Study Protocol with Statistical Analysis Plan

ClinicalTrials.gov Study Document

Document Type	**Study Protocol with Statistical Analysis Plan**
Official Title	Effects of an 8-week Plyometric Training Programme on Sprint, Jump, and Agility Performance in Recreational Male Football Players Aged 14-16 Years: a Randomized Controlled Trial
Brief Title	Effects of an 8-week Plyometric Training Programme on Sprint, Jump, and Agility Performance in Recreational Male Football Players Aged 14-16 Years
NCT Number	Not yet assigned
Organization's Unique Protocol ID	E-77082166-604.01-1455789
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Document Date	8 June 2026
Study Type	Interventional
Responsible Party	Ferhat Kılıçarslan, Erciyes University, Kayseri, Türkiye
Sponsor/Institutional Context	Erciyes University and collaborating investigators from Gazi University and Istanbul Esenyurt University

Document purpose: This public study document provides a written description of the clinical study design, objectives, methods, outcome measures, safety monitoring, ethical oversight, and statistical analysis plan for ClinicalTrials.gov PRS review. It does not include names or identifiable information of research participants.

Document Contents

1. Background and Rationale

Football is an intermittent sport requiring repeated sprinting, acceleration, deceleration, jumping, and rapid changes of direction. In adolescent football players, these performance capacities develop alongside growth, maturation, and sport-specific training exposure. Plyometric training uses rapid eccentric-concentric actions and the stretch-shortening cycle to develop neuromuscular qualities relevant to explosive performance. Because plyometric exercises can be implemented with limited equipment and integrated into routine field training, they are practically relevant for recreational adolescent football settings.

The present study was designed to evaluate whether an 8-week supervised plyometric training programme, added to routine football training, improves sprint, jump, and agility-related field-test performance in recreational male football players aged 14-16 years.

2. Study Objectives and Hypothesis

2.1 Primary objective

The primary objective was to examine the effect of an 8-week supervised plyometric training programme on 30 m sprint time, vertical jump height, and 505 agility test time in recreational male football players aged 14-16 years.

2.2 Secondary objectives

The secondary objectives were to examine the effect of the intervention on standing long jump distance, quick feet test time, zig-zag running test time, and body mass index.

2.3 Hypothesis

It was hypothesized that participants assigned to plyometric training plus routine football training would demonstrate greater improvements from baseline to post-intervention than participants assigned to routine football training only.

3. Study Design

This was a field-based, two-arm, randomized pre-test and post-test controlled trial. Participants were randomized into two parallel groups. The experimental group received an 8-week supervised plyometric training programme in addition to routine football training. The control group continued routine football training only during the same 8-week period.

Data element	Planned/implemented specification
Study type	Interventional
Primary purpose	Other
Study phase	N/A, not a drug or biologic trial
Interventional model	Parallel Assignment
Allocation	Randomized
Masking	None, Open Label
Enrollment	28 participants, actual
Number of arms	2
Time frame	Baseline and immediately after the 8-week intervention

4. Study Setting and Participants

The study was conducted with recreational male football players aged 14-16 years who regularly participated in football training in Ankara, Türkiye. Outcomes were assessed before and immediately after the 8-week intervention period.

4.1 Inclusion criteria

- Male recreational football players aged 14-16 years.
- Regular participation in football training at least two days per week.
- Voluntary participation in the study.
- Written informed consent from a legal guardian.
- Participant assent before study participation.

4.2 Exclusion criteria

- Presence of musculoskeletal injury or medical condition limiting participation in football training or performance testing.
- Failure to complete baseline or post-intervention assessments.
- Inability to participate in the intervention or routine training procedures.

5. Randomization, Allocation, and Masking

Participants were randomly assigned to the experimental group or the control group by drawing lots after baseline eligibility was confirmed. Allocation concealment was not implemented. Because of the

visible nature of the exercise intervention, masking was not feasible. Participants and outcome assessors were aware of group allocation.

6. Arms and Interventions

Arm title	Arm type	Arm description	Linked intervention(s)
Plyometric training plus routine football training	Experimental	Participants in this arm received an 8-week supervised plyometric training programme in addition to their routine football training. Outcomes were assessed at baseline and immediately after the 8-week intervention period.	8-week plyometric training programme; routine football training
Routine football training	Active Comparator	Participants in this arm continued their routine football training during the same 8-week period and did not receive the additional plyometric training programme. Outcomes were assessed at baseline and immediately after the 8-week period.	Routine football training

6.1 Intervention descriptions

Intervention type	Intervention name	Description
Behavioral	8-week plyometric training programme	A supervised 8-week plyometric exercise programme added to routine football training. The programme consisted of progressive lower-limb plyometric exercises designed to improve explosive power, sprint performance, jump performance, and agility-related performance in recreational adolescent male football players. Exercise intensity and complexity were controlled through supervision and progressive loading of movement tasks.
Behavioral	Routine football training	Participants maintained their usual football training programme during the 8-week study period. This training exposure was continued in both study arms and served as the active comparator condition for the control group.

7. Outcome Measures

All outcomes were assessed at baseline and immediately after the 8-week intervention period. When multiple trials were performed, the best valid trial was retained for analysis according to the field-test procedure.

Outcome category	Measure title	Measurement tool/procedure	Unit of measure	Time frame
Primary	Change in 30 m sprint time	30 m sprint test using photocell timing gates placed at the start and finish lines. Lower values indicate better sprint performance.	Seconds	Baseline and immediately after the 8-week intervention

Primary	Change in vertical jump height	Vertical jump assessed using the My Jump 2 application. Higher values indicate better jump performance.	Centimetres	Baseline and immediately after the 8-week intervention
Primary	Change in 505 agility test time	505 agility test using photocell timing gates to measure the timed change-of-direction section. Lower values indicate better agility performance.	Seconds	Baseline and immediately after the 8-week intervention
Secondary	Change in standing long jump distance	Standing long jump test. Higher values indicate better horizontal jump performance.	Centimetres	Baseline and immediately after the 8-week intervention
Secondary	Change in quick feet test time	10 m ladder-based quick feet test. Lower values indicate better footwork performance.	Seconds	Baseline and immediately after the 8-week intervention
Secondary	Change in zig-zag running test time	Zig-zag running test around cones arranged on a marked 3 m x 4.85 m area. Lower values indicate better multidirectional movement performance.	Seconds	Baseline and immediately after the 8-week intervention
Secondary	Change in body mass index	Body mass index calculated from measured body mass and height.	kg/m2	Baseline and immediately after the 8-week intervention

8. Data Collection Procedures

All measurements were performed using standardized field-test procedures before and immediately after the 8-week intervention. Participants were instructed to avoid maximal exertion before testing and were allowed adequate recovery between trials when relevant. Performance tests were conducted under comparable field conditions as far as practically possible.

30 m sprint

Sprint performance was assessed over 30 m using photocell timing gates placed at the start and finish lines. Participants started when they felt ready, without an external start command. Two trials were performed with full recovery, and the best time was recorded in seconds.

Standing long jump

Participants stood with feet shoulder-width apart behind the starting line and performed a maximal bilateral horizontal jump. The distance from the starting line to the nearest landing mark was measured. Two trials were performed, and the best distance was recorded in centimetres.

505 agility test

Participants performed a 10 m approach run followed by a 5 m out-and-back change-of-direction section. Photocell timing gates were placed at the 5 m line to capture the timed section. Two trials were performed with 3-4 minutes of recovery, and the best score was retained.

Quick feet test

A 10 m ladder-based footwork test was used. Timing started when the participant placed the foot between the first and second ladder spaces and stopped when the final foot contact was made beyond the last ladder space. Two trials were performed, and the best score was recorded in seconds.

Zig-zag running test

Participants completed one lap around cones arranged on a marked area of 3 m x 4.85 m. If a participant failed to complete the course correctly, the test was repeated after sufficient rest. Performance was recorded in seconds.

Vertical jump

Vertical jump performance was assessed using the My Jump 2 application on an iPhone 15. The application estimates jump height from flight time captured through high-speed video recording. Each participant performed three jumps, and the best value was recorded in centimetres.

Anthropometry

Height was measured barefoot using a wall-mounted tape measure with 0.1 cm precision. Body mass was measured using an electronic scale while participants wore light sports clothing. Body mass index was calculated in kg/m2.

9. Safety Monitoring and Adverse Events

The plyometric training programme and field-test procedures were supervised by the research team. Participants were monitored for injuries, discomfort, inability to continue the intervention, or other adverse events during training and testing. Any adverse event related to the intervention or assessment procedures was to be recorded by the research team, including the nature of the event, timing, severity, relation to the study procedure, and whether the participant discontinued the intervention or follow-up.

10. Ethical Considerations

The study was approved by the Gazi University Ethics Committee. The ethics committee reviewed the study at its meeting dated 13 January 2026, decision number 01. The approval document was issued on 5 February 2026 with research code 2026-145 and document number E-77082166-604.01-1455789. The ethics approval stated that the study could be conducted provided that permission was obtained from the institutions where the study would take place.

Written informed consent was obtained from the legal guardians of all participants before participation. Participant assent was also obtained before study participation. The manuscript and this public protocol document do not include identifiable individual participant data.

11. Data Management and Confidentiality

Data were recorded using coded participant identifiers. Directly identifying participant information was not included in the analytic dataset or in public study documents. The dataset generated and analysed

during the study is available from the corresponding author on reasonable request, subject to ethical and institutional considerations.

12. Statistical Analysis Plan

12.1 Analysis population

All randomized participants who completed baseline and post-intervention assessments were included in the final analysis. The planned analysis population was therefore the randomized participants with complete pre-test and post-test data.

12.2 Software

Statistical analyses were performed using SPSS version 27.0.

12.3 Data screening and assumptions

Data were screened for missing values, data entry errors, outliers, and distributional assumptions before inferential analysis. Normality was evaluated using the Shapiro-Wilk test, skewness and kurtosis values, and Q-Q plots. Parametric analyses were conducted when assumptions were considered acceptable and group sizes were equal.

12.4 Primary analysis

The primary analysis used a two-way mixed analysis of variance with group as the between-subject factor and time as the within-subject factor. Group included the experimental group and the control group. Time included baseline and immediately after the 8-week intervention. The group x time interaction was treated as the primary decision criterion for intervention effects.

12.5 Additional comparisons

Paired-samples t tests were used to examine within-group pre-test to post-test changes. Independent-samples t tests were used to compare groups at baseline and post-intervention. Change scores were calculated as post-test minus pre-test and compared between groups. For timed tests, negative change values indicate faster performance.

12.6 Effect sizes and statistical significance

Effect sizes were reported as partial eta squared for mixed analysis of variance, Cohen dz for paired-samples comparisons, and Cohen d for between-group comparisons. Statistical significance was set at $p < .05$.

12.7 Sample size and statistical sensitivity

No formal a priori sample size calculation was conducted before participant recruitment. The sample size was determined by the number of eligible recreational football players who volunteered and completed the study procedures. To evaluate the statistical sensitivity of the achieved sample size, a sensitivity power analysis was performed using G*Power. For a two-tailed independent-samples t test comparing change scores between two groups, with alpha = .05, power = .80, an allocation ratio of 1:1, and 14 participants per group, the achieved sample size of 28 participants was sufficient to detect a large standardized between-group effect of approximately Cohen d = 1.10 or greater. Therefore, the study should be interpreted as adequately powered for large effects, whereas smaller effects may not have been detected.

13. Protocol Deviations and Missing Data

Protocol deviations, if any, were to be documented by the research team. Missing data were to be examined descriptively. Because the intended analysis required baseline and post-intervention values for each outcome, the primary analysis was based on participants with complete assessment data.

14. Dissemination

The study findings are intended for dissemination through peer-reviewed scientific publication. Trial registration information will be reported in the manuscript according to journal requirements once the ClinicalTrials.gov NCT number is assigned.

15. Administrative Information

Item	Information
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NCT number	Not yet assigned
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