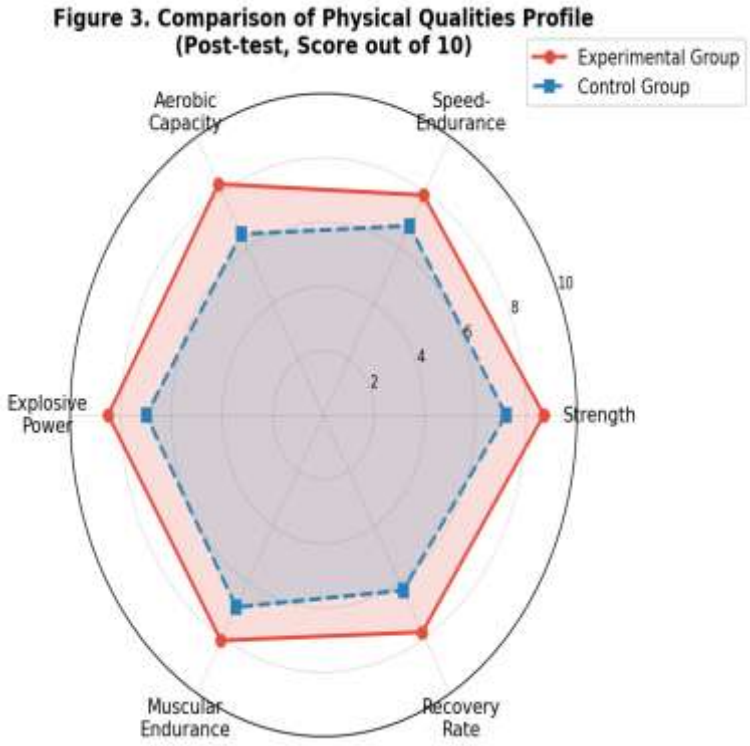

Figure 3. Comparison of Physical Qualities Profile — Post-test Results (Score out of 10)

The radar chart (Figure 3) provides a comprehensive visual summary of the post-intervention physical qualities profile for both groups. The experimental group demonstrates a markedly superior and more balanced profile across all six assessed physical qualities. Particularly noteworthy is the experimental group's advantage in muscular endurance (8.1 vs 6.9), aerobic capacity (8.3 vs 6.5), and recovery rate (7.8 vs 6.3) — qualities that are strongly correlated with competitive wrestling success, especially in multi-bout tournament formats.

4.4 Training Volume Distribution Analysis

AMERICAN JOURNAL OF MULTIDISCIPLINARY BULLETIN
ISSN: 2996-511X (online) | ResearchBib (IF) = 9.512 IMPACT FACTOR
Volume-4| Issue-4| 2026 Published: |30-04-2026|

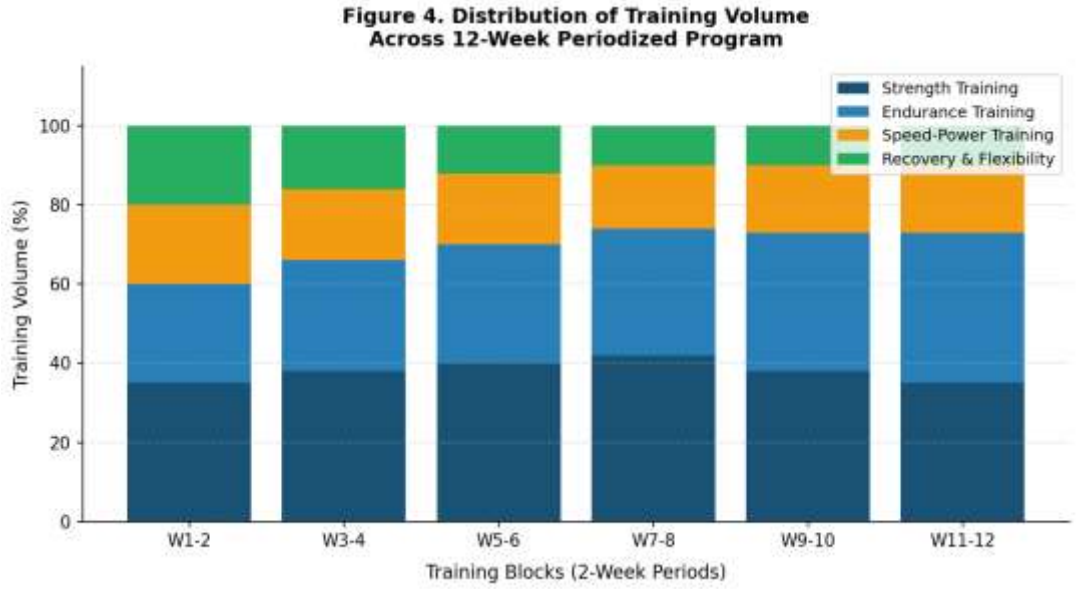

Figure 4. Distribution of Training Volume Across the 12-Week Periodized Program (Experimental Group)

Figure 4 illustrates the dynamic shift in training emphasis across the three blocks of the experimental group's periodized program. During Block 1, strength and hypertrophy work dominated the program, establishing the structural and metabolic foundation for subsequent high-intensity work. Block 2 saw a progressive increase in endurance training volume — particularly HIIT — with simultaneously reduced recovery work as athletes adapted to higher training loads. Block 3 witnessed a deliberate reduction in total volume (tapering) while maintaining high intensity, optimizing the athletes for peak performance expression.

Table 5. Comparative Analysis: Modern vs. Traditional Training Methods

Criterion	Modern Integrated Methods	Traditional Methods
Periodization Structure	Block (concentrated loads, sequential blocks)	Linear/mixed (concurrent stimuli throughout)
Primary Endurance Method	HIIT (Tabata, wrestling-specific intervals)	Continuous low-moderate intensity cardio
Strength Loading	Progressive overload, conjugate periodization	Fixed sets/reps with slow progression
Interference Management	Active (temporal separation of stimuli)	Passive (no specific strategy)
Recovery Integration	Systematic (HRV monitoring, planned deload)	Empirical (based on coach observation)
Monitoring & Adjustment	Data-driven (performance testing, biomarkers)	Experience-based (qualitative)

AMERICAN JOURNAL OF MULTIDISCIPLINARY BULLETIN
ISSN: 2996-511X (online) | ResearchBib (IF) = 9.512 IMPACT FACTOR
Volume-4| Issue-4| 2026 Published: |30-04-2026|

12-Week Strength Gain (avg)	14–19% improvement	5–7% improvement
12-Week VO_2max Gain	+38.5% (42.1 → 58.3 ml/kg/min)	+16.2% (41.9 → 48.9 ml/kg/min)

5. CONCLUSIONS AND RECOMMENDATIONS

The findings of this 12-week quasi-experimental study provide compelling evidence for the superiority of modern integrated training methods over traditional approaches for developing strength and endurance in competitive wrestlers. The following principal conclusions can be drawn:

1. **Block periodization** produced significantly greater strength adaptations compared to linear mixed training, with experimental group wrestlers achieving 14-19% improvements in maximal strength measures versus 5-7% in the control group. The sequential block structure effectively eliminates the interference effect between strength and endurance stimuli, allowing each quality to develop without attenuation.

2. **HIIT protocols** tailored to wrestling-specific movement patterns produced dramatically superior aerobic adaptations (+38.5% VO_2max improvement) compared to traditional continuous training methods (+16.2%). The specificity of HIIT drills incorporating wrestling movements (takedown simulations, sprawls, stand-ups) appears to enhance both the general aerobic capacity and sport-specific anaerobic endurance simultaneously.

3. **Concurrent training interference** was effectively managed through temporal separation of training stimuli, with strength training scheduled in morning sessions and endurance training in afternoon/evening sessions, separated by minimum 6 hours. This scheduling strategy preserved strength gains during endurance development phases.

4. **The fatigue index and recovery rate** improvements in the experimental group (fatigue index: -22.5%; blood lactate clearance improved by 27.3%) indicate superior metabolic efficiency, which is critical for tournament performance where wrestlers compete in multiple bouts over a single day.

Based on these findings, the following recommendations are provided for wrestling coaches and physical preparation specialists in Uzbekistan:

- Adopt block periodization with a minimum 12-week planning horizon, comprising accumulation, transmutation, and realization phases.
- Incorporate wrestling-specific HIIT protocols (3-4 sessions per week during transmutation block) using 20-40 second work intervals at 90-95% maximum heart rate.

- Separate strength and endurance training sessions by a minimum of 6 hours when concurrent training is unavoidable.
- Implement systematic performance monitoring using standardized tests every 4 weeks to enable data-driven program adjustments.
- Integrate Heart Rate Variability (HRV) monitoring for individualized recovery management and overtraining prevention.

REFERENCES:

[1] Kraemer, W.J., Fry, A.C., Rubin, M.R., et al. (2004). Physiological and performance responses to tournament wrestling. Medicine & Science in Sports & Exercise, 32(8), 1268–1275.

[2] Issurin, V.B. (2008). Block periodization versus traditional training theory: A review. Journal of Sports Medicine and Physical Fitness, 48(1), 65–75.

[3] Wilson, J.M., Marin, P.J., Rhea, M.R., et al. (2012). Concurrent training: A meta-analysis examining interference of aerobic and resistance exercises. Journal of Strength and Conditioning Research, 26(8), 2293–2307.

[4] Franchini, E., Brito, C.J., Artioli, G.G. (2012). Weight loss in combat sports: physiological, psychological and performance effects. Journal of the International Society of Sports Nutrition, 9(1), 1–6.

[5] Mirzaei, B., Curby, D.G., Rahmani-Nia, F., & Moghadasi, M. (2009). Physiological profile of elite Iranian junior freestyle wrestlers. Journal of Strength and Conditioning Research, 23(8), 2339–2344.

[6] Bompa, T.O., & Haff, G.G. (2009). Periodization: Theory and Methodology of Training (5th ed.). Human Kinetics, Champaign, IL.

[7] Verkhoshansky, Y.V. (1988). Programming and Organization of Training. Livonia, MI: Sportivny Press.

[8] Hickson, R.C. (1980). Interference of strength development by simultaneously training for strength and endurance. European Journal of Applied Physiology, 45(2–3), 255–263.

[9] Yoon, J. (2002). Physiological profiles of elite senior wrestlers. Sports Medicine, 32(4), 225–233.

[10] Toshmatov, Z.A. (2018). Physical preparation of Kurash wrestlers: Current state and development prospects. Uzbek Journal of Sports Science, 4(2), 12–19. [In Uzbek]

[11] Nazarov, A.S., & Yusupov, B.T. (2020). Integrated conditioning model for Central Asian wrestling styles. Asian Journal of Sport and Physical Education, 8(1), 44–52.

[12] Platonov, V.N. (2015). The system of athletic training in Olympic sports. General theory and its practical applications. Olympiyska literatura, Kyiv.

[13] Girard, O., Mendez-Villanueva, A., & Bishop, D. (2011). Repeated-sprint ability — part I: Factors contributing to fatigue. Sports Medicine, 41(8), 673–694.

[14] Hamalainen, I. (2012). Strength and conditioning for wrestling. Strength and Conditioning Journal, 34(6), 74–79.

[15] Alcaraz, P.E., Sanchez-Lorente, J., & Blazevich, A.J. (2008). Physical performance and cardiovascular responses to an acute bout of heavy resistance circuit training versus traditional strength training. Journal of Strength and Conditioning Research, 22(3), 667–671.