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Original Article

Match-representative holistic training improves explosive power, sprint speed, shooting accuracy, and mental toughness in adolescent soccer players

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Abstract:
Soccer performance arises from interacting physical, technical, and psychological capacities, yet youth training programs often develop these components separately. This study examined whether a match-representative holistic training program could improve lower-limb explosive performance, linear sprint speed, shooting accuracy, and mental toughness in adolescent players. A pretest-posttest controlled design involved 30 male players aged 15–17 years from Rohul United Football Club, Riau, Indonesia. Players were randomly allocated to an experimental group or a control group, with 15 players in each group. For six weeks, the experimental group completed three integrated sessions per week combining explosive actions, sprinting, ball reception, rapid decision-making, defensive pressure, and finishing, whereas the control group continued conventional training in which physical and technical contents were delivered separately. Outcomes were assessed using the standing broad jump, 30-m sprint, a 10-attempt shooting accuracy test, and a 25-item mental toughness questionnaire. Data were analyzed using a two-way repeated-measures analysis of variance, followed by within-group and posttest between-group comparisons. Significant time-by-group interactions were observed for all outcomes (all $p < 0.001$; partial eta squared = 0.980–0.996). In the experimental group, standing broad jump performance increased from 195.87 ± 8.72 to 207.40 ± 9.09 cm, sprint time decreased from 4.78 ± 0.10 to 4.49 ± 0.11 s, shooting accuracy increased from 36.93 ± 3.61 to 49.20 ± 3.91 points, and mental toughness increased from 89.00 ± 5.77 to 103.47 ± 5.62 points. Posttest differences favored the experimental group for every outcome, with large to very large standardized effects. These findings suggest that integrating representative physical, technical, and psychological demands within the same drill can produce broader short-term adaptations than conventional separated practice. Coaches working with adolescent players may use this model as a complementary training strategy while monitoring workload and adapting task difficulty to developmental level.
Keywords: youth development; integrated conditioning; linear acceleration; finishing skill; representative practice; performance transfer

Introduction

Modern soccer is a multidimensional performance environment in which decisive actions occur under simultaneous physical, technical, tactical, perceptual, and psychological demands. Players must repeatedly accelerate, sprint, jump, decelerate, change direction, control and pass the ball, recognize emerging space, and make rapid decisions while coping with direct opposition and competitive pressure (Liu et al., 2021; Stafylidis et al., 2024). Match performance therefore cannot be reduced to a single fitness or skill component. Physical output must be coordinated with perception and technical execution, while psychological regulation influences whether these capacities can be expressed reliably under pressure (Atradinal et al., 2023; Lisenchuk et al., 2021). This interaction is particularly important during adolescence, when players are expected to improve physical capacities and football-specific skill while also learning to solve increasingly complex game problems. Training models for this age group should therefore develop performance qualities without separating them so extensively that the practice environment no longer resembles the functional demands of competition.

Explosive lower-limb performance and sprint ability are central to many high-value actions in soccer, including first-step acceleration, duels for space, jumping, recovery runs, and movements preceding a shot or pass (Chmura et al., 2022; Loturco et al., 2018). In young players, jump and sprint performance are related to lower-limb force and power characteristics, and plyometric training can improve both qualities when it is appropriately prescribed (Diker et al., 2021; López-Segovia et al., 2011; Ramirez-Campillo et al., 2020). More recent evidence from youth team sports also indicates that small-sided game training can improve sprint acceleration and lower-limb explosive power, although gains in maximal sprint speed are less consistent (Liu et al., 2026). These findings underline an important practical distinction: developing a physical quality in isolation does not necessarily ensure that the player can express it at the correct moment within a football action. For

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coaches, the relevant question is not only whether a player becomes faster or more powerful, but whether these qualities can be coordinated with ball control, visual information, timing, and the decisions imposed by an opponent.

Technical performance is likewise highly dependent on context. Shooting accuracy is commonly practiced through repeated, relatively stable attempts, yet shots in competitive soccer are often preceded by high-intensity movement, an imperfect first touch, limited time, changing angles, and pressure from defenders. Practice that removes these informational constraints may improve the movement pattern itself while providing less opportunity to learn when and how that movement should be adapted. Representative learning design proposes that practice tasks should preserve the information-movement relationships that guide behavior in competition (Pinder et al., 2011). Consistent with this perspective, small-sided and conditioned games can improve technical execution because they require players to perceive, decide, and act within an evolving game environment (Clemente et al., 2021; Davids et al., 2013; Hill-Haas et al., 2011). Enrichment-based training in youth football has similarly produced improvements across physical and technical outcomes, including successful shooting, when practice includes variability and football-specific decision demands (Coutinho et al., 2018). Previous work involving authors of the present study also indicates that football skill is associated with interacting physical and attentional qualities rather than technical ability alone (Tantowi et al., 2025).

Psychological capacities add a further layer to this interaction. Concentration, self-confidence, motivation, emotional control, and mental preparation can influence how effectively players maintain task execution when time, score, fatigue, and opposition increase pressure (Cowden, 2017; Demir et al., 2025; Grønset et al., 2024; Weinberg & Gould, 2018; Zhang & Yu, 2025). In football-specific samples, mental toughness has been associated with peak performance, and structured psychological-skills interventions have improved mental toughness, decision-making, and tactical performance (Dalbudak et al., 2026; Mas'ud et al., 2022). Youth football research also emphasizes that psychological well-being and the quality of the surrounding training environment are important to player development (Reverberi et al., 2020). However, psychological development is still frequently treated as a separate classroom, counseling, or questionnaire-based component rather than being deliberately challenged within representative football practice. Repeated exposure to controllable task difficulty, immediate consequences, defensive pressure, and the need to recover from unsuccessful actions may provide a practical route through which psychological skills are trained alongside physical and technical performance.

Interest in integrated or holistic soccer training has consequently increased. A recent systematic review described holistic approaches as models that combine physical, technical, tactical, and mental components rather than organizing them as unrelated training blocks (Kusuma et al., 2024). Reviews of related integrated tactical frameworks have also emphasized the need for stronger empirical testing rather than assuming transfer from theory to performance (Afonso et al., 2020). Empirical work has also begun to show promising effects. Atradinal et al. (2025) reported greater improvements in passing, dribbling, and shooting after a holistic program than after conventional training in young football-school players, while Tassi et al. (2024) found that an ecological/holistic program integrating tactical and psychological constraints improved selected principles of play in elite U21 and U23 players. Earlier model-development work likewise supports the feasibility of holistic football training (Atradinal et al., 2023). Together, these studies suggest that integrated practice can be useful, but the evidence remains heterogeneous across age groups, task designs, and outcomes. Some studies emphasize technical or tactical development, others focus on physical adaptation, and relatively few controlled interventions have examined whether physical, technical, and psychological outcomes improve concurrently in adolescent soccer players.

This gap has both scientific and practical implications. From a scientific perspective, improvements observed in one domain cannot simply be assumed to generalize to other components of performance. A training format that improves technical execution, for example, may not provide a sufficient neuromuscular stimulus, while a physically demanding drill may reduce the perceptual and technical fidelity required for skill transfer. From a coaching perspective, youth programs operate under limited weekly training time and must balance physical preparation, skill development, tactical learning, and psychological readiness. A highly fragmented schedule can increase the time required to address each component and may reduce opportunities for players to coordinate them under realistic conditions. Conversely, an integrated task is only useful if it preserves technical quality, provides an adequate physical stimulus, and can be progressed without excessive fatigue. Controlled evidence is therefore needed to determine whether a deliberately designed match-representative holistic format offers benefits beyond conventional training in which physical and technical contents are delivered separately.

The present intervention was designed to address this problem by linking a short explosive action with acceleration, perception of a pass, ball reception, rapid choice, defensive pressure, and finishing within the same sequence. The term match-representative is used because the drills preserve several information-action relationships that occur around attacking transitions and finishing situations, rather than because they reproduce an entire match. The model also differs from an unstructured game-only approach: physical actions, sprint intensity, repetition volume, defender delay, touch constraints, and finishing options can be deliberately manipulated while the player still has to respond to football-relevant information. The intervention builds on preliminary validation of a holistic model for speed, power, and shooting accuracy (Sinurat et al., 2025), but extends that work by testing training effects in a controlled design and by including a psychological outcome. Its proposed contribution is therefore not that integrated training replaces specialized physical, technical, tactical, or psychological work, but that selected performance qualities may be developed concurrently when practice is structured around representative sequences.

Accordingly, this study examined the effects of a six-week match-representative holistic training program on lower-limb explosive performance, 30-m sprint performance, shooting accuracy, and mental toughness in adolescent male soccer players. A pretest-posttest controlled design was used in which the experimental group completed three integrated sessions per week and the control group continued conventional training with physical and technical contents delivered separately. It was hypothesized that the holistic group would demonstrate greater improvements in standing broad jump distance, 30-m sprint time, shooting accuracy, and mental toughness than the control group. By assessing these four outcomes within the same intervention, the study sought to provide a more integrated test of whether representative practice can produce multidimensional adaptations that are directly relevant to youth coaching practice.

Material & methods

Participants

Thirty male soccer players aged 15–17 years from Rohul United Football Club, Riau Province, Indonesia, participated in the study. All players were actively involved in regular club training and were free from injury during the study period. Participants were randomly allocated to an experimental group (n = 15), which completed the holistic training program, or a control group (n = 15), which continued conventional training. Baseline characteristics included age, height, body mass, and training experience.

The study received ethical approval from the Research Ethics Committee of Semarang State University (No. B/6802/UN37.1.6/KM.07/2026). The procedures followed the principles of the Declaration of Helsinki. Before participation, the players and their parents or guardians received information about the study procedures and provided written informed consent.

Study design and procedures

A pretest-posttest control-group design was used. Before the intervention, all participants completed the same test battery assessing lower-limb explosive performance, linear sprint speed, shooting accuracy, and mental toughness. After baseline assessment, the experimental group completed the holistic program, whereas the control group continued the club's conventional program, in which physical and technical components were trained separately. Both groups were reassessed after six weeks using the same instruments and procedures.

The intervention was delivered three times per week for six weeks, for a total of 18 training sessions. Each holistic session lasted approximately 75 min and consisted of a 15-min warm-up, 45 min of integrated training, and a 15-min cool-down. The drills combined explosive movements, sprinting, ball reception, decision-making, finishing, and defensive pressure to reproduce selected demands of match play.

Outcome measures

Anthropometric measures

Standing height was measured with a portable stadiometer to the nearest 0.1 cm, and body mass was measured with a calibrated digital scale to the nearest 0.1 kg. Age and training experience were obtained from club records and confirmed with the coach.

Standing broad jump

Explosive lower-limb performance was assessed using the standing broad jump (Castro-Piñero et al., 2010). Each player stood behind the take-off line with the feet approximately shoulder-width apart and jumped horizontally using a simultaneous two-foot take-off. Distance was measured from the take-off line to the nearest heel contact at landing. Three trials were completed, and the longest distance was recorded in centimeters.

30-m sprint

Linear sprint speed was assessed over 30 m (Haugen & Buchheit, 2016). Players began from a standing start behind the line and sprinted maximally to the finish. Two trials were completed with sufficient recovery between attempts, and the fastest time was retained in seconds.

Shooting accuracy

Shooting accuracy was evaluated using the Ball Shooting Accuracy Test described by Nurhasan (2001). Numbered target zones were marked within the goal. From a stationary ball positioned 16.5 m from the goal, each player completed 10 attempts. Points were awarded according to the target zone reached; when the ball contacted a boundary between two zones, the higher score was recorded. Attempts that missed the designated target area or were taken from an incorrect distance were scored as invalid. Scores from the 10 attempts were summed.

Mental toughness

Mental toughness was assessed using a 25-item questionnaire adapted from the psychological skills framework described by Weinberg and Gould (2018). The items addressed self-confidence, concentration, motivation, emotional control, and mental preparation. Responses were recorded on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), with higher total scores indicating greater mental toughness. Before field administration, the instrument was reviewed by a sport psychologist and subjected to reliability testing.

Training intervention

Three related holistic models were used. In Model A, players completed five consecutive hurdle jumps and immediately accelerated into an attacking area while a server played a long pass. The receiving player judged the ball trajectory, controlled the ball in one or two touches, and decided whether to shoot directly or provide a cutback pass to a teammate. Defenders pressed and attempted to regain possession.

In Model B, the attacking player completed five forward hurdle jumps before sprinting to receive a diagonal long pass. A defender began a delayed sprint to create progressive pressure. After controlling the ball, the attacker selected a direct shot or a cutback pass according to the positions of teammates and the defender.

In Model C, the attacking player completed five controlled squats and reacted to a verbal or visual cue before sprinting toward a diagonal pass. The player tracked the ball, controlled it in one or two touches, and selected either a shot or an action to exploit available space while defenders reduced the shooting area and attempted to regain possession.

A B C

Fig. 1. Match-representative holistic training models A, B, and C.

Table 1. Weekly holistic training program

Training day	Warm-up (15 min)	Holistic training (45 min)	Cool-down (15 min)
Sunday	Dynamic stretching, light jogging, joint mobility, and core activation.	Model A: hurdle jumps (5 repetitions), sprint at 80–95%, decision-making, and shot on goal.	Static stretching and breathing exercises.
Tuesday	Dynamic stretching, light jogging, joint mobility, and core activation.	Model B: forward hurdle jumps (5 repetitions), sprint at 80–95%, decision-making, and shot on goal.	Static stretching and breathing exercises.
Friday	Dynamic stretching, light jogging, joint mobility, and core activation.	Model C: squats (5 repetitions), sprint at 80–95%, decision-making, and shot on goal.	Static stretching and breathing exercises.

Progression: weeks 1–2, 2 sets × 4 repetitions; weeks 3–4, 3 sets × 4 repetitions; weeks 5–6, 4 sets × 4 repetitions. Rest intervals were 60–90 s between repetitions and 2–3 min between sets.

Data analysis

Data were analyzed using IBM SPSS Statistics version 32.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics are reported as mean ± standard deviation. Normality was assessed using the Shapiro-Wilk test, and homogeneity of variance was evaluated using Levene's test. Baseline characteristics were summarized descriptively, and pretest equivalence of performance outcomes was evaluated before the intervention.

Intervention effects were examined using a two-way repeated-measures analysis of variance, with time (pretest and posttest) as the within-participant factor and group (experimental and control) as the between-participant factor. Main effects of time and group and the time-by-group interaction were evaluated. Partial eta squared (ηp^2) was reported as the effect-size measure, with 0.01, 0.06, and 0.14 interpreted as small, medium, and large, respectively. Within-group standardized effects and percentage changes were calculated for descriptive interpretation, and independent-samples t tests with Cohen's d and 95% confidence intervals were used to compare groups at posttest. Statistical significance was set at $p < 0.05$.

Results

Participant characteristics are presented in Table 2. The experimental and control groups were descriptively similar in age, height, body mass, and training experience before the intervention.

Table 2. Participant characteristics at baseline

Variable	Experimental group (n = 15)	Control group (n = 15)
Age (years)	16.00 ± 0.85	16.00 ± 0.85
Height (cm)	169.53 ± 4.02	169.40 ± 3.88
Body mass (kg)	59.87 ± 3.76	59.73 ± 3.68
Training experience (years)	4.27 ± 1.03	4.07 ± 0.96

Values are mean ± standard deviation.

All pretest and posttest distributions met the normality assumption, and Levene's tests indicated homogeneous variances between groups (all $p > 0.05$; Table 3). The data were therefore considered suitable for parametric analysis.

Table 3. Normality and homogeneity tests

Outcome	Time	Shapiro-Wilk W	p	Levene statistic	p
Standing broad jump	Pretest	0.966	0.437	0.351	0.558
Standing broad jump	Posttest	0.977	0.743	0.735	0.399
30-m sprint	Pretest	0.960	0.303	0.566	0.458
30-m sprint	Posttest	0.961	0.334	1.192	0.284
Shooting accuracy	Pretest	0.924	0.133	2.385	0.134
Shooting accuracy	Posttest	0.955	0.230	2.667	0.114
Mental toughness	Pretest	0.964	0.394	0.062	0.804
Mental toughness	Posttest	0.981	0.855	0.008	0.927

Both groups improved from pretest to posttest, but the magnitude of change was consistently greater in the experimental group (Table 4). In the experimental group, standing broad jump distance increased by 5.89%, sprint time decreased by 6.07%, shooting accuracy increased by 33.23%, and mental toughness increased by 16.26%. The corresponding changes in the control group were 1.67%, -1.25%, 6.48%, and 3.41%, respectively. For sprint time, a negative percentage change indicates faster performance.

Table 4. Within-group changes in performance outcomes

Outcome	Group	Pretest, mean ± SD	Posttest, mean ± SD	Change (%)	ES	p
Standing broad jump (cm)	Experimental	195.87 ± 8.72	207.40 ± 9.09	5.89	1.29	<0.001
30-m sprint (s)	Experimental	4.78 ± 0.10	4.49 ± 0.11	-6.07	-2.76	<0.001
Shooting accuracy (points)	Experimental	36.93 ± 3.61	49.20 ± 3.91	33.23	3.26	<0.001
Mental toughness (points)	Experimental	89.00 ± 5.77	103.47 ± 5.62	16.26	2.54	<0.001
Standing broad jump (cm)	Control	194.67 ± 7.53	197.93 ± 7.37	1.67	0.44	<0.001
30-m sprint (s)	Control	4.80 ± 0.09	4.74 ± 0.08	-1.25	-0.70	<0.001
Shooting accuracy (points)	Control	36.13 ± 2.56	38.47 ± 2.59	6.48	0.91	<0.001
Mental toughness (points)	Control	88.00 ± 5.28	91.00 ± 5.28	3.41	0.57	<0.001

ES = standardized within-group effect size. For sprint time, negative change and ES values indicate faster performance.

The repeated-measures analysis showed significant time-by-group interactions for standing broad jump, sprint time, shooting accuracy, and mental toughness (all $p < 0.001$; $\eta p^2 = 0.980–0.996$; Table 5). These interactions indicate that the pattern of change over time differed between the holistic and conventional training groups. The main effect of group was not significant for standing broad jump ($p = 0.086$), but it was significant for sprint time, shooting accuracy, and mental toughness.

Table 5. Two-way repeated-measures analysis of variance

Outcome	Time F	p	ηp²	Group F	p	ηp²	Time × Group F	p	ηp²
Standing broad jump	4,312.350	<0.001	0.994	3.167	0.086	0.102	1,345.400	<0.001	0.980
30-m sprint	16,475.449	<0.001	0.998	14.254	<0.001	0.337	6,979.178	<0.001	0.996

Outcome	Time F	p	ηp²	Group F	p	ηp²	Time × Group F	p	ηp²
Shooting accuracy	7,143.128	<0.001	0.996	24.095	<0.001	0.463	3,306.532	<0.001	0.992
Mental toughness	17,161.000	<0.001	0.998	11.295	0.002	0.287	7,396.000	<0.001	0.996

All F tests have df = 1, 28. ηp² = partial eta squared.

Posttest comparisons favored the experimental group for every outcome (Table 6). Compared with the control group, the experimental group achieved a longer standing broad jump (mean difference = 9.47 cm), a faster 30-m sprint (mean difference = -0.25 s), higher shooting accuracy (mean difference = 10.73 points), and higher mental toughness scores (mean difference = 12.47 points). Standardized between-group effects were large to very large in magnitude.

Table 6. Posttest comparisons between groups

Outcome	Experimental mean ± SD	Control mean ± SD	t	p	95% CI	Cohen's d	Difference (%)
Standing broad jump (cm)	207.40 ± 9.09	197.93 ± 7.37	3.132	0.004	3.28 to 15.66	1.15	4.79
30-m sprint (s)	4.49 ± 0.11	4.74 ± 0.08	-6.918	<0.001	-0.32 to -0.17	-2.56	-5.27
Shooting accuracy (points)	49.20 ± 3.91	38.47 ± 2.59	8.861	<0.001	8.25 to 13.21	3.19	27.92
Mental toughness (points)	103.47 ± 5.62	91.00 ± 5.28	6.264	<0.001	8.39 to 16.54	2.27	13.70

CI = confidence interval. Negative values for the sprint outcome favor the experimental group because lower time represents better performance.

Discussion

The principal finding was that six weeks of match-representative holistic training produced greater improvements in lower-limb explosive performance, 30-m sprint performance, shooting accuracy, and self-reported mental toughness than conventional separated training. The intervention required players to connect an explosive action with acceleration, perception of a pass, ball control, rapid decision-making, defensive pressure, and finishing. Significant time-by-group interactions were observed for all four outcomes, indicating that the pattern of change differed consistently between the training conditions. The findings therefore support the practical value of developing selected physical, technical, and psychological qualities concurrently, although the mechanisms responsible for each adaptation cannot be isolated from the present design.

Standing broad jump performance improved more in the experimental group than in the control group. Repeated hurdle jumps, accelerations, and soccer-specific actions likely provided a combined neuromuscular stimulus to lower-limb force and power production. This interpretation is consistent with evidence that plyometric training improves jump and sprint performance in young male soccer players (Chelly et al., 2010; Ramirez-Campillo et al., 2020). The match-related context may also have improved the players' ability to express power immediately before a technical action rather than only in an isolated movement.

Sprint time also decreased substantially in the experimental group. Each drill required rapid acceleration after an explosive stimulus and continued movement while players interpreted the direction, speed, and landing point of the ball. Lower-limb power is associated with sprint performance in young soccer players (Diker et al., 2021; López-Segovia et al., 2011), and the present program combined this physical stimulus with perception and action under time pressure. The result may therefore reflect both physical adaptation and improved organization of movement in a soccer-specific context.

The largest percentage improvement occurred in shooting accuracy. Unlike isolated shooting practice, the intervention required players to shoot after jumping or squatting, sprinting, receiving a pass, and evaluating the position of teammates and defenders. Representative learning design proposes that skill transfer is enhanced when practice preserves the information and action opportunities present in competition (Davids et al., 2013; Pinder et al., 2011). The current findings are also consistent with evidence that small-sided and integrated practices can improve technical execution and tactical behavior (Clemente et al., 2021; Coutinho et al., 2018; Hill-Haas et al., 2011; Michailidis, 2013).

Mental toughness increased more in the holistic group than in the control group. The drills repeatedly exposed players to attentional demands, rapid choices, defensive pressure, and the immediate consequences of successful or unsuccessful actions. Such experiences may support confidence, concentration, emotional control, motivation, and mental preparation. This interpretation aligns with sport psychology literature emphasizing the role of psychological skills in sustained performance (Cowden, 2017; Weinberg & Gould, 2018) and with recent evidence that structured psychological interventions can improve mental toughness and decision-making in football (Dalbudak et al., 2026). Nevertheless, because mental toughness was assessed by self-report, the result should be interpreted as a change in players' reported psychological skills rather than as direct evidence of behavior during competition.

Taken together, the cross-domain pattern is consistent with representative learning design and with the broader rationale for holistic training, but it should not be interpreted as proof that one mechanism caused all four improvements. The likely value of the program lies in coupling physical output with the information that regulates subsequent football actions. Players did not simply jump, sprint, or shoot; they had to reorganize these actions in response to ball flight, teammate and defender positions, and limited decision time. This interpretation extends previous holistic and ecological work by showing concurrent changes in physical, technical, and psychological outcomes within a controlled adolescent sample (Kusuma et al., 2024; Pinder et al., 2011; Tassi et al., 2024). Whether these field-test improvements translate into superior match behavior remains an important question for subsequent research.

From a practical perspective, the intervention offers coaches a time-efficient way to target several performance domains within the same session. Task difficulty can be progressed by manipulating repetition volume, sprint intensity, defender delay, available space, the number of permitted touches, and the range of finishing options. These variables should not be increased simultaneously: coaches should preserve technical quality, monitor fatigue, and adjust the challenge to the players' developmental and training status. The model is best used as a complement to, rather than a replacement for, focused physical, technical, tactical, and psychological work. Its main practical advantage is that selected qualities can be rehearsed in the same temporal sequence in which they must be coordinated during play.

Conclusion

This study provides controlled evidence that a six-week match-representative holistic program can produce broader short-term adaptations than conventional separated training in adolescent male soccer players. Relative to baseline, the experimental group increased standing broad jump distance by 5.89%, reduced 30-m sprint time by 6.07%, increased shooting accuracy by 33.23%, and increased mental toughness scores by 16.26%. The corresponding changes in the control group were 1.67%, -1.25%, 6.48%, and 3.41%, respectively. Significant time-by-group interactions for all four outcomes, together with posttest differences favoring the experimental group, indicate that the additional gains were not limited to a single performance domain.

The practical meaning of these changes is that physical qualities were developed in a task context that also demanded ball reception, perception, decision-making, management of defensive pressure, and finishing. Improved broad jump performance suggests enhanced lower-limb explosive capability, while the reduction in 30-m sprint time indicates faster linear sprint performance. The marked gain in shooting accuracy is especially relevant because finishing was practiced after preceding physical and perceptual demands rather than as an isolated action. The improvement in mental toughness scores suggests that repeatedly performing under time pressure, opposition, and immediate performance consequences may also support perceived confidence, concentration, emotional control, motivation, and mental preparation. Because this outcome was self-reported, however, it should be interpreted as a psychological adaptation reported by the players rather than direct evidence of improved behavior during competitive matches.

Theoretically, the study extends holistic training and representative learning design by showing that selected physical, technical, and psychological outcomes can change concurrently when key information-action relationships are preserved within the same drill sequence. The results do not imply that integrated training should replace specialized conditioning, technical refinement, tactical instruction, or formal psychological-skills work. Rather, they support a complementary model in which coaches deliberately connect these elements when the training objective is their coordinated expression. In practice, the three-session-per-week format can be adapted by manipulating sprint intensity, repetition volume, defender delay, available space, touch restrictions, and finishing options. Progression should be individualized, technical quality should remain a priority, and workload should be monitored so that representativeness is not achieved at the cost of excessive fatigue.

For youth soccer programs with limited training time, this approach offers a credible and applicable way to organize multidimensional preparation around football actions rather than around isolated capacities alone. The strongest implication is therefore not simply that the players became faster, more powerful, more accurate, or mentally tougher, but that these improvements occurred within a training model designed to link the qualities that must interact during play. Future research should test the model in larger and more diverse samples, include female players and different age and competitive groups, monitor internal and external load, examine retention over longer periods, and determine whether the observed gains transfer to match-running performance, tactical behavior, and competition-based technical outcomes.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this manuscript, the authors used OpenAI ChatGPT for English language editing and proofreading assistance. The use of this tool was limited to improving language clarity and presentation. The research process, including study design, data collection, data analysis, interpretation of results, and scientific decisions, was entirely conducted by the authors. The authors reviewed and edited all content and take full responsibility for the accuracy, integrity, and content of the publication.

Conflicts of interest

The authors declare no financial or non-financial conflicts of interest related to this study.

Limitations

Several limitations should be considered when interpreting the findings. First, the sample was small and included only 30 male players aged 15–17 years from a single club; the results should therefore not be generalized automatically to female players, other age groups, different competitive levels, or other training environments. Second, the intervention lasted six weeks, so the persistence of the adaptations and their relevance across a full competitive season remain unknown. Third, the outcome battery did not include agility, endurance, match-running data, in-match technical behavior, tactical performance, or measures of internal and external training load. These omissions limit conclusions about the wider transfer of the program and about the dose-response relationship between training exposure and adaptation. Fourth, mental toughness was assessed using self-report; future work should report complete psychometric information for the instrument and combine questionnaire data with behavioral, observational, or coach-rated indicators. Larger multicenter trials, longer follow-up periods, workload monitoring, retention testing, and match-based performance measures are needed to establish the robustness and practical transfer of the present findings.

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