applied sciences

MDPI

Article

The FIFA 11+ Program Significantly Enhances Physical Performance and Dynamic Balance in Male Handball Players

Ridha Aouadi [1], Mohamed Amine Ltifi [1,2], Mohamed Riadh Bedoui [1], Batool Mohammed Foqha [1,2] and Nicola Luigi Bragazzi [3,*]

[1] Research Laboratory (LR23JS01) «Sport Performance, Health & Society», Higher Institute of Sport and Physical Education of Ksar Saîd, Manouba University, Manouba 2010, Tunisia; ridha_aouadi@yahoo.fr (R.A.); mohamedltifi19@gmail.com (M.A.L.); bedoui.med.riadh@gmail.com (M.R.B.); batool.foqha@gmail.com (B.M.F.)
[2] Higher Institute of Sport and Physical Education of Gafsa, University of Gafsa, Gafsa 2112, Tunisia
[3] Laboratory for Industrial and Applied Mathematics (LIAM), Department of Mathematics and Statistics, York University, Toronto, ON M3J 1P3, Canada
* Correspondence: robertobragazzi@gmail.com

Featured Application

The FIFA 11+ program may serve as a standardized warm-up protocol to help improve physical performance and reduce injury risk, particularly in sports that require explosiveness, agility, and balance. In the present study, its application in adult male handball players showed positive outcomes. While promising, these findings are based on a specific athletic population with a relatively small sample size. Further research is needed to determine the program's broader applicability across different sports, age groups, and performance levels.

Abstract

Injury prevention and performance enhancement are key objectives in sports training. The FIFA 11+ program, originally developed to reduce injury risks, has gained attention for its potential benefits in improving physical performance and dynamic balance. This study aimed to examine the impact of an 8-week FIFA 11+ training program on vertical jump, Illinois Agility, and Y-Balance Test (YBT) performances in adult male handball players. Twenty-five players from two senior national male handball teams were recruited and randomly assigned to an experimental group (n = 13) or a control group (n = 11). Assessments were conducted before and after the intervention, including the countermovement jump (CMJ), the Illinois Agility Test (IAT), and the Y-Balance Test (YBT), which measured anterior (AT), posteromedial (PM), and posterolateral (PL) reach directions as well as a composite score (CS). The FIFA 11+ group showed significant improvements after the eight-week program, with increased CMJ (p = 0.013) and reduced IAT time ($p < 0.001$). Dynamic balance, as measured by the YBT, improved significantly in both lower limbs (p = 0.022–0.001), with enhanced postural stability across multiple directions (F = 6.92–20.23, p = 0.022–0.001, ηp^2 = 0.366–0.628, power = 0.68–0.98). In contrast, the control group exhibited minimal or no significant changes. While the results suggest that the FIFA 11+ program can improve specific performance outcomes in this population, the relatively small sample size and focus on a single sport and age group warrant caution in generalizing these findings. Further studies involving larger and more diverse cohorts are recommended.

Keywords: physical performance; balance; handball; FIFA11+ training program; vertical jump

check for updates

Academic Editor: Arkady Voloshin

Received: 9 May 2025
Revised: 23 June 2025
Accepted: 26 June 2025
Published: 28 June 2025

Citation: Aouadi, R.; Ltifi, M.A.; Bedoui, M.R.; Foqha, B.M.; Bragazzi, N.L. The FIFA 11+ Program Significantly Enhances Physical Performance and Dynamic Balance in Male Handball Players. *Appl. Sci.* **2025**, *15*, 7311. https://doi.org/10.3390/app15137311

Copyright: © 2025 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

1. Introduction

The FIFA 11+ program has emerged as a pivotal intervention in the realm of sports training, particularly for its dual role in enhancing athletic performance and reducing injury risk among athletes [1]. Developed by the International Federation of Association Football (Fédération Internationale de Football Association, FIFA), this comprehensive warm-up program is designed to improve neuromuscular control, strength, and balance, which are critical for optimal athletic performance and injury prevention [2,3]. The program has been extensively studied across various sports, demonstrating its effectiveness in reducing injury rates and enhancing performance metrics.

Agility, vertical jump, and postural balance are interconnected physical capacities that are essential in team sports such as handball. Agility requires rapid changes in direction and speed, and the Illinois Agility Test (IAT) is a widely used measure for assessing this component [4,5]. Structured training programs such as FIFA 11+ have demonstrated improvements in agility in athletes from various sports. For example, Foqha et al. [6] and Hosseini et al. [7] reported significant gains in agility following the implementation of FIFA 11+ in soccer and volleyball players, respectively.

Similarly, vertical jump performance reflects lower-limb explosive power and is crucial for offensive and defensive actions in handball. The FIFA 11+ program includes plyometric and strength training components that target this capacity. Prior studies by Silva et al. [8], Bizzini et al. [9], and Ferreira-Júnior et al. [10] reported improvements in vertical jump performance among amateur soccer players, suggesting the program's potential in sports requiring jumping abilities.

Balance, particularly dynamic postural control, plays a central role in injury prevention and movement efficiency. The Y-Balance Test (YBT) quantifies performance in anterior, posteromedial, and posterolateral directions and provides a composite score that reflects overall dynamic balance [11]. Daneshjoo et al. [12] and Onofrei and Amaricăi [13] have shown that programs incorporating balance training, including FIFA 11+, can significantly enhance balance scores, especially in lower-limb dominant sports.

Despite the growing body of scholarly literature, research on the application of the FIFA 11+ program in handball remains limited. Of note, the physical demands of handball—characterized by frequent jumping, cutting, landing, and body contact—closely resemble those of soccer and volleyball. This biomechanical similarity justifies the extrapolation of previous findings to the handball context, although sport-specific validation remains necessary.

Therefore, this study aimed to examine the effects of an 8-week FIFA 11+ training program on agility, vertical jump, and dynamic balance in adult male handball players. It was hypothesized that the FIFA 11+ program would significantly improve performance in:

(1) the Illinois Agility Test (agility),
(2) countermovement jump height (lower-limb power), and
(3) the Y-Balance Test outcomes, including reach distances in the anterior, posteromedial, and posterolateral directions, as well as the composite balance score (dynamic balance).

2. Materials and Methods

2.1. Participants

Twenty-five adult male handball players volunteered to participate in the study. The participants had been competing at the senior national level and had at least 8 years of training and competitive experience in handball. Inclusion criteria were: (1) being actively involved in senior-level competition, (2) being free from any musculoskeletal injuries or neurological disorders in the past six months, and (3) not having participated in any

neuromuscular warm-up program (including FIFA 11+) during the three months prior to the study. Exclusion criteria included recent injury, surgery, or medical conditions contraindicating intense physical activity.

Participants were assigned to groups using cluster randomization. Specifically, the two teams were randomly assigned to either the F11+ Group or the Control Group via a simple coin toss. The anthropometric characteristics of both groups are presented in Table 1. This includes age, body mass, height, and lower limb length.

Table 1. Subject characteristics at the start of the study (Pre-Test). Data are presented as mean ± standard deviation (SD).

	Control Group (n = 11)	**F11+ Group (n = 13)**
Age (years)	24.27± 1.00	24.38± 1.71
Body mass (kg)	85.18 ± 8.84	79.69 ± 10.72
Height (cm)	181.27 ± 6.08	178.85 ± 8.22
Lower limb length (cm)	100.09 ± 7.06	94.52 ± 4.05

The baseline characteristics of the participants indicate no major discrepancies between the control and F11+ Group in terms of age (24.72 ± 1.00 vs. 24.38 ± 1.71 years).

The required sample size was calculated a priori using G*Power software, version 3.1.9.7. A repeated measures ANOVA (within–between interaction) was selected as the statistical test. The assumptions included a medium effect size (f = 0.25), a significance level of α = 0.05, and a statistical power ($1 - \beta$) of 0.80. Based on these parameters, the minimum required total sample size was estimated to be 24 participants. To account for potential dropouts, additional participants were initially recruited (n = 26).

All experimental procedures were approved by the local Institutional Review Board and conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants.

As previously mentioned, the two teams were randomly assigned to either the F11+ Group or the Control Group through simple random sampling using a coin flip (Figure 1). Each team was given a unique identifier, labeling them as the F11+ Group and the Control Group. To maintain confidentiality in the randomization process, an independent researcher not involved in the study conducted the allocation. Following group randomization and prior to the start of the FIFA 11+ program, two participants were excluded, leaving a total of 24 participants in the experiment (Figure 1).

2.2. Anthropometric Measurements

The following anthropometric parameters were measured: body weight, height, and lower limb length. All measurements took place on the same day and followed a consistent sequence outlined below. Body weight was measured to the nearest 0.1 kg using an electronic scale (Seca, Hamburg, Germany), with participants standing barefoot and wearing shorts or light clothing. Height was measured with a wall-mounted stadiometer and a sitting height table (GPM–Swiss Made). These measurements were taken while participants were barefoot. Lower limb length was assessed using a tape measure, as outlined by Steudel-Numbers et al. [14], from the anterosuperior iliac spine to the center of the medial malleolus of the same leg, with the participant in a supine position.

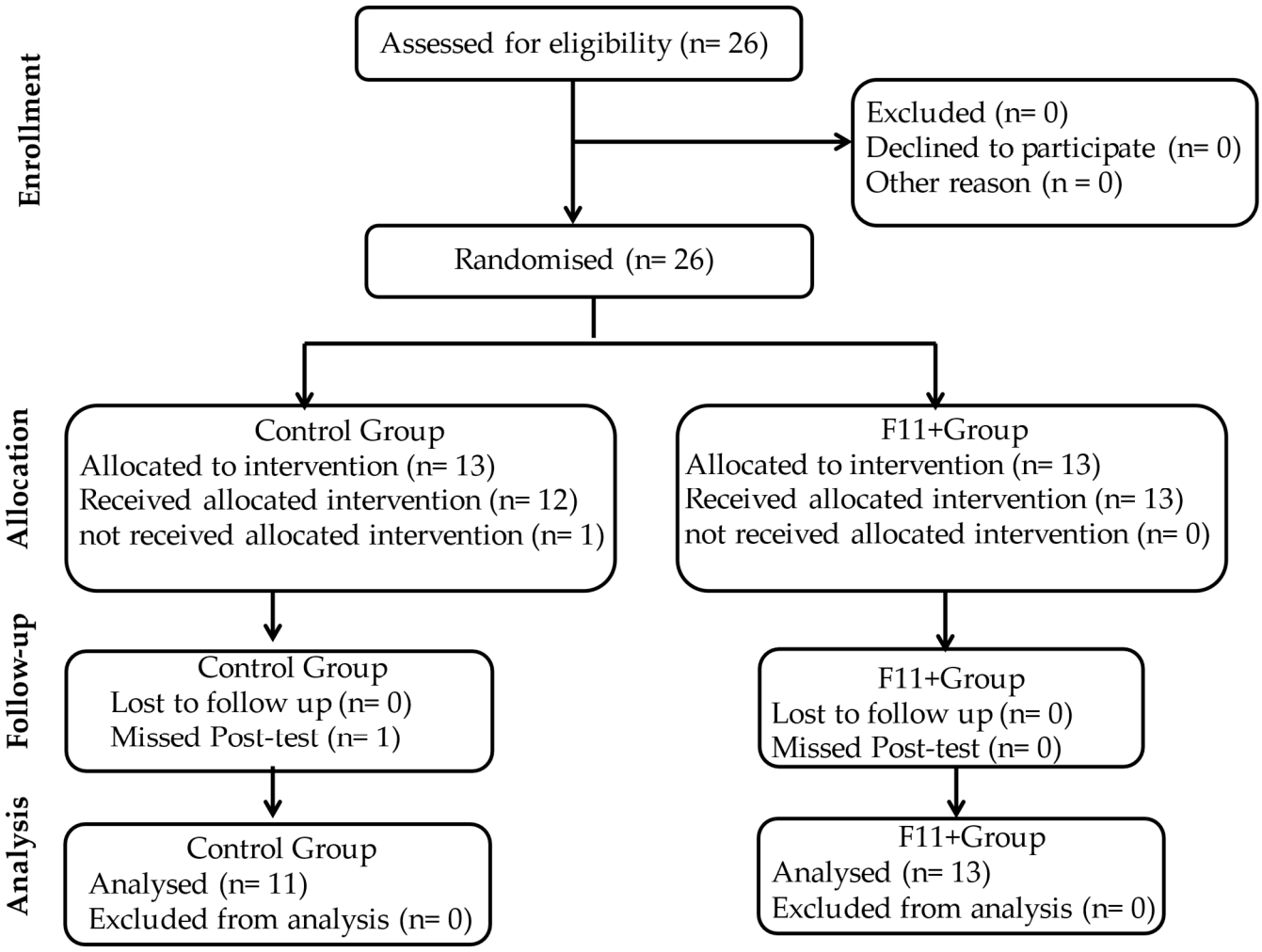


Figure 1. The CONSORT diagram provides a detailed overview of the interventions allocated and the participant flow at each stage.

2.3. Testing Procedures

Vertical jump (CMJ), Illinois Agility Test (IAT), and postural-control assessment using the YBT were performed at baseline and at the end of the 8-week FIFA 11+ training period.

2.3.1. Countermovement Jump: CMJ

During the CMJ, participants began in a standing position and performed a rapid downward movement followed by a maximal vertical jump. They were instructed to keep their arms at their sides and land in the same position to minimize horizontal displacement. Vertical jump height was measured using an optoelectric system (Optojump Next, Microgate, SRL, Bolzano, Italy). Two trials were conducted, with a 3-min rest interval, and the best result was recorded.

2.3.2. Illinois Agility Test: IAT

The IAT was used to assess change-of-direction speed. The course measured 10 m in length and 5 m in width, with cones marking the start, finish, and turning points. Four cones were positioned to indicate the start, finish, and two turning points, while an additional four cones were evenly spaced along the center, each separated by 3.3 m. Participants began in a prone position with their chin on the starting line. Upon the "Go" command, they navigated the course as quickly as possible without touching the cones. Timing was performed using an automated infrared light gate system, with sensors positioned 30 cm

above the ground at both the start and finish lines to ensure accuracy and eliminate human error. Two trials were administered with a 2-min rest, and the fastest time was used for analysis [15] (Figure 2).

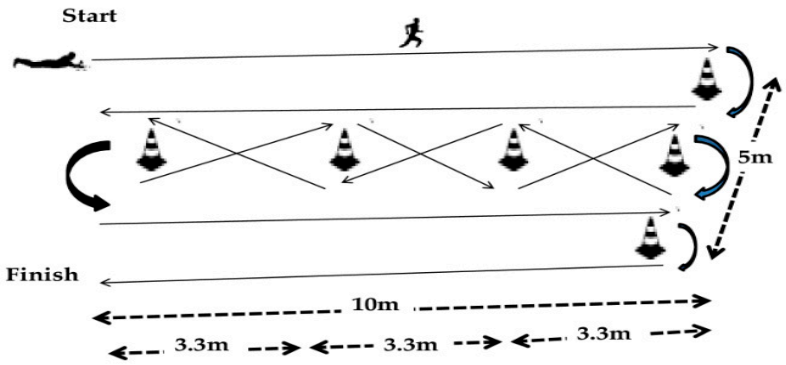


Figure 2. Illinois agility Test.

2.3.3. Postural Balance: YBT

The YBT, as described by Plisky et al. [11], was used to assess dynamic balance. Participants stood barefoot on a central platform and performed maximal reach movements in three directions—anterior (AT), posteromedial (PM), and posterolateral (PL)—with the opposite leg (Figure 3). The test was conducted in a fixed sequence (AT, PL, then PM), starting with the dominant leg. The test was conducted in a fixed sequence (AT, PL, then PM), starting with the dominant leg. Each participant performed multiple trials, and the best valid reach distance in each direction was recorded.

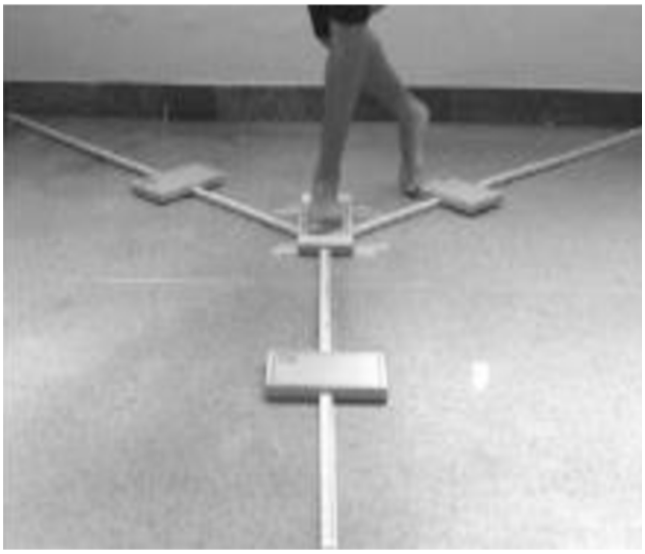


Figure 3. Y-Balance Test [16].

The outcome measures included the maximum reach distances in the three directions and the composite score (CS), which reflects overall balance performance. Reach distances were normalized to limb length, and the composite score was calculated as: (AT + PM + PL)/(3 × limb length) × 100. This formula provides a normalized measure of dynamic balance.

This score was used to compare dynamic balance across participants. Only trials with full control and proper form were considered valid.

2.4. Measurement Protocol

- Familiarization Phase: In accordance with the protocol of Robinson and Gribble [16], participants completed four practice trials for each leg in all three directions (AT, PM, and PL).
- Test Phase: Participants performed two recorded trials in each direction, with measurements taken from the furthest point reached by the indicator on the measuring scale. A trial was considered valid only if the participant successfully returned to the starting position while maintaining control of the movement. Trials were considered invalid and had to be repeated if the participant:
- Used the reaching leg to maintain balance by touching the floor or the measurement device.
- Pushed the measuring device instead of reaching with controlled movement.
- Altered their initial posture, such as removing their hands from the iliac crests.

2.5. Training Program

Both teams followed the same weekly soccer training routine, which included three 90-min sessions and one game each week. Our research assistants visited both teams at least once a week to ensure they were adhering to the prescribed training plan, including a proper warm-up. The FIFA 11+ warm-up program, lasting 20 min, was designed with three levels of difficulty based on the athlete's age and physical fitness. For this study, Level II, which was practiced during the familiarization sessions, was selected. This level is divided into three segments: the first focuses on warm-up tasks and running; the second includes strength-building exercises; and the third involves running activities, including specific drills. The FIFA 11+ program was performed three times per week over an eight-week period, replacing the traditional warm-up of the experimental group. Each session lasted approximately 20 min and was conducted under the direct supervision of the team's coaches, who had previously received detailed instruction on the proper execution of the program. In addition, research assistants visited the teams at least once per week to verify compliance and technique. Adherence was monitored using attendance logs, which were maintained throughout the intervention period to ensure fidelity to the program. During the experimental phase, the FIFA Group followed the third and most challenging level, while the control group continued with their usual soccer training, as outlined by Trajković et al. [17] (Table 2).

Table 2. FIFA11+ Warm-Up Program: Exercises, Durations, and Intensity Levels (F-MARC Protocol).

Exercise	Duration (min)
Part 1: Running Straight runs, hip out, hip in, partner circles, shoulder taps, quick forward and backward movements (6 running exercises, each performed in 2 sets)	8
Part 2: strength, plyometric and balance Bench exercises Static holds, alternating leg lifts, single-leg holds (3 exercises, each performed in 3 sets)	10
Sideways bench Static holds, hip raises and lowers, leg lifts (3 exercises, 3 sets on each side)	

Table 2. *Cont.*

Exercise	Duration (min)
Hamstring exercises Beginner: 3–5 reps, 1 set; Intermediate: 7–10 reps, 1 set; Advanced: 12–15 reps, 1 set (3 exercises)	
Single-leg stance Holding a ball, passing it with a partner, testing your partner's responses (3 exercises, each performed in 2 sets)	
Squats Squats with toe raises, walking lunges, single-leg squats (3 exercises, each performed in 2 sets)	
Jumping Vertical jumps, lateral jumps, box jumps (3 exercises, each performed in 2 sets)	
Part 3: Running Drills Running across the field, bounding, planting and cutting (3 exercises, each performed in 2 sets)	2

2.6. Statistic Analysis

All statistical analyses were performed using IBM SPSS Statistics version 27.0 (IBM Corp., Armonk, NY, USA). Data are reported as mean ± standard deviation (SD). Assumption testing was carried out prior to analysis. The Shapiro–Wilk test was used to assess normality, Levene's test for homogeneity of variances, and Mauchly's test for sphericity where applicable. A 2 × 2 mixed-design ANOVA was employed to examine the effects of the intervention, with one between-subjects factor (group: F11+ vs. control) and one within-subjects factor (time: pre-test vs. post-test). When significant interaction effects were found, post hoc comparisons with Bonferroni correction were applied. Test–retest reliability of the physical tests was assessed using the intraclass correlation coefficient (ICC). The effect size, presented by partial eta-squared (ηp^2), was determined to assess the magnitude of the effects. The use of this effect size aligns with the following classification: $0.01 < \eta p^2 < 0.06$ (small effect), $0.06 < \eta p^2 < 0.14$ (medium effect), and $\eta p^2 \geq 0.14$ (large effect) [18].

3. Results

The ICC, used to establish the reliability of the tests, were 0.91 and 0.89 for CMJ and IAT, respectively. The ICC of the A, PM, PL, and composite YBT scores varied between 0.83 and 0.90. The results demonstrate significant improvements in the F11+ Group following the eight-week FIFA 11+ program. In the CMJ (Figure 4), the F11+ Group showed a significant increase in performance ($F = 7.26$, $p = 0.013$, $\eta p^2 = 0.248$, power = 0.73), whereas no significant changes were observed in the Control Group ($p = 0.939$). Similarly, the IAT (Figure 5) revealed a notable reduction in completion time for the F11+ Group ($F = 15.98$, $p < 0.001$, $\eta p^2 = 0.421$, power = 0.97), while the Control Group exhibited no significant improvements ($p = 0.218$) (Table 3).

Regarding dynamic balance, the YBT showed significant enhancements in the F11+ Group across multiple parameters, with a marked increase in the composite score ($F = 20.46$, $p \leq 0.01$, $\eta p^2 = 0.630$, power = 0.98). Finally, the total score was significantly improved in the F11+ Group ($F = 20.73$, $p < 0.001$, $\eta p^2 = 0.633$, power = 0.98), while the control group showed no significant improvements ($p = 0.431$). The test involves maximal reaching distances in AT, PL, and PM directions.

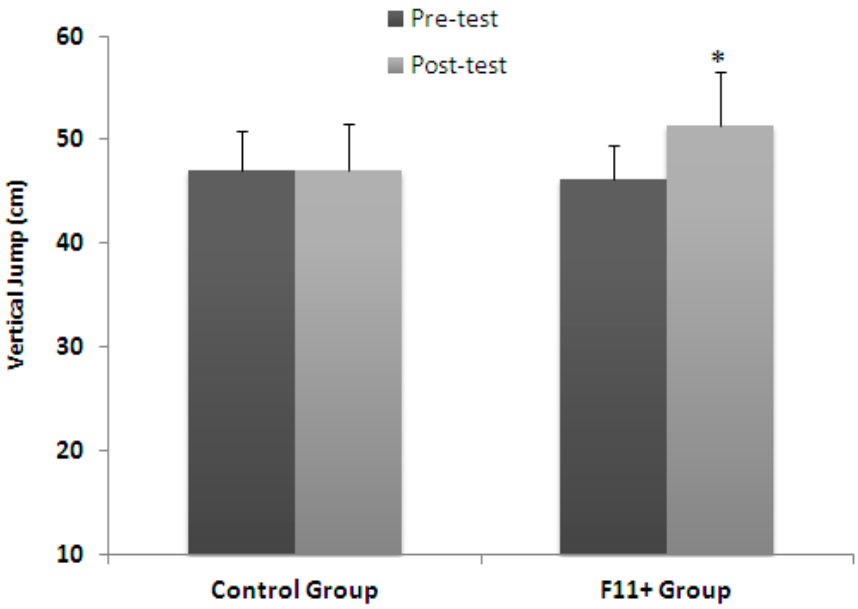


Figure 4. Descriptive effects for the mean vertical jump (VJ: (Mean ± SD) performance following the FIFA11+ protocols training in the F11+ Group and Control Group. * $p < 0.05$.

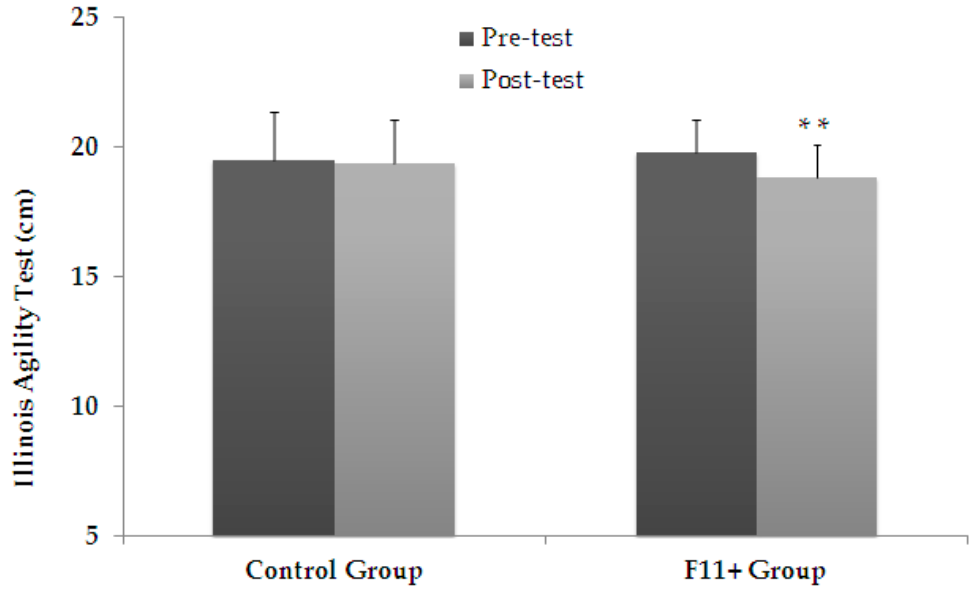


Figure 5. Descriptive effects for the mean Illinois Agility Test (IAT: (Mean ± SD) performance following the FIFA11+ protocols training in the F11+ Group and Control Group. ** $p < 0.01$.

Table 3. Descriptive statistics (Mean ± SD) for the mean vertical jump (VJ), and Illinois Agility Test (IAT) performances following the FIFA11+ protocols training in the F11+ Group and Control Group.

	F11+ Group (n = 13)						**Control Group (n = 11)**		
	Pre-Test	**Post-Test**	**F**	***p***	**ηp^2**	**Observed Power**	**Pre-Test**	**Post-Test**	***p***
VJ (cm)	46.15± 3.36	51.38 ± 5.17	7.26 *	0.013	0.248	0.73	47.09± 3.78	47.00 ± 4.56	0.939
IAT (s)	19.76 ± 1.30	18.80 ± 1.31	15.98 **	0.001	0.421	0.97	19.46 ± 1.89	19.36 ± 1.72	0.218

VJ: vertical jump; IAT: Illinois Agility Test; ηp^2: Partial Eta Squared; Mean difference: Post-Test–Pre-Test Note *: significantly different from Pre-Test (*: $p < 0.05$; **: $p < 0.01$).

In contrast, the Control Group showed no significant improvements in YBT.

Additionally, postural stability improved significantly in the PL and PM directions within the F11+ Group (F = 6.92–20.23, p: 0.022–0.001, ηp^2 = 0.366–0.628, power = 0.68–0.98), whereas the Control Group displayed no significant changes (p = 0.369–0.662). In the F11+ Group, the smallest significant improvement was observed in the PL direction (F = 6.92, p = 0.022, ηp^2 = 0.366, power = 0.68) (Table 4). These findings highlight the effectiveness of the FIFA 11+ program in enhancing jump performance, agility, YBT, and postural stability in the F11+ Group.

Table 4. Means and standard deviation (SD) for anterior (AT), posteromedial (PM), posterolateral (PL) direction, total Score (TS) and composite score (CS) in F11+ Group and Control Group.

	F11+ Group (n = 13)						Control Group (n = 11)		
	Pre-Test	Post-Test	F	p	ηp^2	Observed Power	Pre-Test	Post-Test	p
Anterior Direction: AT (cm)	78.03 ± 4.22	83.94 ± 5.24 **	16.56	0.002	0.580	0.96	76.64 ± 4.36	76.93 ± 3.98	0.303
Posteromedial direction: PM (cm)	89.83 ± 5.82	96.35 ± 4.70 **	20.23	0.001	0.628	0.98	90.26 ± 4.86	90.15 ± 4.29	0.662
Posterolateral direction: PL (cm)	91.02 ± 4.98	93.58 ± 5.38 *	6.92	0.022	0.366	0.68	90.08 ± 5.49	90.56 ± 4.44	0.369
Total Score (TS)	258.88 ± 13.47	273.87 ± 14.07 **	20.73	0.001	0.633	0.98	256.97 ± 14.46	257.64 ± 12.41	0.431
Composite Score (CS)	91.49 ± 6.72	96.81 ± 7.40 *	20.46	0.01	0.630	0.98	89.32 ± 4.98	89.56 ± 4.51	0.407

ηp^2: Partial Eta Squared; Mean difference: Post-Test–Pre-Test. Note *: significantly different from Pre-Test (*: $p < 0.05$; **: $p < 0.01$).

4. Discussion

The results of this study provide compelling evidence that the FIFA 11+ program significantly enhances athletic performance in adult male handball players, as demonstrated by improvements in vertical jump, agility, and postural balance. These findings reinforce the growing body of scholarly literature highlighting the effectiveness of this structured warm-up program beyond its primary purpose of injury prevention. By integrating strength, plyometric, balance, and agility exercises, the FIFA 11+ program appears to provide a well-rounded training stimulus that enhances multiple physical capacities essential for handball performance.

One of the most notable findings of this study was the significant improvement in vertical jump height among players in the F11+ Group. The increase in jump height is likely attributable to the program's emphasis on plyometric and strength exercises, which are known to enhance neuromuscular adaptations, explosive power, and intermuscular coordination. Plyometric training, in particular, has been shown to improve the rate of force development, which is critical for explosive movements such as jumping [2,3]. These results align with previous studies reporting significant gains in vertical jump performance following the FIFA 11+ program. Zarei et al. [2] observed a 7.5% improvement in vertical jump among soccer players after an eight-week implementation of the program, while Akbari et al. [19] found similar enhancements in young football players. The underlying mechanisms for these improvements likely involve better neuromuscular coordination and increased lower limb muscle activation, as suggested by Zemková and Kovačíková [4]. Additionally, strength development in key muscle groups involved in jumping, such as the quadriceps, hamstrings, and calves, may contribute to the observed gains in performance [20].

The significant reduction in IAT times further supports the effectiveness of the FIFA 11+ program in improving agility, a key attribute for handball players who frequently perform rapid directional changes during gameplay. The improvement in agility observed in this

study is consistent with previous research findings. For instance, Zarei et al. [2] reported a 2.6% enhancement in agility performance among soccer players following the FIFA 11+ program, while Slauterbeck et al. [5] and Zemková and Zapletalová [21] also documented significant improvements in agility-related tasks after similar training interventions. The agility improvements seen in this study can be explained by the program's focus on dynamic movements, proprioceptive training, and change-of-direction drills. Neuromuscular control and coordination are crucial for agility, as they enable athletes to execute quick directional shifts while maintaining stability and control over their movements [21]. The FIFA 11+ program includes exercises that challenge postural control and reaction time, which likely contributed to the reduction in agility test times. Additionally, enhanced muscle activation and motor unit recruitment, as highlighted by Lopes et al. [3], may have improved the players' ability to generate force efficiently during rapid movements.

Postural balance is a critical component of athletic performance, particularly in sports like handball, where maintaining stability during dynamic movements is essential. The results of this study indicate that the FIFA 11+ program significantly improved postural balance, as evidenced by the increased YBT scores in multiple directions. These findings align with prior research, which has demonstrated the positive effects of proprioceptive and stability training on balance performance [8,22]. The FIFA 11+ program incorporates exercises that challenge balance and proprioception, such as single-leg stance drills, dynamic stability exercises, and core activation movements. These training components likely contributed to the observed improvements in balance performance. Similar findings were reported by Halabchi et al. [23] and Attar and Alshehri [24], who found that balance training interventions significantly enhanced proprioceptive control and postural stability. The improvements in different directions of the YBT suggest that the program effectively strengthens stabilizing muscles and improves neuromuscular control, both of which are essential for reducing the risk of injuries and enhancing overall performance [6].

Moreover, balance improvements are particularly important in handball, as players frequently engage in complex, high-intensity movements that require stability, such as jumping, landing, and changing direction [25,26]. Enhanced postural control may contribute to better injury resilience, as unstable movements are often linked to an increased risk of lower limb injuries [8]. Therefore, integrating structured balance training within warm-up routines, as seen in the FIFA 11+ program, represents a practical strategy for improving both performance and injury prevention.

Nevertheless, a methodological limitation of this study lies in the use of cluster-level allocation: since participants were assigned to groups based on team membership via coin flip, this constitutes a form of cluster randomization. While practical for real-world team settings, this approach may limit the independence of observations between groups and should be considered when interpreting the results.

Additionally, the absence of long-term follow-up data limits our understanding of whether the observed improvements in performance would persist over time. The study also did not include injury surveillance, which prevents us from drawing direct conclusions about the FIFA 11+ program's effectiveness in injury prevention within this specific population. Although the program was originally developed with injury reduction in mind, our study focused solely on performance-related outcomes.

Another consideration is the relatively small sample size (n = 24), which may limit the generalizability of the findings. While statistically significant differences were observed, larger sample sizes would increase the power of the analysis and allow for subgroup comparisons.

Finally, it is worth noting that the intervention group may have experienced a motivational bias due to the increased attention and novelty associated with the FIFA 11+

program. This psychological factor may have influenced their performance, and future studies should consider strategies to control for such potential biases.

In summary, the findings of this study reinforce the effectiveness of the FIFA 11+ program as a structured and evidence-based capable of improving essential physical performance parameters in adult male in handball players. These results highlight the value of integrating neuromuscular warm-up routines to enhance vertical jump, agility, and dynamic balance—qualities that are critical to handball performance and injury prevention. By incorporating plyometric, strength, balance, and agility exercises, the program offers a holistic approach to physical conditioning that extends beyond traditional warm-up routines. The significant improvements observed in vertical jump, agility, and postural balance highlight the program's potential to optimize athletic performance across various sports disciplines. Given these findings, sports practitioners, coaches, and athletes are encouraged to implement the FIFA 11+ program as part of regular training regimens. The structured and scientifically validated nature of this program provides an efficient and practical solution for improving multiple aspects of physical performance while simultaneously reducing the risk of injuries. Future research could further explore the long-term effects of continued FIFA 11+ implementation and its impact on different levels of athletic performance, particularly in elite handball players.

5. Conclusions

Despite the limitations discussed—namely the small sample size, the lack of long-term follow-up, and the use of cluster randomization—this study provides a meaningful contribution to the literature and offers practical guidance for implementation. These findings confirm that FIFA 11+, beyond injury prevention, offers a structured and comprehensive training approach that boosts performance by combining strength, plyometrics, balance, and agility exercises. Future research should aim to explore the long-term adaptations, assess adherence over a full competitive season, and evaluate the potential psychological or motivational effects of the program in team sport environments.

Author Contributions: R.A., M.A.L., M.R.B., B.M.F. and N.L.B. contributed to the conception and design of the study. R.A. and M.A.L. performed the testing. R.A. and M.A.L. wrote the first draft of the manuscript. R.A., M.A.L. and N.L.B. provided supervision, English editing, and managed the funding process. R.A., M.A.L. and N.L.B. offered administrative support and handled style curation. R.A., M.A.L. and N.L.B. were responsible for manuscript formatting. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding. The APC was funded by N.L.B.

Institutional Review Board Statement: The study received approval from the Manouba University Institutional Review Board (Tunisia) and complied with the ethical guidelines set forth in the Declaration of Helsinki.

Informed Consent Statement: Participants were informed of their right to withdraw from the study at any point without any penalties. Written consent was obtained from the parents of all participants after they received comprehensive oral and written explanations regarding the experimental procedures, along with potential risks and benefits.

Data Availability Statement: The original contributions presented in this study are included in the article. Further inquiries can be directed to the corresponding author.

Acknowledgments: The authors would like to thank the Research Laboratory "Sport Performance, Health & Society" (LR23JS01) for providing access to the necessary equipment and facilities used in this study.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Yalfani, A.; Saki, F.; Taghizadeh Kerman, M. The Effects of the FIFA 11+ and 11+ Kids Training on Injury Prevention in Preadolescent Football Players: A Systematic Review. *Ann. Appl. Sport. Sci.* **2020**, *8*. [CrossRef]
2. Zarei, M.; Abbasi, H.; Daneshjoo, A.; Barghi, T.S.; Rommers, N.; Faude, O.; Rössler, R. Long-term effects of the 11+ warm-up injury prevention programme on physical performance in adolescent male football players: A cluster-randomised controlled trial. *J. Sports Sci.* **2018**, *36*, 2447–2454. [CrossRef]
3. Lopes, K.G.; Bottino, D.A.; Farinatti, P.; de Souza, M.; Maranhão, P.A.; de Araujo, C.M.S.; Bouskela, E.; Lourenço, R.A.; de Oliveira, R.B. Strength training with blood flow restriction—a novel therapeutic approach for older adults with sarcopenia? A case report. *Clin. Interv. Aging* **2019**, *14*, 1461–1469. [CrossRef]
4. Zemková, E.; Kováčiková, Z. Sport-specific training induced adaptations in postural control and their relationship with athletic performance. *Front. Hum. Neurosci.* **2022**, *16*, 1007804. [CrossRef]
5. Slauterbeck, J.R.; Choquette, R.; Tourville, T.W.; Krug, M.; Mandelbaum, B.R.; Vacek, P.; Beynnon, B.D. Implementation of the FIFA 11+ Injury Prevention Program by High School Athletic Teams Did Not Reduce Lower Extremity Injuries: A Cluster Randomized Controlled Trial. *Am. J. Sports Med.* **2019**, *47*, 2844–2852. [CrossRef] [PubMed]
6. Foqha, B.M.; Schwesig, R.; Ltifi, M.A.; Bartels, T.; Hermassi, S.; Aouadi, R. A 10-week FIFA 11+ program improves the short-sprint and modified agility T-test performance in elite seven-a-side soccer players. *Front. Physiol.* **2023**, *14*, 1236223. [CrossRef]
7. Hosseini, M.S.; Rajabi, R.; Minoonejad, H.; Barati, A.H. Effect of Eight Weeks of FIFA 11+ Training on the Agility and Explosive Power of Male College Volleyball Players. *Ann. Mil. Health Sci. Res.* **2019**, *17*, e97233. [CrossRef]
8. Silva, J.R.L.D.C.; Silva, J.F.D.; Salvador, P.C.D.N.; Freitas, C.D.L.R. The Effect of "FIFA 11+" on vertical jump performance in soccer players. *Rev. Bras. Cineantropom. Desempenho Hum.* **2015**, *17*, 733–741. [CrossRef]
9. Bizzini, M.; Impellizzeri, F.M.; Dvorak, J.; Bortolan, L.; Schena, F.; Modena, R.; Junge, A. Physiological and performance responses to the "FIFA 11+" (part 1): Is it an appropriate warm-up? *J. Sports Sci.* **2013**, *31*, 1481–1490. [CrossRef]
10. Ferreira-Júnior, J.B.; da Encarnação, I.G.A.; Rezende, V.H.S.; Oliveira, J.C.G.; Souza, L.A.; Assunção, J.C.; Hekmatikar, A.H.A.; Coelho, D.B. Effects of different intensities of FIFA 11+ on physical performance of U-15 soccer players. *Apunt. Sports Med.* **2023**, *58*, 100419. [CrossRef]
11. Plisky, P.J.; Rauh, M.J.; Kaminski, T.W.; Underwood, F.B. Star Excursion Balance Test as a predictor of lower extremity injury in high school basketball players. *J. Orthop. Sports Phys. Ther.* **2006**, *36*, 911–919. [CrossRef]
12. Daneshjoo, A.; Mokhtar, A.H.; Rahnama, N.; Yusof, A. The effects of comprehensive warm-up programs on proprioception, static and dynamic balance on male soccer players. *PLoS ONE* **2012**, *7*, e51568. [CrossRef] [PubMed]
13. Onofrei, R.R.; Amaricai, E. Postural Balance in Relation with Vision and Physical Activity in Healthy Young Adults. *Int. J. Environ. Res. Public Health* **2022**, *19*, 5021. [CrossRef] [PubMed]
14. Steudel-Numbers, K.L.; Weaver, T.D.; Wall-Scheffler, C.M. The evolution of human running: Effects of changes in lower-limb length on locomotor economy. *J. Hum. Evol.* **2007**, *53*, 191–196. [CrossRef] [PubMed]
15. Vescovi, J.D.; McGuigan, M.R. Relationships between sprinting, agility, and jump ability in female athletes. *J. Sports Sci.* **2008**, *26*, 97–107. [CrossRef]
16. Robinson, R.H.; Gribble, P.A. Support for a reduction in the number of trials needed for the star excursion balance test. *Arch. Phys. Med. Rehabil.* **2008**, *89*, 364–370. [CrossRef]
17. Trajković, N.; Pajek, M.; Sporiš, G.; Petrinović, L.; Bogataj, Š. Reducing Aggression and Improving Physical Fitness in Adolescents Through an After-School Volleyball Program. *Front. Psychol.* **2020**, *11*, 2081. [CrossRef]
18. Macadam, P.; Cronin, J.B.; Simperingham, K.D. The Effects of Wearable Resistance Training on Metabolic, Kinematic and Kinetic Variables During Walking, Running, Sprint Running and Jumping: A Systematic Review. *Sports Med.* **2017**, *47*, 887–906. [CrossRef]
19. Akbari, H.; Sahebozamani, M.; Daneshjoo, A.; Amiri-Khorasani, M. Effect of the FIFA 11+ programme on vertical jump performance in elite male youth soccer players. *Montenegrin J. Sports Sci. Med.* **2018**, *7*, 17–22. [CrossRef]
20. Barengo, N.C.; Meneses-Echávez, J.F.; Ramírez-Vélez, R.; Cohen, D.D.; Tovar, G.; Bautista, J.E. The impact of the FIFA 11+ training program on injury prevention in football players: A systematic review. *Int. J. Environ. Res. Public Health* **2014**, *11*, 11986–12000. [CrossRef]
21. Zemková, E.; Zapletalová, L. The Role of Neuromuscular Control of Postural and Core Stability in Functional Movement and Athlete Performance. *Front. Physiol.* **2022**, *13*, 796097. [CrossRef] [PubMed]
22. Pomares-Noguera, C.; Ayala, F.; Robles-Palazón, F.J.; Alomoto-Burneo, J.F.; López-Valenciano, A.; Elvira, J.L.L.; Hernández-Sánchez, S.; De Ste Croix, M. Training Effects of the FIFA 11+ Kids on Physical Performance in Youth Football Players: A Randomized Control Trial. *Front. Pediatr.* **2018**, *6*, 40. [CrossRef] [PubMed]
23. Halabchi, F.; Abbasian, L.; Mirshahi, M.; Mazaheri, R.; Pourgharib Shahi, M.H.; Mansournia, M.A. Comparison of Static and Dynamic Balance in Male Football and Basketball Players. *Foot Ankle Spec.* **2020**, *13*, 228–235. [CrossRef] [PubMed]
24. Al Attar, W.S.A.; Alshehri, M.A. A meta-analysis of meta-analyses of the effectiveness of FIFA injury prevention programs in soccer. *Scand. J. Med. Sci. Sports* **2019**, *29*, 1846–1855. [CrossRef]

25. Al Kitani, M.; Ambussaidi, A.; Al Busafi, M.; Al-Hadabi, B.; Sassi, R.H.; Bouhlel, E.; Gmada, N. Acute effect of post activation potentiation using drop jumps on repeated sprints combined with vertical jumps in young handball players. *Isokinet. Exerc. Sci.* **2021**, *29*, 147–154. [CrossRef]
26. Aksović, N.; Bjelica, B.; Milanović, F.; Cicović, B.; Bubanj, S.; Nikolić, D.; Skrypchenko, I.; Rozhechenko, V.; Zelenović, M. Evaluation and comparative analysis of the results of a vertical jump between young basketball and handball players. *Pedagog. Phys. Cult. Sports* **2022**, *26*, 126–133. [CrossRef]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.