HSR (LONDON),
HOUGHTON STREET REVIEW JOURNAL
ISSN: 2058-5519|Impact factor-15.9
http://houghtonstreetreview.com/index.php/hsr

EFFECTIVE METHODS FOR DEVELOPING STRENGTH AND SPEED QUALITIES IN YOUNG GYMNASTS

Murzoyeva Kh.A.
Physical Education Instructor, University of World Economy and Diplomacy
E-mail: Hurshi1323@gmail.com

Abstract: Objective: This study aimed to evaluate the effectiveness of plyometric and cluster-set training methods in developing strength and speed qualities in young gymnasts aged 10–13 years. Methods: Thirty-six female gymnasts (EG=18, CG=18, mean age 11.6±1.1 years) participated. A 12-week combined training program incorporating plyometric exercises, cluster sets, and specific speed drills was applied to the experimental group. Countermovement jump height (CMJ), reactive strength index (RSI), 10-meter sprint time, and a sport-specific strength test were used as outcome measures. Results: The experimental group demonstrated significant improvements in CMJ height (19.2%), RSI (24.7%), specific strength (17.8%), and sport-specific performance time (12.4%; $p<0.05$; Cohen's d: 0.82–1.14). No statistically significant between-group difference was observed for the 10-m sprint ($p=0.09$). Changes in the control group were statistically insignificant across all measures. Conclusion: The 12-week cluster-plyometric methodology significantly improves explosive and reactive strength in young gymnasts; however, its effect on short-distance sprint speed remains limited and warrants further dedicated investigation.

Keywords: young gymnasts, strength, speed, plyometric training, cluster sets, CMJ, reactive strength, sport-specific preparation.

1. INTRODUCTION

Rhythmic and artistic gymnastics belong to sports disciplines requiring a high level of explosive strength, reactive strength, and precise coordination of rapid movements. These physical qualities not only determine competitive performance but also underpin a gymnast's long-term sporting career (Frontiers in Physiology, 2024). In particular, for young gymnasts aged 10–13 years — a critical window coinciding with accelerated growth — the systematic, methodologically grounded development of strength and speed lays the essential foundation for high athletic achievement in subsequent years.

Recent research involving young gymnasts has demonstrated the efficacy of two principal training approaches: traditional plyometric training and cluster sets. Trevino et al. (2019) reported that a 10-week short-duration (7–9 min) strength-power program significantly improved jump height and sport-specific performance in female gymnasts aged 13±2 years, while no meaningful change in 10-m sprint speed was detected. García-Pinillos et al. (2024) subsequently demonstrated, through a randomized controlled trial involving 54 young female gymnasts (15.4±1.2 years), that cluster sets (PLYct) produced superior improvements in both CMJ and RSI compared with traditional plyometric sets (PLYtr).

HSR (LONDON),
HOUGHTON STREET REVIEW JOURNAL
ISSN: 2058-5519|Impact factor-15.9
http://houghtonstreetreview.com/index.php/hsr

Within the Uzbek sports science literature, research specifically addressing the development of specialized physical qualities in young gymnasts remains limited. Bekmirzaev et al. (2023) highlighted the effectiveness of resistance implements in improving motor qualities and technical performance in gymnasts. Nevertheless, the combined application of cluster sets and plyometric methods in 10–13-year-old gymnasts has yet to be examined experimentally within the local context.

A large-scale observational study published in Frontiers in Physiology (2025) confirmed that mechanical load — particularly jumps — is the primary driver of strength and power adaptations during a 12-week preparatory training phase, while physiological load governs aerobic adaptation. These findings provide an important theoretical basis for designing complex training programs.

Study Aim

The primary aim of this study was to evaluate the effect of a 12-week cluster-plyometric methodology on strength qualities (CMJ, RSI, specific strength) and speed qualities (10-m sprint, sport-specific performance time) in young gymnasts aged 10–13 years, using conventional training as a comparator.

Hypothesis

A 12-week cluster-plyometric methodology will produce statistically significant improvements in explosive and reactive strength in young gymnasts compared with conventional training. However, its effect on short-distance sprint speed is hypothesized to be limited, consistent with existing evidence reporting an absence of meaningful sprint adaptations following short-duration strength-power programs.

2. MATERIALS AND METHODS

2.1. Study Design

A randomized controlled trial (RCT) was conducted between September and December 2024. Allocation to groups was carried out using a table of random numbers. The assessor responsible for outcome measurements was blinded to group assignment (assessor-blind design). The study was conducted at a specialized sports school in the Tashkent Region of Uzbekistan.

2.2. Participants

Thirty-six female gymnasts participated (mean age: 11.6±1.1 years; training experience: 3.1±0.8 years; body mass: 34.2±4.8 kg; height: 142.3±6.1 cm). Inclusion criteria were: (1) active enrolment at a specialized sports school; (2) minimum two years of gymnastics training experience; (3) absence of severe injury during the study period; and (4) written informed consent from a parent or legal guardian. Participants were randomly allocated to an experimental group (EG, n=18) or a control group (CG, n=18). Baseline equivalence between groups was confirmed for all outcome measures prior to the intervention ($p>0.05$ for all variables).

2.3. Intervention Protocol

HSR (LONDON),
HOUGHTON STREET REVIEW JOURNAL
ISSN: 2058-5519|Impact factor-15.9
http://houghtonstreetreview.com/index.php/hsr

The experimental group participated in the specialized cluster-plyometric program three times per week for 12 weeks (36 sessions in total). Each session lasted 85 minutes and comprised the following structure:

Phase	Content	Purpose	Duration
Warm-up	Dynamic stretching, leg drills, coordination ladder exercises	Neuromuscular activation, injury prevention	15 min
Cluster Block	Plyometric jumps (CMJ, box jumps, depth jumps) in cluster format: 3×(4×1) sets, 20–30 s intra-cluster rest, 3 min inter-set rest	Explosive strength development, fast-twitch fiber recruitment	35 min
Speed Block	Specific speed drills: 5×10 m sprints, reactive jumps, apparatus-integrated rapid movements	Speed, coordination, sport-specific movement	20 min
Cool-down	Passive stretching, breathing exercises	Recovery, flexibility maintenance	15 min

The program followed a progressive overload principle and was divided into three training blocks: weeks 1–4 (learning phase: low-to-moderate intensity), weeks 5–8 (development phase: moderate-to-high intensity), and weeks 9–12 (consolidation phase: high intensity). Every fourth week was designated as an unloading week. The control group continued conventional gymnastics training under the supervision of the school's regular instructor throughout the same period (three sessions per week, 60 min per session, standard gymnastics preparation).

2.4. Outcome Measures

Variable	Assessment	Unit	Reliability (ICC)
Explosive strength	Countermovement Jump (CMJ) — force platform	cm	0.96
Reactive strength	Reactive Strength Index (RSI) — drop jump; RSI = jump height /	m/s	0.93

HSR (LONDON),
HOUGHTON STREET REVIEW JOURNAL
ISSN: 2058-5519|Impact factor-15.9
http://houghtonstreetreview.com/index.php/hsr

Variable	Assessment	Unit	Reliability (ICC)
	ground contact time		
Sprint speed	10-m sprint (laser timing gate; best of two trials)	s	0.94
Specific strength	Upper-body strength test: maximum push-ups in 30 seconds	reps	0.91
Sport-specific performance	Gymnastics combination test: time to complete a standardized 45-s element sequence	s	0.89

All assessments were conducted at baseline (T0) and at 12-week follow-up (T12) across two consecutive days: strength tests on day 1 and speed tests on day 2. Measurements were performed at least 48 hours prior to any evening training session.

2.5. Statistical Analysis

Data were analyzed using IBM SPSS Statistics 27.0. Normality of distribution was assessed using the Shapiro-Wilk test. Within-group changes were evaluated using a paired-samples t-test (normal distribution), and between-group comparisons were performed using an independent-samples t-test or Mann-Whitney U test as appropriate. The significance threshold was set at $p<0.05$. Effect sizes were calculated using Cohen's d: $d<0.2$ — trivial; 0.2–0.5 — small; 0.5–0.8 — moderate; >0.8 — large.

3. RESULTS

At baseline, no statistically significant differences were observed between EG and CG for any outcome variable ($p>0.05$ for all), confirming the initial equivalence of groups. Following the 12-week intervention, the following results were recorded.

3.1. Explosive Strength (CMJ)

In the experimental group, CMJ height increased from 22.4±2.8 cm to 26.7±3.1 cm (+19.2%; $p=0.002$; Cohen's $d=1.07$ — large effect). In the control group, the change from 22.1±2.6 cm to 23.2±2.9 cm (+4.9%; $p=0.18$) did not reach statistical significance. The between-group difference was statistically significant ($p=0.001$). This finding aligns with the superiority of cluster-based training over traditional methods in CMJ gains reported by García-Pinillos et al. (2024).

3.2. Reactive Strength Index (RSI)

HSR (LONDON),
HOUGHTON STREET REVIEW JOURNAL
ISSN: 2058-5519|Impact factor-15.9
http://houghtonstreetreview.com/index.php/hsr

In the EG, RSI improved from 0.89±0.11 to 1.11±0.13 m/s (+24.7%; p=0.001; d=1.14 — large). In the CG, the change from 0.88±0.10 to 0.94±0.11 m/s (+6.8%; p=0.21) was statistically insignificant. The between-group difference was significant (p<0.001). The magnitude of improvement is attributed to the cluster format's enhancement of stretch-shortening cycle efficiency, facilitating more intensive fast-twitch muscle fiber recruitment.

3.3. Sprint Speed (10 m)

For the 10-m sprint, the EG mean time decreased from 2.41±0.18 s to 2.34±0.16 s (−2.9%; p=0.07; d=0.34 — small), while the CG showed a change from 2.43±0.17 s to 2.40±0.18 s (−1.2%; p=0.34). No statistically significant between-group difference was found (p=0.09). This result is fully consistent with the finding of Trevino et al. (2019) that a short-duration strength-power program did not improve 10-m sprint speed in young female gymnasts.

3.4. Specific Strength (Push-ups)

In the EG, the 30-s push-up count increased from 18.3±2.4 to 21.6±2.7 repetitions (+17.8%; p=0.004; d=0.94 — large). In the CG, the change from 18.1±2.2 to 19.0±2.4 (+5.0%; p=0.23) was not significant. The between-group difference was significant (p=0.003). This finding provides quantitative support for the conclusions of Sawczyn et al. (2016) regarding the role of specific strength training in improving the quality of gymnastic element execution.

3.5. Sport-Specific Performance Time

The time required to complete the 45-s element combination decreased in the EG from 41.8±3.2 s to 36.6±2.9 s (−12.4%; p=0.003; d=0.82 — large). In the CG, the change from 42.1±3.4 s to 40.7±3.1 s (−3.3%; p=0.17) was not significant. The between-group difference was significant (p=0.004).

3.6. Summary of Results

Variable	EG T0	EG T12	CG T0	CG T12	EG p	CG p	Cohen's d
CMJ (cm)	22.4±2.8	26.7±3.1*	22.1±2.6	23.2±2.9	0.002	0.18	1.07 (large)
RSI (m/s)	0.89±0.11	1.11±0.13*	0.88±0.10	0.94±0.11	0.001	0.21	1.14 (large)
10-m sprint (s)	2.41±0.18	2.34±0.16	2.43±0.17	2.40±0.18	0.07	0.34	0.34 (small)
Push-ups (reps)	18.3±2.4	21.6±2.7*	18.1±2.2	19.0±2.4	0.004	0.23	0.94 (large)

HSR (LONDON),
HOUGHTON STREET REVIEW JOURNAL
ISSN: 2058-5519|Impact factor-15.9
http://houghtonstreetreview.com/index.php/hsr

Variable	EG T0	EG T12	CG T0	CG T12	EG p	CG p	Cohen's d
Sport-specific (s)	41.8±3.2	36.6±2.9*	42.1±3.4	40.7±3.1	0.003	0.17	0.82 (large)

** p<0.05 — statistically significant compared with T0; EG — experimental group, CG — control group, T0 — baseline, T12 — week 12.*

4. DISCUSSION

The principal findings of this study indicate that the 12-week cluster-plyometric methodology produced large effect sizes (Cohen's d: 0.82–1.14) across measures of explosive strength (CMJ: +19.2%), reactive strength (RSI: +24.7%), specific strength (+17.8%), and sport-specific performance (+12.4%). Conversely, no statistically significant between-group difference was observed for 10-m sprint speed, a finding consistent with the existing literature.

The 19.2% improvement in CMJ exceeds the gains reported by Trevino et al. (2019) following a 10-week program. Three principal explanations are proposed: first, the present intervention was two weeks longer (12 weeks); second, cluster sets facilitate superior fast-twitch fiber activation compared with traditional sets (García-Pinillos et al., 2024); and third, the combination of progressive overload and scheduled unloading weeks appears to optimize neuromuscular adaptation.

The 24.7% improvement in RSI provides further evidence for the specific advantages of the cluster format. In the study by García-Pinillos et al. (2024) involving 54 gymnasts, cluster-set training yielded a 0.07 m/s advantage over traditional training in RSI (p=0.014). The brief intra-cluster rest intervals (20–30 s) reduce fatigue accumulation and allow maximal power output on each repetition — a mechanism considered central to reactive strength adaptation.

The absence of a statistically significant between-group difference in 10-m sprint speed (p=0.09) fully corroborates the findings of Trevino et al. (2019). This phenomenon can be explained by the fact that neuromuscular adaptations specific to linear sprint speed require dedicated, prolonged sprint training beyond the scope of plyometric or strength-power programs. Furthermore, as demonstrated by Frontiers in Physiology (2025), mechanical loads (jumps) primarily drive strength and power adaptations, while physiological loads govern aerobic capacity — neither mechanism directly translates to enhanced short-distance sprint performance.

The 12.4% reduction in sport-specific performance time confirms that improvements in explosive and reactive strength transfer directly to gymnastics performance outcomes, providing quantitative support for the conclusions of Jiang (2023) regarding the relationship between physical fitness indices and competitive results.

Limitations

Several limitations of this study must be acknowledged. First, the sample size (n=36) is relatively small, limiting the generalizability of findings to broader populations. Second, the study was

HSR (LONDON),
HOUGHTON STREET REVIEW JOURNAL
ISSN: 2058-5519|Impact factor-15.9
http://houghtonstreetreview.com/index.php/hsr

conducted at a single institution, and inter-site variability was not accounted for. Third, the appropriateness of the 10-m sprint as a speed measure for all age subgroups warrants scrutiny — sport-specific agility and speed tests should be incorporated in future work. Fourth, full standardization of the control group's training content was not achieved. Future research should employ multi-site designs, larger samples, and dedicated sprint-specific interventions to resolve the unresolved question of speed adaptation in this population.

5. CONCLUSION

This study demonstrates that a 12-week cluster-plyometric methodology produces statistically significant and practically meaningful improvements in explosive strength (+19.2%; d=1.07), reactive strength (+24.7%; d=1.14), specific strength (+17.8%; d=0.94), and sport-specific performance time (+12.4%; d=0.82) in young gymnasts aged 10–13 years ($p<0.05$). No statistically significant improvement in 10-m sprint speed was observed, underscoring the need for dedicated speed-focused research in this cohort.

Practical implications: The cluster-plyometric methodology is recommended for implementation in extracurricular training sessions at specialized sports schools and gymnastics clubs. The three-times-weekly, 85-minute structured approach — comprising warm-up, cluster block, speed block, and cool-down, governed by progressive overload — is both materially and financially feasible for broad institutional adoption.

Directions for future research: (1) replication with larger, multi-site samples ($n\geq80$); (2) incorporation of a dedicated sprint component into the cluster-plyometric program and examination of combined effects; (3) stratified analysis by biological maturity stage (peak height velocity, PHV); (4) a six-month follow-up phase to evaluate the sustainability of training-induced adaptations.

References

1. García-Pinillos F., Latorre-Román P.Á., Párraga-Montilla J.A., et al. (2024). Countermovement jump and reactive strength index of artistic gymnasts improve more with cluster-based plyometric training than with traditional methods. Scientific Reports, 14, 24891. https://doi.org/10.1038/s41598-024-76150-1
2. Trevino M.A., Herda T.J., Fry A.C., et al. (2019). Effects of supplementary strength–power training on neuromuscular performance in young female athletes. Sports, 7(8), 189. https://doi.org/10.3390/sports7080189
3. Frontiers in Physiology (2025). Can mechanical load and physiological intensity during gymnastics training explain physical adaptations? An observational study. Frontiers in Physiology, 16, 1645514. https://doi.org/10.3389/fphys.2025.1645514
4. Frontiers in Physiology (2024). Isokinetic strength assessment in young artistic gymnasts over a 2-year training program. Frontiers in Physiology, 15, 1380024. https://doi.org/10.3389/fphys.2024.1380024
5. Jiang Y. (2023). Indices of physical fitness in rhythmic gymnastics athletes. Revista Brasileira de Medicina do Esporte, 29, e2022_0644. https://doi.org/10.1590/1517-8692202329012022_0644

HSR (LONDON),
HOUGHTON STREET REVIEW JOURNAL
ISSN: 2058-5519|Impact factor-15.9
http://houghtonstreetreview.com/index.php/hsr

6. Sawczyn S., Mishchenko V., Moska W., et al. (2016). The effect of specific strength training on the quality of gymnastic elements execution in young gymnasts. Journal of Physical Education and Sport, 16(4), 1289–1296. https://doi.org/10.7752/jpes.2016.04205
7. Bekmirzaev M. et al. (2023). The use of weights for the development of strength abilities of gymnasts. European Asian Journal of Sports Science, 2(1), 30–38. https://eajss.uz
8. Bobo-Arce M., Méndez-Rial B. (2013). Determinants of competitive performance in rhythmic gymnastics: A systematic review. Journal of Human Sport and Exercise, 8(3), S711–S727. https://doi.org/10.4100/jhse.2013.8.Proc3.18
9. Impellizzeri F.M., Marcora S.M., Coutts A.J. (2019). Internal and external training load: 15 years on. International Journal of Sports Physiology and Performance, 14(2), 270–273. https://doi.org/10.1123/ijspp.2018-0935
10. PMC (2024). The importance of physical fitness parameters in rhythmic gymnastics: A systematic review. International Journal of Environmental Research and Public Health. https://pmc.ncbi.nlm.nih.gov/articles/PMC11435787