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THE EFFECT OF COMBINED EXERCISES ON MOVEMENT SPEED, PHYSIOLOGICAL MARKERS, AND BASIC SKILLS OF FOOTBALL GOALKEEPERS

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Abstract
The purpose of the current study was to examine the effects of combined exercise training on movement speed, gender-specific biochemical responses, and on the fundamental movement skills of male football goalkeepers. The study was conducted with a sample of 12 primary schools, using a quasi-experimental design: non-equivalent groups of equivalent proportion. The study sample was (n=12) First-division goalkeepers who played for clubs in Al-Diwaniyah Governorate during the 2023–2024 season, divided equally between both the groups. Experimental group followed combined exercises training-based programme, and control group followed a traditional training programme. Exclusive and save statistical equivalence following pre-tests. The 12-week interventions course consisted of 36 sessions in total, with three sessions each week. The follow-up results proved that the experimental group's post-test score in all the selected variables was significantly better. These results highlight the effect of joint training programs on increasing the physiological responsiveness, the speed of movement as well as the core goalkeeping skills.

Introduction

In modern football, the position of goalkeeper requires performance not only on the physical, physiological, technical elements, but also on the cognitive level of development. In addition to their primary role of preventing the opposition from scoring, goalkeepers are now as expected to play out from the back, help their team to retain possession of the ball, as well as begins counterattacks if possible. While they are crucially important they are easily overlooked in more traditional training programmes in favour of outfield players. This lack of reflection to the goalkeeping role in the literature has been widely condemned to underline the need for goalkeeper-specific training for the demands placed on them as a player [1,2].

One of the greatest physical attributes a keeper can have is the ability to move quickly, especially in short, powerful bursts. Keepers often have to dive, change directions quickly, or move sideways or vertically with great accuracy. These activities are also not merely motoric, but involve neuromuscular coordination and anaerobic power. Hence the incorporation of combined drills, which involves the simultaneous execution of strength, agility and skill-related tests, has become, from a scientific perspective, an accepted training strategy to enhance the performance of goalkeepers [3,4].

Recent studies have also informed and reinforced the importance of measuring specific physiological indices (e.g., creatine phosphokinase (CPK) and lactate dehydrogenase (LDH)) as potential biochemical markers of high-intensity workloads in muscle. Specifically, CPK is used as an index of muscular stress and microtrauma, and LDH levels directly correlates with anaerobic glycolysis and fatigue thresholds [5]. Assessment of these enzymatic markers gives a more objective view about training load adaptation and recovery status.

Combined training regimens have also been demonstrated to promote both physical fitness improvements and skill learning. Their content usually involves plyometric work, resistance exercises, and sport-specific training exercises that mimic game demands directly44. For goalkeepers, these training programmes enhance

Proximus Journal of Sports Science and Physical Education
Volume 2, Issue 7, July 2025
https://proximusjournal.com/index.php/PJSSPE
ISSN (E): 2942-9943

reactive strength, agility, timing and anticipation—all of which are fundamental for high ball (HB) handling, narrowing angle and making saves [6,7].

In addition, the tactical design of these programs may help better maintain technical execution while fatigued, a time point at which fatal errors are frequently observed during games. By preparing the goalkeeper's body and nervous system to retain his or her performance under pressure, coaches may be able to greatly minimize any decrease in performance during match critical periods [8,9].

Based on these considerations, the purpose of the present study is to assess the effects of 12 week, mixed track and field training on movements speed, physiological indices (CPK, and LDH), as well as on basic technical skills of firstIraqi division football goalkeepers. It also aims to help further expand the limited, but growing, literature on goalkeeper performance, and to formulate training-related guidelines based on the available evidence in elite levels of competition.

Research Problem

In spite of the importance goal keepers currently have in football, there is a clear absence of specific training methods for them. The majority of traditional CPD courses take into account general well-being or outfield players only, without considering the specific needs of professionals when performing the duties of a goalkeeper. The absence of this is particularly troubling with respect to the development of speed of movement, the control of physiological responses (e.g., muscle stress and fatigue), and the enhancement of fundamental skills like ball handling, anticipation, and distribution at game-intensity. Yet, the absence of targeted, evidence-based training guidelines for goalkeepers calls for the following question:

Is a multi-exercise training program for enhancing the speed of movement, physiological indicators (CPK, LDH) and basic goalkeeping skills of first-division football goalkeepers effective?

Research Objectives

This study seeks to achieve the following objectives:

1. To determine the effect of combined exercises on the movement speed of football goalkeepers.
2. To examine changes in physiological markers (CPK and LDH) resulting from a structured combined exercise program.
3. To evaluate the impact of the program on the development of fundamental goalkeeper skills, including anticipation, ball control, and distribution.

Research Hypotheses

The study is based on the following hypotheses:

1. There will be statistically significant improvements in movement speed among goalkeepers who undergo combined training compared to those who do not.
2. Combined exercises will result in favorable changes in physiological markers (reduced CPK and LDH levels).
3. Goalkeepers who follow the combined exercise program will demonstrate measurable improvements in core technical skills relative to the control group.

Research Scope

The present study was conducted within the following defined frameworks:

1. Human Scope: The research sample consisted of goalkeepers from first-division football clubs in Al-Qadisiyah Governorate.
2. Temporal Scope: The study was carried out over a period extending from June 30, 2023, to November 20, 2024.

Proximus Journal of Sports Science and Physical Education
Volume 2, Issue 7, July 2025
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ISSN (E): 2942-9943

3. Spatial Scope: Field experiments and the implementation of the training program were conducted at Al-Najma Sports Club Stadium, located in Al-Qadisiyah Governorate.

Research Methodology

This study adopted the experimental approach, utilizing a two-group design (experimental and control), as this methodology provides high precision in controlling independent variables and assessing the actual impact of the training intervention. Such a design is considered one of the most reliable models for measuring cause-effect relationships in sports science research, particularly when studying the physiological and performance-based responses to structured training programs.

Research Population and Sample

The research population included goalkeepers representing first-division football clubs in Al-Qadisiyah Governorate during the 2023–2024 season. The participating clubs were Al-Diwaniyah, Al-Ittifaq, Afak, and Al-Mahnawiyah, with three goalkeepers selected from each club, yielding a total of 12 goalkeepers.

Participants were randomly distributed into two equal groups:

- Experimental Group (n = 6): Goalkeepers who followed a specially designed training program based on combined exercises.
- Control Group (n = 6): Goalkeepers who continued with their traditional training routines without modifications.

To ensure baseline equivalence between the two groups, pre-tests were conducted. These tests aimed to measure homogeneity and statistical parity across critical variables (e.g., height, weight, age, years of training, motor speed, CPK and LDH levels, and basic goalkeeping skills). The results, presented in Table 1, confirmed the absence of any significant differences, supporting the unbiased random assignment of participants and the validity of the comparative analysis.

Table 1. Homogeneity and Equivalence Between Groups Across Key Variables

Variable	Unit	Control Group (Mean ± SD)	CV%	Experimental Group (Mean ± SD)	CV%	T-value	Significance
Height	cm	178.5 ± 4.89	2.74	178.6 ± 4.93	2.76	0.06	NS
Body Mass	kg	72.5 ± 3.62	4.99	73.17 ± 3.13	4.27	0.34	NS
Age	years	28.5 ± 2.66	9.35	30.00 ± 3.69	12.29	0.81	NS
Training Age	years	10.83 ± 1.72	15.90	11.17 ± 2.64	23.64	0.26	NS
Motor Speed	sec	2.67 ± 0.27	10.11	2.65 ± 0.29	11.08	0.19	NS
CPK	U/L	147.5 ± 5.01	3.40	145.3 ± 5.54	3.81	0.71	NS
LDH	U/L	160.3 ± 7.12	4.44	163.5 ± 6.25	3.82	0.82	NS
High Ball Handling	score	20.5 ± 2.88	14.05	21.67 ± 3.39	15.63	0.64	NS
Ground Ball Handling	score	19.33 ± 2.50	12.95	18.83 ± 2.32	12.30	0.36	NS

Proximus Journal of Sports Science and Physical Education
Volume 2, Issue 7, July 2025
https://proximusjournal.com/index.php/PJSSPE
ISSN (E): 2942-9943

Ball Clearance & Deflection	score	7.00 ± 1.10	15.65	7.33 ± 1.03	14.08	0.54	NS

*NS = Not Significant at α = 0.05; df = 10; critical value = 2.22

Field Procedures – Nelson Test for Measuring Motor Speed

Purpose:

The Nelson Test is designed to measure motor speed, particularly the neuromuscular responsiveness of athletes. This is a crucial performance determinant in goalkeeping, where rapid reactions to external stimuli are vital for success in live match scenarios.

Equipment:

- A flat, unobstructed area (20 meters long × 2 meters wide)
- Measuring tape
- High-precision digital stopwatch

Procedure Description:

The athlete starts at a designated midpoint, facing the examiner positioned at the far end holding the stopwatch. The examiner raises one arm vertically and, at a sudden moment, signals either right or left. Upon this cue, the stopwatch starts, and the athlete must sprint as quickly as possible toward the indicated side, aiming to reach the lateral line 6.4 meters away. Timing stops the moment the athlete crosses the line.

Scoring Protocol:

Each athlete performs six total trials—three in each direction—with a minimum rest period of 20 seconds between runs to mitigate fatigue effects. The final motor speed score is calculated using the following formula:

Final Time = Sum of six trial times ÷ 6

All results are recorded in seconds to one decimal place (00.0 s).

Biochemical Analysis – CPK and LDH Enzymes

Procedure:

To assess the physiological impact of anaerobic training, blood samples were collected by a qualified medical team to measure the levels of Creatine Phosphokinase (CPK) and Lactate Dehydrogenase (LDH)—both well-known markers of muscular stress and fatigue.

Sampling:

Each participant provided two 5 mL blood samples at the following intervals:

- Pre-exercise sample: before initiating any physical activity.
- Post-exercise sample: five minutes after completing the training session.

The blood was drawn into sterile tubes for biochemical testing, then centrifuged to separate the serum component used in the analysis.

Analysis Method:

*The serum samples were analyzed using an automated clinical chemistry analyzer (Auto Analyzer) operating under the End Point Method at a controlled temperature of 37.5°C. Samples were inserted into the machine's diagnostic system, where they underwent full automation through three built-in analytical units.

Upon completion, a light indicator signaled that the results were ready. The technician validated the process, and the analyzer displayed the final enzyme values on screen, which were then digitally stored for statistical analysis.

Proximus Journal of Sports Science and Physical Education
Volume 2, Issue 7, July 2025
https://proximusjournal.com/index.php/PJSSPE
ISSN (E): 2942-9943

3. Fundamental Goalkeeping Skills [10]

A. Test Name: High Ball Catching from Alternating Shots

Purpose:
To assess the goalkeeper's ability to receive and securely catch high balls resulting from consecutive goal-directed shots.

Required Equipment:

- 10 standard footballs
- Official-sized goalpost
- Goalkeeper marker cone (borek)
- Nylon rope fixed with anchors at a height of 1.5 meters

- Performance Description:
- The goalkeeper begins in a ready stance on the goal line. Upon the examiner's signal, the coach initiates a shot toward the goal. Each ball must pass over a rope that is fixed horizontally at a height of 1.25 meters, placed 4 meters in front of the ball array. This setup ensures that the trajectory of the shot simulates a realistic high-ball scenario. The ten footballs are arranged in order and numbered from 1 to 10 to be used consecutively throughout the test.
- If any shot does not meet the required condition—i.e., the ball fails to travel over the rope—the attempt is repeated to maintain testing accuracy and standardization.
- Each goalkeeper is granted ten consecutive attempts, during which their reaction time, catching accuracy, and ball control are evaluated based on predetermined scoring criteria. This test is intended to simulate match-

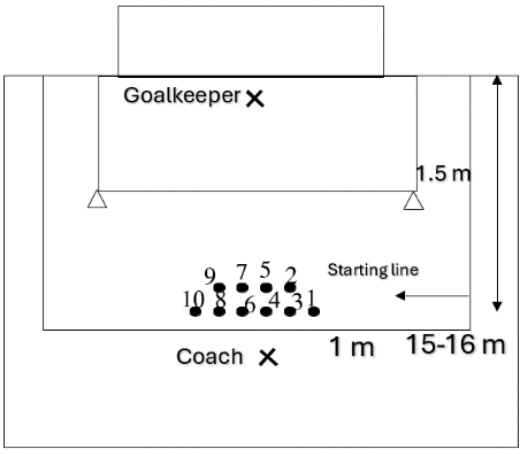

Figure (1): Illustration of the High Ball Catching from Alternating Shots Test

Proximus Journal of Sports Science and Physical Education
Volume 2, Issue 7, July 2025
https://proximusjournal.com/index.php/PJSSPE
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relevant situations where goalkeepers must quickly assess the ball's path and respond with precise and controlled high-ball catches.

Scoring Criteria:

The goalkeeper is awarded points based on the quality of performance in each attempt, following the rubric below:

- 3 points are awarded when the goalkeeper successfully catches the ball cleanly and directly, with no rebound.
- 2 points are given if the goalkeeper gains control of the ball after a single rebound off their hands or body.
- 1 point is awarded when the goalkeeper successfully deflects the ball away from the goal—either to the sides or over the crossbar—preventing a score.
- 0 points are recorded if the ball enters the goal and no effective save is made.
-

B. Test Name: Low Ball Catching from Alternating Shots

Purpose:

To assess the goalkeeper's ability to receive and securely control low, ground-directed balls resulting from consecutive goal attempts.

Required Equipment:

- Ten (10) standard footballs
- Official-sized goal compliant with FIFA specifications
- Training hurdles (borek)
- Nylon rope fixed at a height of 1 meter with vertical poles
- Whistle for signaling shot initiation

Performance Description:

Proximus Journal of Sports Science and Physical Education
Volume 2, Issue 7, July 2025
https://proximusjournal.com/index.php/PJSSPE
ISSN (E): 2942-9943

The goalkeeper assumes a ready stance on the goal line. Upon the signal from the coach or examiner, the coach initiates a ground-level shot toward the goal. Each ball must travel beneath a horizontally fixed rope set at a height of 1 meter, ensuring a low trajectory that simulates realistic ground-ball challenges.

Balls are arranged and numbered sequentially from 1 to 10, and attempts are executed in order. If a shot fails to meet the required conditions—such as not passing under the rope—the attempt is repeated to ensure standardized test administration.

Each goalkeeper is given ten consecutive attempts to respond to the ground shots, during which their reaction time, positioning, and ball control are evaluated according to a structured scoring rubric.

Scoring Criteria:

Goalkeepers are awarded points based on the quality and success of each attempt, as follows:

- 3 points are awarded for full control and direct clean catch without rebound.
- 2 points are given if the ball is successfully secured after a rebound from the hands.
- 1 point is awarded when the goalkeeper deflects the ball effectively to either side without gaining control.
- 0 points are recorded if the ball enters the goal without being blocked or deflected.
-

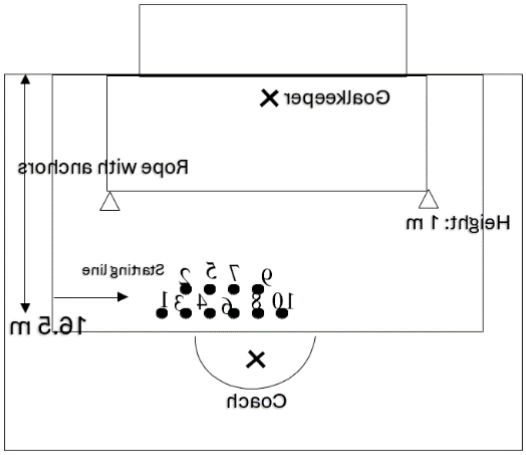

Figure (2): Illustration of the Low Ball Catching from Alternating Shots Test

C. Test Name: Goal Denial and Ball Deflection

Purpose:

This test is designed to evaluate the

Proximus Journal of Sports Science and Physical Education
Volume 2, Issue 7, July 2025
https://proximusjournal.com/index.php/PJSSPE
ISSN (E): 2942-9943

goalkeeper's ability to prevent goals by reacting quickly and making effective defensive decisions. It specifically measures reflexes, positional awareness, and shot-blocking accuracy under unpredictable match-like conditions.

Required Equipment:

- Five (5) standard footballs
- Measuring tape for precise field markings
- Official-sized goalpost compliant with regulatory standards
- Training hurdles (borek)
- Whistle for organizing shot execution and timing

- Performance Description:
- A semi-circle with a 14-meter radius is drawn in front of the goal. The goalkeeper begins in a ready stance, positioned near the goal line. Around the perimeter of the semi-circle, seven players are stationed, tasked with passing the ball among themselves in a pre-arranged sequence that is unknown to the goalkeeper.
- At an unpredictable moment, one of the players attempts a direct shot on goal from outside the arc. The goalkeeper must react swiftly and attempt to intercept or deflect the shot. This setup simulates the unpredictability and split-second decision-making typical of real-game scenarios.
- Each goalkeeper is given five trials, with a new shot initiated in each attempt under similar conditions.
-

Scoring Criteria:

Goalkeepers are evaluated based on

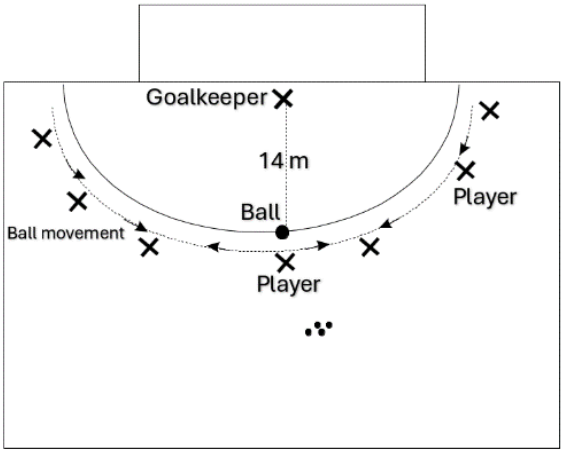

Figure (3): Illustration of the Goal Denial and Ball Deflection Test

Proximus Journal of Sports Science and Physical Education
Volume 2, Issue 7, July 2025
https://proximusjournal.com/index.php/PJSSPE
ISSN (E): 2942-9943

the success of their response to each shot:

- 2 points are awarded if the goalkeeper successfully blocks or deflects the ball away from the goal.
- 0 points are recorded if the goalkeeper fails to stop the ball and a goal is scored.

Pilot Study

The pilot study was conducted on July 7, 2023, involving a sample of two players selected from the original research population. Its primary purpose was to ensure the feasibility and clarity of all experimental procedures before applying them to the main sample. The pilot phase aimed to:

1. Confirm the suitability of the selected tests for the skill and performance levels of the goalkeepers in the sample.
2. Calibrate precise dimensions and identify optimal camera placement for documentation and technical analysis.
3. Identify any potential organizational or technical difficulties that may arise during actual testing.
4. Measure the time required to complete each individual test and estimate the total duration needed for evaluating all variables in the study.

Pre-Test Phase

The pre-testing procedures were carried out on July 15, 2023, at 4:00 PM, on the field of Al-Najma Sports Club in Al-Qadisiyah. This phase included measurement of the following variables:

- Motor speed
- Creatine phosphokinase (CPK) enzyme level
- Lactate dehydrogenase (LDH) enzyme level
- A set of fundamental goalkeeping skills related to technical performance

All tests were conducted under standardized environmental conditions for all participants in terms of time, location, and equipment used, to ensure maximum accuracy and objectivity. The entire process was documented thoroughly to enable later data retrieval and analysis with precision.

Compound Exercise Components

Based on principles drawn from current sports science literature and modern training theories for football players, the researcher designed a series of compound exercises tailored to the skill level of the sample and the objectives of the preparatory phase. The training content was constructed with consideration to the following key factors:

1. Exercise diversity, achieved by incorporating resistance bands attached to various parts of the body (e.g., legs, hips, and arms), creating multidirectional resistance stimuli.
2. The training program spanned 12 weeks, with three weekly sessions on Saturdays, Mondays, and Wednesdays, totaling 36 training units.
3. The program was implemented during the specialized preparatory period preceding the official competition season.

Proximus Journal of Sports Science and Physical Education
Volume 2, Issue 7, July 2025
https://proximusjournal.com/index.php/PJSSPE
ISSN (E): 2942-9943

4. Compound exercises were included at the beginning of the main phase of each session, directly after the warm-up, to ensure optimal physical and neural readiness.
5. Rest periods were determined based on effort duration, with inter-set rest ranging from 1.5 to 2 minutes, and inter-exercise rest up to 3 minutes.
6. Training intensity was defined by the workload and time, based on each athlete's maximum effort values during execution.
7. The average duration of compound exercises per session ranged between 26 and 35 minutes.
8. The program followed the principle of progressive intensity, starting with simple movements and advancing toward complex, high-difficulty drills.
9. The researcher personally supervised the compound training section of each session, while the remaining components were managed by the assigned field coach.
10. The program utilized a high-intensity interval training (HIIT) model, given its proven impact on improving both physical and physiological indicators in athletes.

Post-Test Phase

The post-tests were conducted on October 5, 2023, at 4:00 PM on the same field used during pre-testing—Al-Najma Stadium in Al-Qadisiyah. All conditions were standardized across the pre- and post-tests to ensure reliability and objectivity of the results. Consistency was maintained across:

- Timing of the test
- Geographic location
- Equipment and tools used
- Personnel supervising the procedures
- Application protocols

The same variables measured during the pre-test were re-evaluated, including:

- Motor speed
- CPK enzyme levels
- LDH enzyme levels
- Core goalkeeping skills

Statistical Methods Used

To analyze the collected data and compare pre- and post-test results, the researcher employed the following statistical tools appropriate for the nature of the variables:

- Arithmetic Mean: To determine the overall central tendency for each variable.
- Standard Deviation: To measure the dispersion of data points around the mean and identify variability.
- Coefficient of Variation (CV%): Used to express relative dispersion by comparing the standard deviation to the mean.
- Paired Samples t-test: To assess statistical differences between pre- and post-test measurements within the same group.
- Independent Samples t-test: To compare post-test outcomes between the experimental and control groups.

Table (2) Differences Between Pre- and Post-Tests in the Control Group

Variable	Unit	Pre-Test (M ± SD)	Post-Test (M ± SD)	T (calculated)	T (tabulated)	Significance
Motor Speed	Seconds	2.67 ± 0.27	2.43 ± 0.43	1.38	2.57	Not Significant

Proximus Journal of Sports Science and Physical Education
Volume 2, Issue 7, July 2025
https://proximusjournal.com/index.php/PJSSPE
ISSN (E): 2942-9943

CPK	U/L	147.5 ± 5.01	154.17 ± 5.85	3.07		Significant
LDH	U/L	160.3 ± 7.12	167.33 ± 6.68	2.50		Not Significant
High Ball Catching	Score	20.5 ± 2.88	23.00 ± 2.00	2.71		Significant
Low Ball Catching	Score	19.33 ± 2.50	21.17 ± 1.60	2.02		Not Significant
Ball Deflection (Clearance)	Score	7.00 ± 1.10	7.67 ± 0.82	1.58		Not Significant

Significance level at 0.05; degrees of freedom (df) = 5; tabulated T value = 2.57

Interpretation:

Table (2) shows statistically significant improvements in only two variables for the control group: CPK levels and high ball catching, with calculated t-values (3.07 and 2.71) exceeding the critical value of 2.57. No significant changes were observed in other variables, indicating that the traditional training program followed by the control group was not sufficient to induce measurable improvements in motor speed, physiological indicators, or technical skills.

Table (3) Differences Between Pre- and Post-Tests in the Experimental Group

Variable	Unit	Pre-Test (M ± SD)	Post-Test (M ± SD)	T (calculated)	T (tabulated)	Significance
Motor Speed	Seconds	2.65 ± 0.29	2.00 ± 0.12	5.65	2.57	Significant
CPK	U/L	145.3 ± 5.54	164.50 ± 8.67	5.41		Significant
LDH	U/L	163.5 ± 6.25	175.83 ± 8.35	2.80		Significant
High Ball Catching	Score	21.67 ± 3.39	26.50 ± 1.76	3.71		Significant
Low Ball Catching	Score	18.83 ± 2.32	25.00 ± 2.68	3.90		Significant
Ball Deflection (Clearance)	Score	7.33 ± 1.03	9.00 ± 1.10	2.71		Significant

Significance level at 0.05; degrees of freedom (df) = 5; tabulated T value = 2.57

Interpretation:

The results presented in Table (3) demonstrate statistically significant differences across all tested variables in the experimental group. The calculated t-values—ranging from 2.71 to 5.65—all exceed the critical value of 2.57, confirming the effectiveness of the compound training program. These improvements span motor speed, physiological markers (CPK and LDH), and key goalkeeping skills including high and low ball catching, and ball deflection.

This consistent improvement indicates that the compound exercise protocol contributed substantially to enhancing the goalkeepers' neuromuscular coordination, anaerobic endurance, and functional skill performance. The observed benefits affirm the suitability of using such integrated training models for position-specific conditioning in football.

Table (4) Differences Between Post-Test Scores of Controls and Experimental Groups

Variable	Unit	Control Group (M ± SD)	Experimental Group (M ± SD)	T (calculated)	T (tabulated)	Significance
Motor Speed	Seconds	2.43 ± 0.43	2.00 ± 0.12	2.31	2.22	Significant

Proximus Journal of Sports Science and Physical Education
Volume 2, Issue 7, July 2025
https://proximusjournal.com/index.php/PJSSPE
ISSN (E): 2942-9943

CPK	U/L	154.17 ± 5.85	164.50 ± 8.67	2.42		Significant
LDH	U/L	167.33 ± 6.68	175.83 ± 8.35	1.95		Not Significant
High Ball Catching	Score	23.00 ± 2.00	26.50 ± 1.76	3.22		Significant
Low Ball Catching	Score	21.17 ± 1.60	25.00 ± 2.68	3.00		Significant
Ball Deflection (Clearance)	Score	7.67 ± 0.82	9.00 ± 1.10	2.39		Significant

Significance level at 0.05; degrees of freedom (df) = 10; tabulated T value = 2.22

Interpretation:

The analysis in Table (4) reveals statistically significant differences in post-test outcomes between the experimental and control groups for five out of six variables. These include motor speed, CPK, high ball catching, low ball catching, and ball deflection, all showing calculated t-values exceeding the critical threshold of 2.22. This demonstrates the superiority of the compound exercise program over traditional training in enhancing performance and physiological function.

The only variable that did not reach statistical significance was LDH, with a t-value of 1.95, indicating that although some improvements were observed, they were not substantial enough to differentiate the two groups at the 0.05 level.

Overall, these findings validate the effectiveness of compound training in developing a goalkeeper's physical, physiological, and technical competencies—providing an evidence-based framework for future training methodologies.

Discussion of Pre–Post and Between-Group Results

The analysis of Tables 2 and 3 revealed significant post-test improvements in both the control and experimental groups. However, the breadth and magnitude of progress were notably greater in the experimental group. While the control group showed limited gains in CPK enzyme levels and high-ball catching, these modest improvements likely resulted from basic training activities rather than scientifically optimized protocols. The traditional training lacked structured progression, intensity control, and integration of neuromuscular demands, explaining the absence of meaningful development across the remaining variables.

In contrast, the experimental group achieved statistically significant improvements in all measured indicators. This affirms the effectiveness of compound exercises, especially when designed with appropriate intensity, volume, and rest intervals. The use of elastic resistance bands—applied to the arms, hips, and legs—simultaneously engaged both neuromuscular and motor control systems, thereby improving neuromuscular coordination [3].

These findings are in line with previous research. Tomáš et al. [3] highlighted the impact of specialized speed and coordination drills on goalkeeper performance. Similarly, West [9] emphasized that training scenarios simulating realistic match conditions significantly enhance both physical and technical performance. This alignment explains the improvement in movement speed, which is one of the most crucial qualities in goalkeeping due to its strong association with reflexes and shot-stopping capabilities.

The researcher attributes the improvement in the experimental group's performance to the precise design of the training program, which adhered to progressive overload principles, task diversity, and specificity.

Proximus Journal of Sports Science and Physical Education
Volume 2, Issue 7, July 2025
https://proximusjournal.com/index.php/PJSSPE
ISSN (E): 2942-9943

Furthermore, the incorporation of high-intensity interval training (HIIT) stimulated the central nervous system and facilitated faster and more accurate neuromuscular responses under stress, in line with findings by Silva et al. [4].

From a biochemical perspective, the increase in CPK levels observed in the experimental group is consistent with physiological expectations following high-intensity training. Elevated CPK reflects micro-damage to muscle fibers and increased cell membrane permeability—markers of muscular adaptation to anaerobic effort [5]. Hafizi et al. confirmed that this enzymatic response is directly proportional to the intensity and volume of the training stimulus [11].

On the other hand, LDH did not show significant post-test differences between groups. This may suggest that LDH requires either a longer adaptation period or a different type of anaerobic stimulus to register noticeable changes—a conclusion supported by the delayed enzyme response patterns reported in the literature [4].

The post-test comparison in Table 4 clearly shows the superiority of the experimental group across five out of six variables: movement speed, CPK, high and low ball catching, and ball deflection. This outcome is attributed to the compound exercises' ability to integrate physical demands with realistic skill-based scenarios. The motor speed improvements, in particular, underscore the goalkeeper's need for explosive movement during dives, lateral shifts, and ball interceptions. Additionally, the impact of combined exercise report [12] also highlights that the modification of training intensity to simulate match-like pressures is associated with better performance maintenance.

The three technical skills tested, high ball catching, low ball control, and ball deflection, were significantly improved in the board game group. This aligns with the concept of functional training, with the performance of skills within high intensity physical environments. This idea is further supported by West [9] who declared that training realism and connection with competitive performance needs are crucial for technical progress.

These results are consistent with the philosophy of coaching proposed by Jixing, & Fuli [13], in which "A good coach plans the training in a way that would provoke demands in a match, and the goalkeeper can respond as he or she were there."

Conclusions

According to the findings, the study made the following conclusion:

The multicomponent training system was effective in increasing speed, increasing CPK and LDH levels, and improving goalkeeper technical skills: evidencing the broad spectrum of the impact of an intervention in physical, physiological and skill areas.

The multi-directional dynamic resistance generated from the resistance bands, which were connected in several body parts, was used to encourage neuromuscular activation and coordination.

The high training volume as well as the deliberate recovery periods in the program was found to have been sufficient enough to provide the physiological stimulus and adaptation in particular to CPK and LDH response.

Combining intense physical efforts with specific technical drills resulted in performance benefits simulating competitive scenarios taking place on the field of play, validating the need for sport-specific designed goalkeeper training.

Recommendations

The researcher recommends as follows:

Use compound movements in the training of goalkeepers in order to create balanced physical and technical development.

Scale up this training model to other age groups and to similar sports associations (e.g. futsal, handball) in order to determine its overall effect.

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Incorporate the use of high intensity interval training (HIIT) in goalkeeper preparation, since this type of training is well documented to improve performance and physiological measures.

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