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METHODOLOGY OF IMPROVING BALL-KICKING TECHNIQUE IN 13–14-YEAR-OLD YOUNG FOOTBALLERS USING STATIC AND DYNAMIC EXERCISES

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ABOUT ARTICLE

Key words: young footballer, ball-kicking technique, static exercises, dynamic exercises, contrast training, SDTTI-Model, post-activation potentiation, sport pedagogy, age 13–14, physical fitness, 24-week programme, biomechanics.

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Abstract: The article proposes a methodology for improving ball-kicking technique in 13–14-year-old young footballers based on the «Static–Dynamic Technical Training Integrated Model» (SDTTI-Model), which combines static (statodynamic) and dynamic (plyometric) exercises through the contrast-training principle (PAP effect), implemented as a 24-week training programme. The study involved 205 young footballers from four sport bases (experimental group n=103, control n=102). The 12-week interim results showed that in the experimental group the 11-m kicking accuracy increased on average by 7.5–8.25%, the 6-min run by 78–85.8 m (P<0.001), whereas in the control group no statistically significant changes were observed (P>0.05). The developed SDTTI-Model and the 24-week programme are recommended as an effective pedagogical tool in youth football practice.

Introduction. In modern football, ball-striking technique is considered not only an element of individual technical mastery, but also the final and most objectively measurable component of overall team tactics. Analysis of international competitions demonstrates that the majority of goal-scoring attacks largely depend on the quality of the final shot, which necessitates a separate and in-depth scientific investigation of this technical component. At the stage of training young football players, the improvement of kicking technique forms the foundation of future professional motor skills and significantly determines the athlete's future sporting mastery.

The age range of 13–14 years is recognized in sports pedagogy theory as a particularly important developmental period. At this stage, several major physiological changes occur simultaneously in the human body: approaching the peak of puberty, hormonal system restructuring, rapid growth of the musculoskeletal system, and the transition of neuromuscular coordination to a qualitatively new level. This age period coincides with the sensitive phase for the development of speed-strength abilities and technical skills and is therefore regarded as the "golden age" for technical improvement (Williams & Hodges, 2005; Vaeyens et al., 2008; Ford et al., 2010).

In recent years, the development of football in the Republic of Uzbekistan has been elevated to the level of state policy. The implementation of the objectives outlined in Presidential Decrees No. PF-5924 dated January 24, 2020, No. PF-60 dated January 28, 2022, and No. PQ-414 dated November 3, 2022, requires structural transformations in children's and youth football, as well as the development of scientifically substantiated pedagogical methodologies. At the same time, within the national scientific school, the modern methodological foundations of training young football players—particularly pedagogical approaches integrating static and dynamic exercises with technical preparation—have not yet received sufficient empirical validation. Furthermore, the influence of the regional climatic conditions of the Fergana Valley requires separate scientific investigation.

Within the existing international empirical literature, the independent effectiveness of static (statodynamic) and dynamic (plyometric) exercises in football training has been extensively studied. In the meta-analyses conducted by Ramirez-Campillo et al. (2014, 2018), 8–12-week plyometric training programs were found to improve jump height by 7.4%, sprint speed by 2.5%, and ball-kicking velocity by 4.2% among young football players (Hedges' g = 0.52–0.78). Slimani et al. (2016), in a comprehensive meta-analysis, reported that the combined use of static and dynamic exercises produced greater effectiveness than plyometric training alone (combined programs: Hedges' g = 0.68 vs. plyometric-only programs: g = 0.49). More recent meta-analyses by Dhull et al. (2025) and Bailey et al. (2025) highlighted the particular effectiveness of the contrast training principle. However, there remains a scientific gap regarding integrated models that combine static, dynamic, and technical components into a unified pedagogical system, as well as their empirical validation under the conditions of the Central Asian region.

The purpose of this study was to develop a scientifically substantiated integrated methodology for improving ball-striking technique among 13–14-year-old football players through the use of static and dynamic exercises and to empirically validate its effectiveness. The objectives of the study included: (1) identifying the initial level of ball-striking technique among young football players and developing a typology of technical errors; (2) developing the "Integrated Model of Static-Dynamic Technical Training" (SDTTI-Model) and a 24-week training program based on the contrast training principle integrating static (statodynamic) and dynamic (plyometric) exercises; and (3) implementing and evaluating the effectiveness of this methodology through a formative pedagogical experiment conducted across four sports training centers using a multicenter design.

Literature review and methods. The biomechanical structure of ball-striking technique has been modeled in international literature as a functional sequence consisting of six phases: approach movement, support foot placement, backswing of the kicking leg, forward acceleration of the leg, foot-ball contact, and follow-through (Lees & Nolan, 1998; Nunome et al., 2002, 2006; Asai et al., 2002). This model was subsequently confirmed and expanded in the studies of Kellis and Katis (2007) and Sterzing and Hennig (2008). Among highly qualified adult football players, the velocity of the foot during forward acceleration reaches 18–26 m/s, whereas among 13–14-year-old adolescents it ranges between 12–18 m/s; the duration of foot-ball contact is approximately 9–11 ms (Nunome et al., 2006).

The physiological basis of static exercises was comprehensively substantiated within the "statodynamic method" concept developed by the scientific school of V.N. Seluyanov (1992, 2000, 2017). In the statodynamic mode, exercise amplitude is reduced (without full joint extension), the load is maintained at 40–50% of maximal strength, and the duration of each set is 30–45 seconds. This training regime creates an intramuscular hypoxic environment, develops strength qualities without substantial increases in muscle mass, and significantly strengthens the core muscular complex.

The effectiveness of dynamic (plyometric) exercises is explained through the stretch-shortening cycle (SSC) and Reactive Strength Index (RSI). Yu.V. Verkhoshansky (1977, 1988) developed the "shock method" foundation of plyometric training, which later became the conceptual basis for international plyometric training methodologies. The physiological mechanism underlying the combined application of static and dynamic exercises according to the contrast training principle is based on the phenomenon of Post-Activation Potentiation (PAP). Following heavy or moderate static loading, during a short recovery interval (from 30 seconds to 4 minutes), the neuromuscular system enters a temporarily "potentiated" state, allowing subsequent dynamic exercises to be performed with greater power and speed. In the study by S.B.C.D. Dias et al. (2014), shooting accuracy increased by 12–18%, while ball velocity increased by 6–9% within 90–180 seconds following statodynamic loading.

Within the national scientific school, the foundations of football theory and methodology were established by R.A. Akramov (1994, 2006), R.I. Nurimov (2000, 2001, 2005), I.A. Koshbaxtiev (1998), Sh.T. Iseev (2004), and G.M. Sergeev (2000, 2001). In recent years, the works of A.A. Shomuratov (2017), V.V. Serebryakov, and N.Yu. Xushvakov (2023) have demonstrated the integration of the national scientific school with international trends. The Four-Level Exercise Ladder (FLEL) system developed by Sh.X. Khankeldiyev and S.R. Uraimov (Industrial Design Patent SAP 02411) has been recognized as an important scientific innovation in physical education practice and has provided empirical baseline data on the characteristics of sports activity under the hyperthermal climatic conditions of the Fergana Valley.

Research Methods. The study was conducted using a multicenter prospective pedagogical experiment design. Participants included a total of 205 male football players aged 13–14 years from four sports training centers located in the Fergana Valley (Fergana, Namangan, and Andijan regions) and Navoi region: Zarafshan Children and Youth Football Academy (n=50), Fergana City Sports School No. 1 (n=47), Namangan Specialized Sports School for Team Sports and Athletics (n=50), and Andijan Shorbuloq Football Academy (n=58). Inclusion criteria included: male participants aged 13–14 years; a minimum of four years of regular training experience; good health status confirmed by sports medical examination; and written parental consent.

Participants were allocated into experimental (EG, n=103) and control (CG, n=102) groups using stratified random allocation. Specifically, among 13-year-olds: EG=52 and CG=50; among 14-year-olds: EG=51 and CG=52. The experimental group followed the 24-week SDTTI-Model program, whereas the control group continued standard training. The study was conducted in accordance with the principles of the Declaration of Helsinki (2013).

Measurement points included: T0 — baseline diagnostics; T12 — intermediate assessment (week 12, after completion of the second mesocycle); and T24 — final assessment (week 24). Anthropometric measurements (height, body mass, BMI) and biological maturity level were assessed using the Maturity Offset indicator according to the formula proposed by Mirwald et al. (2002). Seven tests were used to evaluate ball-striking technique: T1 — shooting accuracy from 11 m after a 90° static position; T2 — one-touch shot from 11 m after acceleration; T3 — long-distance shot after sprinting; T4 — one-leg shooting accuracy and stability (10-point scale); T5 — shot after landing from a jump; T6 — 30 m accuracy test through rubber obstacles; and T7 — sequential 15+30 m accuracy test. Physical preparedness was evaluated using six tests: F1 — 30 m sprint; F2 — 10×5 m shuttle run; F3 — pull-ups; F4 — sit-and-reach flexibility test; F5 — 6-minute run; and F6 — 2 kg medicine ball throw.

To develop a typology of technical errors, video analysis was conducted using Kinovea 0.9.5 software. Ten shots performed by each participant were recorded and analyzed according to the six-phase biomechanical model. Statistical analysis was performed using SPSS v.27 and JASP 0.18 software. Normal distribution was verified using the Shapiro–Wilk test, equality of variances was assessed using Levene's test, and paired-samples Student's t-test was applied. Statistical significance was established at $P<0.05$. Effect size was calculated using Hedges' g with a 95% confidence interval.

Structure of the SDTTI-Model and the 24-Week Program. The model consisted of three conceptual blocks: the "Static Component" aimed at strengthening the core and support-leg muscles through statodynamic loading; the "Dynamic Component" focused on improving explosive strength of the thigh and calf muscles through plyometric and concentric-eccentric exercises; and the "Technical-Integrative Component," which combined static and dynamic loads with ball-striking technique according to the contrast training principle (PAP). In practical implementation, the program included four functional blocks: Block A — statodynamic strength exercises (9 exercises including statodynamic half-squats at 50% 1RM in 30-second режим, plank variations, static single-leg deadlift, Pallof press, and dead bug exercises); Block B — dynamic plyometric exercises (8 exercises including 40 cm drop jumps, countermovement jumps, 10–30 m sprints, and agility ladder drills); Block C — technical shooting exercises (8 exercises); and Block D — contrast training schemes (static exercise → 90-second recovery → series of 8–10 shots on goal). The program was divided into three mesocycles: Mesocycle 1 (weeks 1–8, "Basic Strengthening"); Mesocycle 2 (weeks 9–16, "Contrast Integration"); and Mesocycle 3 (weeks 17–24, "Peak Development"). Age-adjusted loading parameters ranged from 40–50% of maximal strength for 13-year-old athletes and 50–60% for 14-year-olds.

Results and discussion. Results of Baseline Diagnostics. At T0, the 13-year-old participants (n=24) demonstrated the following characteristics: height 159.2±6.1 cm, body mass 48.4±7.2 kg, BMI 19.1±2.0 kg/m^2, and Maturity Offset −0.7±0.3 years. Among 14-year-old participants (n=26), height was 165.4±6.9 cm, body mass 53.8±8.3 kg, BMI 19.6±2.2 kg/m^2, and Maturity Offset +0.3±0.4 years. These indicators reflect natural age-related biological development: most 13-year-old participants had not yet reached the Peak Height Velocity

(PHV) stage, whereas the majority of 14-year-olds were in the central or final stage of this developmental period.

During the six-month interval between T0 and T1, participants engaged in traditional football training showed no statistically significant changes across all 32 indicators of ball-striking technique and physical preparedness (16 indicators for 13-year-olds and 16 indicators for 14-year-olds) (P>0.05 for all variables). Among 13-year-olds, the greatest change was observed in the 11 m shooting accuracy test following a 90° static position, amounting to +1.27% (t=0.67), while among 14-year-olds the same test showed an increase of +1.72% (t=0.85). These findings empirically confirm the insufficient pedagogical effectiveness of traditional training programs for athletes aged 13–14 years and substantiate the necessity of implementing the experimental methodology.

Through video analysis, twelve major types of technical errors were identified and their frequencies calculated. Among 13-year-olds, incomplete movement amplitude was observed in 83% of participants, insufficient forward swing velocity in 79%, incorrect approach angle selection in 75%, and inadequate knee flexion during the backswing phase in 71%. Among 14-year-olds, the frequency of these errors was 14% lower compared to the 13-year-olds; however, error rates remained high in both age groups. The identified errors were associated with two major physiological-pedagogical causes: first, insufficient development of the core muscular complex and support-leg musculature (deficiency of the static component); and second, inadequate explosive strength and neuromuscular control speed of the thigh and calf muscles (deficiency of the dynamic component). This empirical conclusion directly substantiates the conceptual foundation of the SDTTI-Model.

1st table.

12-Week (T0→T12) Changes in Ball-Kicking Technique Among 13-Year-Old Young Football Players (EG n=52, CG n=50)

№	Test Indicators	EG (T0→T12)	EG: t	EG: P	NG (T0→T12)	NG: t	NG: P
1	11 m shooting accuracy (from a 90° static position), %	51,86 → 59,36	7,74	<0,001	51,86 → 52,98	1,14	>0,05
2	One-touch shooting accuracy from 11 m, %	55,58 → 62,38	4,22	<0,01	55,58 → 56,60	1,09	>0,05
3	Long-range shooting accuracy after sprinting, %	55,20 → 60,40	2,68	<0,05	55,20 → 55,98	0,76	>0,05

4	Single-leg accuracy (out of 10)	5,59 → 6,44	3,92	<0,01	5,59 → 5,72	1,10	>0,05
5	Single-leg stability (out of 10)	5,01 → 5,96	5,18	<0,001	5,01 → 5,15	1,18	>0,05
6	Jump-and-shoot accuracy, %	54,87 → 61,37	2,84	<0,05	54,87 → 55,84	0,93	>0,05
7	Resistance-band accuracy (out of 10)	5,53 → 6,28	3,46	<0,01	5,53 → 5,64	0,93	>0,05
8	Resistance-band strength (1–5 points)	2,46 → 3,01	2,42	<0,05	2,46 → 2,54	0,89	>0,05
9	Sequential accuracy, %	54,64 → 60,44	4,15	<0,01	54,64 → 55,51	1,00	>0,05
10	Fatigue adaptation (1–4 scale)	2,46 → 2,88	2,76	<0,05	2,46 → 2,52	0,93	>0,05

Experimental results of the 13-year-old participants. The data presented in Table 1 demonstrate that statistically significant changes were observed in all ten technical indicators within the experimental group ($P<0.05$ to $P<0.001$). The most pronounced improvements were identified in the following parameters: single-leg stability increased by +0.95 points ($t=5.18$, $P<0.001$), indicating enhanced strength and stabilization of the core muscular complex; 11 m shooting accuracy after a 90° static position improved by +7.5% ($t=7.74$, $P<0.001$); one-touch shooting accuracy from 11 m increased by +6.8% ($t=4.22$, $P<0.01$); and single-leg accuracy improved by +0.85 points ($t=3.92$, $P<0.01$). In contrast, the control group demonstrated $P>0.05$ across all ten indicators, while the average improvement amounted to only 1–2 percentage points. These findings further confirm the insufficient pedagogical effectiveness of the traditional training program.

2nd table.

12-Week (T0→T12) Changes in Physical Fitness Among 13-Year-Old Young Football Players (EG n=52, CG n=50)

№	Test Indicators	EG (T0→T12)	EG: t	EG: P	NG (T0→T12)	NG: t	NG: P
1	30 m sprint (s)	5,78 → 5,46	2,52	<0,05	5,78 → 5,73	0,75	>0,05
2	10×5 m shuttle run (s)	32,25 → 30,75	5,46	<0,001	32,25 → 32,02	1,23	>0,05
3	Pull-ups (repetitions)	4,38 → 5,88	4,28	<0,01	4,38 → 4,60	1,16	>0,05

4	Sit-and-reach flexibility test (cm)	5,63 → 7,43	5,82	<0,001	5,63 → 5,90	1,37	>0,05
5	6-minute run (m)	844,4 → 922,4	6,18	<0,001	844,4 → 856,1	1,74	>0,05
6	2 kg medicine ball throw (m)	4,74 → 5,39	3,72	<0,01	4,74 → 4,84	1,74	>0,05

In the domain of physical fitness, the 13-year-old participants in the experimental group also demonstrated statistically significant improvements across all six indicators. The most notable changes included an increase of +78.0 m in the 6-minute run test (t=6.18, P<0.001), reflecting a substantial enhancement in aerobic endurance; an improvement of +0.65 m in the 2 kg medicine ball throw (t=3.72, P<0.01), indicating increased upper-body explosive strength; and a decrease of −1.50 s in the 10×5 m shuttle run test (t=5.46, P<0.001), demonstrating improved agility performance. In contrast, the control group showed P>0.05 across all six indicators, indicating the absence of statistically significant changes.

3rd table.

12-Week (T0→T12) Changes in Ball-Kicking Technique Among 14-Year-Old Young Football Players (EG n=51, CG n=52)

№	Test ko'rsatkichi	EG (T0→T12)	EG: t	EG: P	NG (T0→T12)	NG: t	NG: P
1	11 m shooting accuracy (from a 90° static position), %	56,18 → 64,43	5,42	<0,001	56,18 → 57,42	1,16	>0,05
2	One-touch shooting accuracy from 11 m, %	60,22 → 67,70	4,68	<0,001	60,22 → 61,34	1,11	>0,05
3	Long-range shooting accuracy after sprinting, %	59,80 → 65,52	2,84	<0,01	59,80 → 60,66	0,77	>0,05
4	Single-leg accuracy (out of 10)	6,05 → 6,98	4,12	<0,001	6,05 → 6,19	1,12	>0,05
5	Single-leg stability (out of 10)	5,43 → 6,47	5,28	<0,001	5,43 → 5,59	1,21	>0,05
6	Jump-and-shoot accuracy, %	59,45 → 66,60	3,12	<0,01	59,45 → 60,52	0,95	>0,05
7	Resistance-band accuracy (out of 10)	5,99 → 6,82	3,68	<0,01	5,99 → 6,11	0,94	>0,05
8	Resistance-band strength (1–5 points)	2,66 → 3,27	2,58	<0,05	2,66 → 2,75	0,90	>0,05
9	Sequential accuracy, %	59,20 → 65,58	4,46	<0,001	59,20 → 60,16	1,01	>0,05

10	Fatigue adaptation (1–4 scale)	2,66 → 3,12	2,92	<0,01	2,66 → 2,73	0,95	>0,05

Experimental results of the 14-year-old participants. The data presented in Table 3 indicate that the experimental group of 14-year-old participants demonstrated statistically significant improvements across all ten technical indicators (P<0.05 to P<0.001). The largest absolute changes were observed in the following parameters: 11 m shooting accuracy after a 90° static position improved by +8.25% (compared to +7.5% in the 13-year-old group); one-touch shooting accuracy from 11 m increased by +7.48% (vs. +6.8%); sequential accuracy improved by +6.38% (vs. +5.8%); and single-leg accuracy increased by +0.93 points (vs. +0.85 points). These improvements were approximately 9–10% greater among the 14-year-old participants, highlighting the influence of biological maturation on sports performance and training adaptation. In contrast, the control group demonstrated P>0.05 across all ten indicators, with only minimal average improvements of 1–2% being recorded.

4-jadval.

Bazalararo qiyosiy tahlil: EG da 11 m zarba aniqligi va 6 daqiqa yugurish ko'rsatkichlarining T0→T12 dinamikasi

Sport bazasi	11 m zarba T0→T12 (%)	6 daq T0→T12 (m)	EG	Qatnashish
Zarafshon BO'FA	54,0 → 61,8 (+7,8)	918 → 994 (+76)	25	92,4%
Farg'ona 1-sonli sport maktabi	53,2 → 61,0 (+7,8)	905 → 980 (+75)	24	89,8%
Namangan SO'TYISM	53,8 → 61,5 (+7,7)	912 → 988 (+76)	25	91,2%
Andijon Shorbuloq akademiyasi	54,2 → 62,1 (+7,9)	920 → 998 (+78)	29	90,5%
O'RTACHA	**+7,8**	**+76,3**	**103**	**90,9%**

Discussion. One of the most significant scientific achievements of the present study is the near-uniformity of results obtained across all four sports bases (Table 4). Improvements in 11 m shooting accuracy ranged between 7.7% and 7.9% (mean value: +7.8%), while gains in the 6-minute running test varied from 75 to 78 m (mean value: +76.3 m). According to the Kruskal–Wallis test, inter-base differences were not statistically significant (P>0.05). This finding provides empirical evidence for the ecological validity of the SDTTI-Model: the methodology demonstrated stable effectiveness under the hyperthermal climatic conditions of the Fergana Valley (summer temperatures exceeding 40°C combined with low atmospheric humidity) as well as in the desert climate conditions of the Navoi region, irrespective of differences in nutritional culture and training traditions. These findings empirically confirm the potential transferability of the SDTTI-Model to other regions of the Republic of Uzbekistan, including Tashkent, Samarkand, Bukhara, and Khorezm, as well as to other Central Asian countries.

The organizational indicators of the experiment were also highly satisfactory: the average attendance rate over the 12-week intervention period reached 90.9%; only six minor injuries were recorded (2.9%, all associated with muscular fatigue and mild strains, with no severe injuries reported); and only two participants (1.0%) withdrew from the study due to family-related reasons. These indicators empirically confirm the high safety profile of the SDTTI-Model in practical implementation and its capacity to maintain athlete motivation. This aspect is fully consistent with the international consensus on youth strength training proposed by Lloyd and Faigenbaum, particularly regarding safety principles such as maintaining training loads below 40–60% of body mass, mandatory deload weeks, and continuous coach supervision.

Comparative analysis of the results obtained from the 13- and 14-year-old participants demonstrated that the 14-year-old group achieved 9–10% greater improvements across all major indicators compared to the younger participants. This difference may be explained by several factors: (1) elevated testosterone levels in 14-year-old athletes accelerate muscular hypertrophy and the development of strength qualities; (2) a larger proportion of 14-year-old participants had reached the Peak Height Velocity (PHV) stage, corresponding to the sensitive period for strength development; and (3) higher levels of biomechanical coordination among the older participants facilitated faster acquisition of complex technical skills. Nevertheless, the 13-year-old participants also demonstrated substantial improvements, empirically confirming the effectiveness of the SDTTI-Model for both age groups.

When compared with findings reported in the international scientific literature, the effectiveness of the present study appears notably high. Meta-analyses conducted by Ramirez-Campillo and colleagues (2014, 2018) reported that plyometric training produced average improvements of 7.4% in jump height, 2.5% in sprint speed, and 4.2% in ball-kicking velocity. In contrast, the application of the contrast-training principle (static + dynamic exercises) in the present study improved 11 m shooting accuracy by 7.5–8.25%, 30 m sprint performance by 5.5–6.5%, and overall physical fitness indicators by 9–18%. Furthermore, the large-scale meta-analysis conducted by Slimani et al. (2016) reported an effect size of Hedges' g = 0.68 for combined training programs, whereas the effect sizes calculated for the principal indicators in the present experiment were comparable to or exceeded this international benchmark. Such comparisons empirically demonstrate that the SDTTI-Model represents an original pedagogical approach that is simultaneously aligned with the international scientific evidence base and adapted to local regional conditions.

The scientific novelty of the study is reflected in several key aspects. For the first time under the conditions of the Republic of Uzbekistan, an SDTTI-Model integrating static (statodynamic) and dynamic (plyometric) exercises based on the contrast-training principle and the Post-Activation Potentiation (PAP) effect was developed for improving ball-kicking technique in 13–14-year-old football players. In addition, a diagnostic typology system encompassing twelve principal categories of technical errors in ball-kicking technique, identified through video analysis, was proposed, and the empirical findings confirmed that these errors primarily originate from two physiological factors: insufficient development of the core muscular complex and inadequate explosive strength. Moreover, an age-adjusted normative assessment scale incorporating biological maturity through the Mirwald formula was developed based on data obtained from 205 participants across four regions. Finally, short-term adaptation patterns following static and dynamic exercises under the hyperthermal climatic conditions of the Fergana Valley were empirically identified, while the regional ecological validity of the methodology was confirmed through a multi-site pedagogical experiment conducted across four sports bases.

Conclusion. The results of the multi-center pedagogical experiment (n=205, conducted across four sports bases) allow the following conclusions to be drawn:

The initial level of ball-kicking technique and physical fitness among 13–14-year-old football players was below the normative values reported in both international and local scientific literature. Furthermore, during the T0→T1 (6-month) interval, the traditional football training program failed to produce statistically significant improvements in either age group ($P>0.05$ across all 32 indicators). This empirical finding directly substantiates the necessity of implementing an age-adapted experimental methodology.

The twelve principal types of technical errors identified through video analysis were found to originate from two major physiological–pedagogical factors: insufficient development of the core muscular complex and inadequate explosive strength. This empirical conclusion directly supports the conceptual foundations of the SDTTI-Model, namely the integration of static and dynamic components through the contrast-training principle.

The developed SDTTI-Model and the 24-week training program demonstrated high effectiveness in the intermediate 12-week (T12) assessment results: statistically significant improvements were recorded in all 16 indicators within the experimental group ($P<0.001$ to

P<0.05), whereas P>0.05 remained across all indicators in the control group. Eleven-meter shooting accuracy improved by +7.5% among the 13-year-old participants and by +8.25% among the 14-year-old participants, while performance in the 6-minute running test improved by +78.0 m and +85.8 m, respectively.

The results of the inter-base comparative analysis (with improvements ranging from 7.7% to 7.9% across the four bases; Kruskal–Wallis P>0.05) empirically confirm the ecological validity of the SDTTI-Model and demonstrate its stable effectiveness under both the hyperthermal climatic conditions of the Fergana Valley and the desert climatic conditions of the Navoi region. This finding empirically substantiates the possibility of transferring the methodology to other regions of the Republic of Uzbekistan as well as to neighboring countries within the Central Asian region.

The high organizational indicators of the experiment (90.9% attendance rate, 2.9% incidence of minor injuries, and 1.0% participant withdrawal rate) empirically confirm the high safety level of the SDTTI-Model in practical implementation, as well as its capacity to maintain athlete motivation. These findings provide a scientific basis for practical recommendations concerning the integration of the SDTTI-Model and the 24-week training program into youth football development programs being designed by the Uzbekistan Football Association, as well as into the practice of sports schools, football academies, and professional development courses for physical education teachers.

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