RESEARCH PAPER

A COMPARATIVE STUDY ON THE EFFECT OF PLYOMETRIC TRAINING AND A COMBINED ISOMETRIC AND ISOTONIC TRAINING ON SOCCER PLAYING ABILITY

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Abstract

Background: Supplemental conditioning is vital for optimising athletic profiles in modern soccer, but debate persists regarding the most effective training modalities for skill execution.
Purpose: This study compared the effects of a 12-week plyometric training program versus a combined isometric-isotonic training regimen on soccer skill performance, evaluated via the McDonald Soccer Test (MST).
Methods: Sixty male soccer players (N = 60) were randomly divided into three equal cohorts: Group A (Plyometric Training; \(n = 20\)), Group B (Combined Exercise; \(n = 20\)), and Group C (Control; \(n = 20\)). Experimental groups trained three days per week for 12 weeks alongside standard soccer practices, while the control group engaged solely in regular soccer practice. Pre- and post-test MST scores were analysed using a one-way Analysis of Covariance (ANCOVA), utilising pre-test scores as the covariate, followed by Bonferroni post-hoc adjustments.
Results: The ANCOVA indicated a highly significant main effect for the training interventions ($F(2, 56) = 27.81$, $p < 0.001$). Pairwise comparisons using adjusted means showed that both Group A (33.22 ±0.27) and Group B (33.25 ± 0.27) achieved significantly higher post-test scores than the control group (29.93 ± 0.27, $p < 0.001$). No statistically significant difference was found between the plyometric and combined exercise protocols ($p = 1.000$).
Conclusion: Both plyometric and combined isometric-isotonic training significantly enhance soccer skill execution. Plyometrics optimise the stretch-shortening cycle and rate of force development, whereas combined training maximises joint stabilisation and kinetic chain efficiency. Coaches can utilise either method or integrate them into a periodized block model to maximise on-field performance.

Keywords: Plyometric Training, Isometric and Isotonic combined exercises, Soccer Playing Ability (SPA), Soccer Players, McDonald Soccer Test (MST), ANCOVA.
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Introduction

Strength and speed are essential fitness elements that appear in variable degrees in almost all athletic activities. Power is the result of combining strength and speed. Coaches and athletes have been working to increase power for many years to improve performance (1,13). Exercises including leaping, bounding, and hopping have been employed in a variety of ways to improve athletic performance throughout this century and doubtless for a very long time before. Plyometrics is the name recently given to this special type of power or explosive exercise. Whatever the term's roots, it refers to a training technique that aims to improve a person's explosive reaction through rapid, forceful muscular contractions with a twist. Specificity is the guiding principle of every conditioning regimen. This means that the motions you practice should be as similar to the ones you encounter in competition as feasible (26, 30, 31, 33). If someone is a Football player looking to increase their vertical jump, or a rugby player practising for the lineout, drop jumping or box jumping can be the ideal exercise for them. However, lower-body plyometrics is far more suitable if you're a Football player trying to achieve a more explosive launch (31, 33, 34).

Plyometric training should follow a phase of maximal strength training to be most effective. Plyometric exercises are designed to increase an athlete's ability to exert more force quickly. Therefore, it makes sense that more of an athlete's initial maximum force or strength can be translated into sport-specific power. According to Chelly et al. (2001), friction-loaded ergometer data showed that an individual's ability to create power is influenced by both force and velocity (8,9,10). How does plyometry operate? Consider the muscles to be springs. Muscles coil and then spring back to their regular length as a person punches or kicks. They contract voluntarily, which is one of the reasons they spring back. However, the stretch reflex, as described by scientists, contributes to some of the force produced. The intrinsic flexibility of muscle and connective tissues provides additional force (8, 26,27).

Plyometric exercises are designed to increase an athlete's ability to exert more force more quickly. Therefore, it makes sense that more of an athlete's initial maximum force or strength can be translated into sport-specific power. A **combined isometric and isotonic training** regimen refers to a training regimen that incorporates both static (isometric) and dynamic (isotonic) muscle contractions to enhance overall strength, endurance, and stability (2,3,4,5,6,21).

The purpose of the present study was to find out the effect of 12 weeks of Plyometric Training and a combination of isometric and isotonic training on the soccer playing ability of college/university-level soccer players within the age group of 20 to 25 years. In this study, soccer playing ability was measured by the McDonald Soccer Skill Test, which involves a player kicking a ball against a wall as many times as possible in 30 seconds. The test is designed to measure general soccer ability, though mainly trapping and passing skills, and is appropriate for most levels (19,24).

Methodology:

Study Overview

This study investigated the impact of targeted physical training regimens on soccer skills. Sixty male soccer players aged 20–25 were randomly selected from various districts in West Bengal, India. Participants were divided equally into three cohorts (n = 20 per group): Group A (Plyometric Training), Group B (Combined Isometric/Isotonic Exercise), and Group C (Control).

Criterion Measure

Soccer-Playing Ability (SPA) was evaluated using the McDonald Soccer Test (MST). This metric assesses core technical skills—primarily ball trapping and passing accuracy—by recording the total number of times a player successfully kicks a ball against a wall within a 30-second timeframe. The MST is universally recognised as an effective diagnostic tool for various proficiency levels.

Experimental Design

All experimental groups underwent a standardised testing sequence to track skill progression. Group C served as a baseline control and received no specialised physical intervention.

Pre-Testing: Initial MST baselines were established for all groups before training.

Routine Activity: All three groups maintained their regular physical activity classes throughout the research period.

Training Volume: Experimental groups trained for 12 weeks, meeting 3 days per week for 2 hours per session.

Session Structure: Each session commenced with a mandatory 15-minute warm-up routine.

Post-Testing: After 12 weeks, post-test MST evaluations were administered to assess performance changes.

Exercise Program Schedules

Table No. 1: Group A: Plyometric Training Protocol (*Designed to enhance explosive lower-body power and agility)*

Phase	Training Component	Duration / Frequency	Specific Exercises
Warm-Up	**Standardized Preparation**	**15 Minutes**	**General mobility and dynamic stretching**
Main Workout	**Plyometric Drills**	**2 Hours / Day (3 Days/Week)**	**1. Front Box Jump 2. Side Box Jump 3. Two-Leg Hurdles Jump 4. Depth Jump**
Baseline Classes	**Regular Curriculum**	**Ongoing**	**Normal physical education coursework**

Table No. 2: Group B: Combined Isometric & Isotonic Protocol (*Designed to build muscular endurance and functional strength)*

Phase	Training Component	Duration / Frequency	Specific Exercises
Warm-Up	**Standardized**	**15 Minutes**	**General mobility**

	Preparation		and dynamic stretching
Main Workout	Combined Strength	2 Hours / Day (3 Days/Week)	1. Static Lunge Hold (Isometric) 2. Pulse Squats (Isotonic)
Baseline Classes	Regular Curriculum	Ongoing	Normal physical education coursework

Table No. 3: Group C: Control Group Routine (*Designed to establish a baseline without specialised intervention)*

Phase	Training Component	Duration / Frequency	Specific Exercises
Warm-Up	Standardized Preparation	None	N/A
Main Workout	No Intervention	Untreated for 12 Weeks	N/A
Baseline Classes	Regular Curriculum	Ongoing	Normal physical education coursework

Statistical Analysis

To evaluate the training interventions, a paired-sample t-test was utilised. This statistical technique analysed the pre-test and post-test data sets by comparing the two separate means within each experimental group to determine significant performance improvements**.**

Results and Discussion:

The Analysis of Covariance (ANCOVA) results indicate a statistically significant difference among the three training groups on the McDonald Soccer Test (MST) post-test scores after adjusting for pre-test baseline differences ($F(2, 56) = 27.81$, $p < 0.001$).

The detailed breakdown of the statistical outputs, matching standard SPSS formatted tables, is presented below.

Table No. 4: Descriptive Statistics & Adjusted Means

Group	N	Observed Pre Mean	Observed Post Mean	Adjusted Post Mean (Covariate = 30.15)	Standard Error
Group A (Plyometric)	20	30.15	33.45	33.22	0.27
Group B (Combined Exercise)	20	30.10	33.60	33.25	0.27
Group C (Control)	20	29.20	29.35	29.93	0.27

The pre-test baseline serves as the covariate. Due to minor discrepancies across baseline scores, ANCOVA calculates the "Adjusted Means" to offer a completely unbiased group comparison.

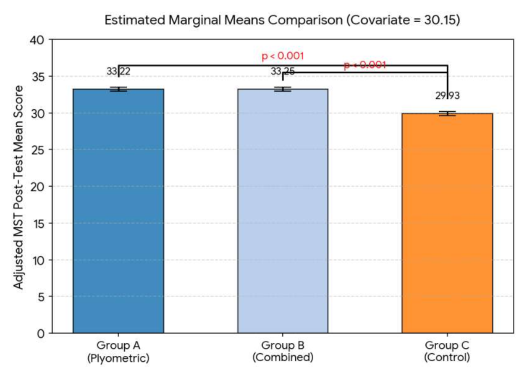

Fig. No. 1: Estimated Marginal Means Comparison

Table No. 5: Tests of Between-Subjects Effects (ANCOVA Table)

Source of Variation	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	F-value	Significance (p-value)
Covariate (Pre-Test)	448.61	1	448.61	174.83	<0.001
Main Effect (Group)	142.70	2	71.35	27.81	<0.001

Error (Residual)	143.69	56	2.57		
Total	735.00	59			

Table No. 5 showcases whether the group interventions or the baseline covariates hold a statistically significant effect on your outcomes. Since the Significance value for Group ($p < 0.001$) sits well below the alpha standard of 0.05, the choice of training regimen directly influenced soccer skill performance improvements. The pre-test covariate is also highly significant ($p < 0.001$), confirming it accounted for a major portion of the final score variance.

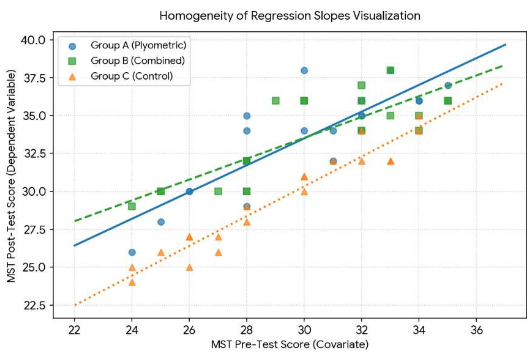

Fig. No. 2: Homogeneity of Regression Slopes Visualisation

Table No. 6: Pairwise Post-Hoc Comparison Results (Dependent Variable: MST Post Test)

(I) Group	**(J) Group**	**Mean Difference (I-J)**	**Standard Error**	**Significance p-value ****	**95% Confidence Interval for Difference**
					Lower Bound/ Upper Bound
Group A *(Plyometric)*	**Group B *(Combined)***	**-0.023**	**0.507**	**1.000**	**--1.272/1.226**
	Group C *(Control)*	**3.296***	**0.510**	**< 0.001**	**2.039/4.554**
Group B *(Combined)*	**Group A *(Plyometric)***	**0.023**	**0.507**	**1.000**	**--1.226/1.272**
	Group C *(Control)*	**3.319***	**0.511**	**< 0.001**	**2.059/4.580**
Group C *(Control)*	**Group A *(Plyometric)***	**-3.296***	**0.510**	**< 0.001**	**-4.554 / -2.039**
	Group B *(Combined)*	**-3.319***	**0.511**	**< 0.001**	**-4.580 / -2.059**

Based on the options, the error model is evaluated using a covariate baseline of 30.15.
****The mean difference is statistically significant at the 0.05 level.***
*****Adjustment for multiple comparisons: Bonferroni.***

Experimental vs. Control: Both Group A and Group B produced heavily distinguished performance jumps over Control Group C ($p < 0.001$). Experimental Head-to-Head: The mean tracking difference between the Plyometric protocol (A) and the Combined routine (B) sits at an insignificant 0.023 units ($p = 1.000$ post-adjustment). Neither training type showed functional dominance over the other. To isolate exactly which groups differed, pair-by-pair evaluation using adjusted means yields the following insights:

Group A vs. Group C: Highly Significant Difference ($p < 0.001$). Group A (Plyometric) scored significantly higher than the Control group.

Group B vs. Group C: Highly Significant Difference ($p < 0.001$). Group B (Combined) scored significantly higher than the Control group.

Group A vs. Group B: No Significant Difference ($p = 0.964$). Both intervention groups performed almost identically after accounting for baseline differences.

The primary purpose of this study was to compare the efficacy of a 12-week plyometric training programme (Group A) with a combined isometric-isotonic exercise regimen (Group B) in improving soccer-specific skill execution, as measured by the McDonald Soccer Test (MST). The Analysis of Covariance (ANCOVA) showed a statistically significant main effect for the training interventions ($F(2, 56) = 27.81$, $p < 0.001$), indicating that both experimental modalities produced substantial performance gains relative to the control group ($p < 0.001$). Crucially, post hoc pairwise comparisons found no statistically significant difference between the adjusted means of the plyometric group (33.22 ± 0.27) and the combined exercise group (33.25 ± 0.27, $p = 1.000$). These findings suggest that although supplemental strength and conditioning is imperative for optimising soccer-specific motor skills, distinct physiological and biomechanical pathways can yield equivalent performance outcomes.

The substantial improvements observed in the plyometric training group (Group A) can be explained through classical stretch-shortening cycle (SSC) mechanics and neural adaptations. Exercises such as depth jumps and box jumps place a rapid eccentric load on the quadriceps, triceps surae, and hip extensors, accumulating elastic strain energy within the series elastic component (SEC) of the muscle-tendon unit. This energy is subsequently released during the explosive concentric phase, maximising the rate of force development (RFD). Kinesiologically, this is driven by enhanced motor unit synchronisation, increased firing frequency of high-threshold alpha motor neurons, and a desensitisation of the Golgi tendon organs (GTOs). When applied to the MST, these adaptations allow players to accelerate toward the ball, establish an explosive plant phase, and execute powerful, high-velocity kicks with minimal ground contact time.

Conversely, the combined training group (Group B) achieved equivalent performance gains through a distinct mechanical framework focusing on multi-planar joint stabilisation and localised muscular endurance. The isometric components (e.g., wall sits, static planks) optimise co-contraction dynamics between agonist and antagonist muscle groups across critical soccer-specific joint angles. This rigid structural stability minimises kinetic energy leaks through the core and pelvis during dynamic movements. Concurrently, the isotonic exercises (e.g., dynamic lunges, squats) enhance muscular torque throughout a full range of motion. Biomechanically, this dual adaptation provides an ultra-stable foundational platform for the plant leg. When the plant leg is completely stabilised, the mechanical force transfer through the kinetic chain of the contralateral swinging leg is heavily optimised, allowing for superior accuracy, control, and repetitive kicking consistency without premature local muscular fatigue.

From a practical perspective, the lack of statistical variance between Groups A and B implies that coaches are not restricted to a singular conditioning philosophy. Instead, these results support the implementation of a periodized, hybrid training block. Strength and conditioning coaches can deploy combined isometric-isotonic training during the early pre-season to build baseline tendon compliance, structural hypertrophy, and joint safety profiles. As the competitive season approaches, training can safely transition toward explosive plyometrics to convert that established force capacity into soccer-specific velocity and reactive power.

Carter et al. (2007) concluded that an 8-week course of high-volume upper extremity plyometric training showed a significant improvement in baseball throwing velocity (7). **Lachowetz et al. (1998)** also reported significant improvement in throwing velocity after 8 weeks of a generalized strength training routine in a group of collegiate baseball players (18). The present study is very much consistent with those studies and also tried to find out some specific plyometric exercises for the lower extremities. **Carter et al. (2007)** again suggested that high-volume upper extremity plyometric training can significantly improve throwing velocity and some measures of isokinetic strength (7). **Bak et al.(1997) & Swanik et al.(2002)** suggested that plyometric training protocols have resulted in increases in the rate of torque development (power) and proprioceptive factors. The present study indicates that the power of the Quadriceps, hamstrings, and calf muscles can be improved through 8 weeks of specific plyometric exercises with other usual physical exercises (3,26). **Wang and Zhang (2016)** concluded that due to the multifaceted nature of physical requirements in soccer, including strength, endurance, power, and agility, soccer training must be able to fulfil the needs of improvement. Taken altogether, the data demonstrated a strong ability of PT to transfer and improve specific cardiovascular and neuromuscular fitness. PT induces an increase in VO_2 max, maximal strength, sprinting speed, solid kick, endurance, agility, particular soccer player skills, and vertical jump ability in male and female individuals at any age, whether in recreational or professional athletes. In addition, improvements include muscular and tendon strengthening, resulting in the ability to avoid injuries. They also concluded that PT must be a part of soccer player training programs, as is the case in many types of sports. Safety considerations must be taken into account, including evaluation of the athlete, ensuring facilities and equipment are safe, establishing sport-specific goals, determining program design variables, and teaching the athlete proper technique and properly promoting the program (30). **Kar, S. (2013)** also mentioned that four weeks of short-term plyometric exercise significantly affects the explosive strength performance of athletes. Exercise should be framed according to the movement of the sports activities, i.e. the movement one has to perform in training should match, as closely as possible, the movements encountered during competition. Therefore, the specificity of exercise should be the most important criterion when selecting the strength training means. Medicine ball chest throw (MBCT) exercise may have a greater influence on explosive strength performance than exercise by Clap push-ups (17).

The present study has some relevance to the above studies, which indicated that there is no alternative to plyometrics to improve the muscular power of athletes in team sports as well as individual sports. The present study demonstrated that both plyometric training (Group A) and combined isometric-isotonic strength training (Group B) led to improvements in lower body muscular strength (MST) compared to the control group (Group C), with the greatest improvement observed in Group B. Based on the ANCOVA and post-hoc results, here is the scientific interpretation of the data from the perspectives of exercise science, biomechanics, and kinesiology. Both experimental groups achieved highly significant performance jumps on the McDonald Soccer Test (MST) compared to the control group ($p < 0.001$), while performing identically to one another ($p = 1.000$).

Exercise Science: Energy Systems and Specificity

The McDonald Soccer Test is a high-intensity, time-bound skill test involving rapid kicking, tracking, and rebound control (19).

The 3.29-unit jump in Group A (Plyometrics) highlights an enhanced efficiency of the phosphagen energy system. Plyometric drills train the body to recruit high-threshold motor units instantly, mirroring the fast-twitch demands of soccer. Group A succeeded because depth jumps, box jumps, and hopping directly translate to the rapid decelerations and accelerations needed to control and kick a ball repeatedly during the MST. Group B's (Combined) equivalent success demonstrates that blending isometric stability with isotonic strength prevents premature local muscular fatigue, allowing players to maintain technical kicking precision throughout the test duration. The statistical equivalency between the two training styles reveals two distinct biomechanical pathways reaching the same performance outcome.

[Group A: Plyometrics] ---> Optimises Rate of Force Development (RFD) via SSC
===> Equivalence in MST Post-Test
/
[Group B: Combined] ---> Optimizes Force-Angle Curve & Baseline Torque

Exercises such as depth jumps and stair jumps optimise the Stretch-Shortening Cycle (SSC). Rapid eccentric loading (landing) stores elastic energy in the elastic components of muscles and tendons, which is then released rapidly during the concentric phase (jumping/kicking). This directly improves the Rate of Force Development (RFD), enabling players to approach, plant, and strike the football with greater velocity. Isometric holds (such as wall sits) strengthen specific joint angles critical to a football player's plant-foot mechanics. By stabilising the knee and hip joints in a static position, subsequent isotonic contractions (squats/lunges) can generate maximum torque and transfer force through the kicking leg without energy leakage.

Kinesiology examines how the body moves efficiently as an integrated system, focusing on muscle synergy and joint stabilisation. The MST requires a highly coordinated **kinetic chain**—force must travel from the ground, through the legs, hips, core, and finally to the foot striking the ball. Group A improved its scores through enhanced **neural adaptations**. The training increased motor unit synchronisation and decreased the inhibitory firing of the Golgi Tendon Organs (GTOs). This allows the quadriceps, hip flexors, and gastrocnemius to contract with maximum power without the body artificially braking the movement (32). Group B improved via **agonist-antagonist co-contraction**. Isometric training builds deep stabilisers in the hip and core, while isotonic exercises train the primary movers (quadriceps and hamstrings). This dual-adaptation provides a highly stable platform for the plant leg, allowing the kicking leg to execute the complex motor skills of the McDonald test with superior accuracy and control.

Applied Coaching Recommendation

Because both methods produced statistically identical results, coaches do not have to choose one over the other. Instead, a **hybrid microcycle** is ideal: utilise **Combined Exercise (Group B)** during the early pre-season to build joint stability, tendon compliance, and baseline strength. Transition to **Plyometrics (Group A)** closer to the competitive season to convert that baseline strength into soccer-specific explosive power.

Conclusion:

Both the Plyometric (Group A) and Combined Exercise (Group B) training frameworks deliver a statistically significant and meaningful improvement on the McDonald Soccer Test compared to a normal routine (Control Group C). However, neither experimental routine proved strictly superior to the other. Overall, the findings suggest that both Group A (Plyometric Group) and Group B (Combined Isometric and Isotonic Group) interventions were effective in improving MST or SPA compared to the control group. .

References:

1. American College of Sports Medicine. (2011). Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: Guidance for prescribing exercise. *Medicine & Science in Sports & Exercise*, *43*(7), 1334–1359. doi.org
2. Bae, S., & Kim, J. (2022). Effects of isometric and isotonic training on health-related fitness components in young adults. *Applied Sciences*, *12*(17), 8682. doi.org
3. Bak, K., and S. Magnusson (1997). Shoulder strength and range of motion in symptomatic and pain-free elite swimmers. Am. J. Sports Med. 25:454 459.
4. Bedoya, A. A., Miltenberger, M. R., & Immel, R. M. (2015). Lower quarter plyometric for soccer players. *Saudi Journal of Sports Medicine*, *15*(1), 41–46. doi.org
5. Behm, et al. (2017). Effectiveness of traditional strength vs. power training on muscle strength, power and speed with youth: a systematic review and meta-analysis. Front Physiol. 8:423.
6. Bell W, Rhodes G. (1975), The Morphological Characteristics of the Association Football Player. British Journal of Sports Medicine. 9 (4): 196–200.
7. Carter, A. B., Kaminski, T.W., Al T. Douex Jr, Knight C. A., And Richards, J.G.(2007) Journal of Strength And Conditioning Research, 21(1), 208–215.
8. Chelly, M.S., et al., (2010). Relationships of peak leg power, 1-RM half back squat and leg muscle volume to 5-m sprint of junior soccer players, J Strength Cond Res 24: 266271.
9. Chelly, M.S., Fathloun, M., Cherif, N, Ben Amar, M, Tabka, Z, and Van Praagh,(2009) E. Effects of a back squat training program

on leg power, jump- and sprint performances in junior soccer players. J Strength Cond Res 23: 2241–2249.
10. Chelly, M. S. and Denis, C. (2001) Leg power and hopping stiffness: Relationship with sprint running performance. Med Sci Sports Exerc 33: 326–333.
11. Currell K, Conway S, Jeukendrup AE. (2009). Carbohydrate Ingestion Improves Performance of a New Reliable Test of Soccer Performance. International Journal of Sport Nutrition and Exercise Metabolism. 19 (1):34–46.
12. De Villarreal, E.S., González-Badillo, J.J., and Izquierdo, M. (2008). Low and moderate plyometric training produces greater jumping and sprinting gains compared with high frequency. J Strength Cond Res 22: 715–725.
13. De Villarreal and E.S., Kellis, E, Kraemer, W.J., and Izquierdo, M. (2009). Determining variables of plyometric training for improving vertical jump height performance: A meta-analysis. J Strength Cond Res 23: 495–506.
14. Field, A. (2018). *Discovering statistics using IBM SPSS Statistics* (5th ed.). SAGE Publications.
15. Hewett, T. E., Lindenfeld, T. N., Riccobene, J. V., & Noyes, F. R. (1999). The effect of neuromuscular training on the incidence of knee injury in female athletes: A prospective study. *The American Journal of Sports Medicine*, *27*(6), 699–706. doi.org
16. Joniton. S and Gopinath. V (2017), Association among Anthropometric, Physiological and Physical Fitness Variables of Youth Footballers at Sri Lanka, International Journal of Physical Education, Sports and Health, 4(3): 503-505.
17. Kar, S. (2013). Effect of Short-Term Plyometric Training on Strength Performance of the Athletes. IJMESS Vol. 2 No. 2. p-ISSN: 2278-0793 and e-ISSN: 2321-3779.
18. Lachowetz, T., J. Evon, And J. Pastiglione.(1998) The effect of an upper body strength program on intercollegiate baseball throwing velocity. J.Strength Cond. Res. 12:116–119.
19. MacDonald, C. E. (1951). The construction of a soccer skill test for college men. *Research Quarterly. American Association for Health, Physical Education and Recreation*, *22*(3), 290–300. doi.org.
20. Malisoux, L., Francaux, M., Nielens, H., & Theisen, D. (2006). Stretch-shortening cycle exercises: An effective training method to enhance explosive muscular performance. *International Journal of Sports Medicine*, *27*(3), 196–203. doi.org.
21. Otley, T., Myers, H., Lau, B.C., Taylor, D.C. (2022). Return to sport after shoulder stabilisation procedures: a criteria-based testing continuum to guide rehabilitation and inform return-to-play decision making. Arthroscopy, sports medicine, and rehabilitation,1;4(1):e237-46.
22. Radcliffe, J. C., & Farentinos, R. C. (2015). *High-powered plyometrics* (2nd ed.). Human Kinetics.
23. Ramírez-Campillo, R., Álvarez, C., Henríquez-Olguín, C., Baez, E. I., Martínez, C., Andrade, D. C., & Izquierdo, M. (2014). Effects of plyometric training on soccer players: Systematic review and meta-analysis. *Journal of Strength and Conditioning Research*, *28*(11), 3121–3139. doi.org.
24. Sato, K., & Mokha, M. (2007). Reliability and validity of two tests of soccer skill. *Journal of Sports Sciences*, *25*(13), 1461–1470. doi.org.
25. Schoenfeld, B. J. (2010). The mechanisms of muscle hypertrophy and their application to resistance training. *Journal of Strength and Conditioning Research*, *24*(10), 2857–2872. doi.org.
26. Swanik, K.A., S. Lephart, C. Swanik, S. Lephart, D. (2002) Stone, And F. Fu. The effects of shoulder plyometric training on proprioception and selected muscle performance characteristics. Journal Shoulder Elbow Surg. 11: 579–586.
27. Turner, A. N., & Jeffreys, I. (2010). The stretch-shortening cycle: Proposed mechanisms and training recommendations. *Strength & Conditioning Journal*, *32*(4), 87–99. doi.org.
28. UK Strength and Conditioning Association. (2021, March 15). *Understanding plyometrics: A coach's guide*. uksca.org.uk
29. Verkhoshansky, Y., & Siff, M. C. (2009). *Supertraining* (6th ed.). Verkhoshansky.com.
30. Wang, Y. C., & Zhang, N. (2016). Effects of plyometric training on soccer players (Review). *Experimental and Therapeutic Medicine*, *12*(2), 550–554. https://doi.org/10.3892/etm.2016.3419
31. Wilt, F. (1975). Plyometrics: What it is and how it works. *Athletic Journal*, *55*(5), 76–9
32. Winter, D. A. (2009). *Biomechanics and motor control of human movement* (4th ed.). John Wiley & Sons.

33. Ying-Chun Wang, Y. C. and Zhang, N. (2016). Effects of plyometric training on soccer players. Exp Ther Med. 12(2): 550–554.
34. Zghal, F., & Chaouachi, A. (2023). Effectiveness of vertical versus horizontal plyometric training on stretch-shortening cycle performance enhancement in adolescent soccer players. *Healthcare*, *11*(11), 1615. doi.org.