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# Comparison of the Effects of a 6-Week FIFA 11+ Program and Harmoknee on Jumping Ability Improvement in Amateur Female Football Players

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***Abstract:*** *Jumping is one of the movements in soccer that supports the technique in this sport. Jumping ability is used to win aerial duels and avoid opponent tackles. Research testing the effectiveness of the FIFA 11+ and HarmoKnee warm-up programs in improving jumping performance in female soccer players is still limited. This study aims to analyse the effect of FIFA 11+ and Harmoknee exercises on physical performance parameters, especially on the jumping performance of female amateur soccer players. This study used an experimental approach with participants divided into two experimental groups. The sample consisted of 24 female amateur soccer players. The standing long jump test data collection instrument was used. The data analysis technique for hypothesis testing used a paired t-test, and to compare the two exercises, an independent t-test. The results showed that there was an effect of the FIFA 11+ and HarmoKnee warm-up programs on jumping performance, with a significant effect ($p = 0.000 < 0.05$). There was no difference in the effect of the two exercises on jumping performance ($p = 0.963 > 0.05$), but the effect size was found to be greater in FIFA 11+ than in Harmoknee. It was concluded that the FIFA 11+ warm-up method had a slightly superior effect on improving jumping performance compared to HarmoKnee in female soccer players. However, both the FIFA 11+ and HarmoKnee warm-ups can be effectively implemented during the general preparation period of a periodized training program. Practitioners or physical trainers need to consider incorporating these programs into daily sessions during the preparation period.*
***Keywords:*** *Warm-up, physical, power, soccer*

## Introduction

Soccer players require moderate to high levels of aerobic and anaerobic power, good agility, and a variety of technical and tactical skills to increase their chances of success in the sport (Carling, 2013; Reilly et al., 2000). To respond to the physical demands of play, training components such as anaerobic power, speed, and agility must be integrated into training (Amiri-Khorasani et al., 2011). Before participating, a warm-up is generally necessary to "prepare" oneself for training or a match (Sander et al., 2013). A warm-up program is essentially a type of light or moderate exercise aimed at improving performance (Sander et al., 2013; Sotiropoulos et al., 2010; Subasi et al., 2008) by increasing blood flow and elasticity, as well as muscle neuron activity (Škof & Strojnik, 2007).

Both 11+ and HarmoKnee are multifaceted soccer-specific warm-up programs aimed at improving the general fitness of soccer players while also considering intrinsic risk factors such as strength and balance. In general, the exercises included in multifaceted warm-up programs have been shown to improve athletic performance among male soccer players (Fradkin et al., 2010). Specifically, improvements have been reported in counter-movement jump height (Sotiropoulos et al., 2010), isokinetic strength (Brito et al., 2010; Daneshjoo et al., 2012), and sprinting ability (Fletcher & Jones, 2004). Core stability training is another important component included in multifaceted warm-up programs. These core exercises have been shown to improve technical skills and game awareness (Holm et al., 2004; Leetun et al., 2004; Paterno et al., 2004). Therefore, a multifaceted warm-up program is expected to improve physical performance. Specifically, a systematic review of studies of warm-up, running speed, jumping, and skill performance (1966–2008) reported that 79% (of 32 articles) showed improvements in jump height, sprint test completion time, and technical skill performance, while only 3% showed no change (Fradkin et al., 2010).

Although the primary goal of FIFA 11+ and Harmoknee is injury prevention, knowledge of the training effects of these training programs on physical performance may help identify potential mechanisms behind the reported reduction in injury incidence (Zarei et al., 2018). Although several studies have explored the training effects of both

programs (especially FIFA 11+) on several measures of neuromuscular performance (lower limb balance (Daneshjoo et al., 2013) and core stability (Impellizzeri et al., 2013), knee proprioception (Brito et al., 2010), knee strength (Brito et al., 2010)), and sprinting and jumping ability (Bizzini et al., 2013) (which are part of the athletic physical performance spectrum), not many of these studies have used female players as samples despite being the target population of both programs.

This study is the most recent in our region, considering the limited research available on this topic. Therefore, the primary objective of this study was to analyse the effects of FIFA 11+ and Harmoknee training on physical performance parameters, particularly jumping performance, in female amateur soccer players. We hypothesised that both programs would exhibit beneficial and superior effects on physical performance (particularly jumping ability).

## Methods

This study used an experimental method to determine the effects of a treatment intentionally given by the researcher. The sample in this study was all young female soccer athletes from Batu City, East Java Province, totalling 24 people aged (19.4 ± 0.7 years). This experimental study used two groups that received different treatments, namely the FIFA 11+ method and Harmoknee. All participants understood and agreed to participate in this study with informed consent. This research was conducted following approved by the Faculty of Sports and Health Sciences of Yogyakarta State University (protocol number: B/853/UN34.16/PT.01.04/2024).

### *Procedure*

The program was implemented on the research sample. Before being administered to the sample, the program was validated by expert lecturers to ensure its eligibility for testing. Both groups participated in the same volume and methodology of weekly soccer training (three sessions of approximately 90 minutes each and one match per week). Both groups were visited at least once a week by our research assistants to monitor whether the groups were using the same soccer training and whether the control group was using a structured injury prevention program instead of a regular warm-up.

***Table 1.*** *Players' regular soccer training sessions during the intervention*

| Exercise | Duration (min) |
|---|---|
| Technical drills (Passing exercise) | 15 |
| Tactical drills (defensive drills, offensive drills, situations) | 20 |
| Small-sided games with or without goal keeper | 20 |
| Simulated competitive games and set-pieces | 15 |

### *FIFA 11+ Procedure*

11+ consists of three parts. The first part includes running drills (Part 1). The second part includes six drills, all of which are at three difficulty levels, aimed at improving strength, balance, muscle control, and core stability (Part 2). The third and final part consists of advanced running drills (Part 3). The varying difficulty levels increase the program's efficiency and allow coaches and players to individually adapt the program. 11+, which replaces the typical warm-up, takes approximately 20-25 minutes to complete. All 27 drills focus on core stability, neuromuscular control, eccentric hamstring strength, and agility.

***Table 2.*** *FIFA 11+ programs*

| Warm Up Exercise | Exercise Component | Durasi |
|---|---|---|
| FIFA 11+ | Part 1: Running Exercise<br>Straight Ahead, hop out, hop in, circling partner, shoulder contact, quick forward, & backward | 8 menit |
| | Part 2: Strenght, Plyometric, and Balance Exercise<br><br>The bench: one leg lift and hold<br>Side Bench: with leg lift<br>Hamstring: Nordic exercise<br>Single-leg: Test your partners<br>Squat: one leg squats<br>Jumping: Box jump | 10 Menit |
| | Part 3: Running Exercise<br>Across the pitch, bounding, plant and cut | 2 Menit |

### *HarmoKnee warm-up*

The HarmoKnee warm-up program includes five sections: warm-up, muscle activation, balance, strength, and core stability, all of which can be combined and performed within a regular soccer training session (Table 3). The total program duration is 20 to 25 minutes Kiani et al., 2010). Similar to the 11+ program, HarmoKnee is also performed three times per week.

***Table 3.*** *HarmoKnee Program*

| Warm Up Exercise | Exercise Component | Duration |
|---|---|---|
| HarmoKnee | **Warm-up**<br>Jogging (≥4-6 min), Backward jogging on the toes (Approximately 1min), High-knee skipping (Approximately 30 s), Defensive pressure technique (Approximately 30 s), One and one (≥ 2min) | 10 min |
| | **Muscle activation**<br>Activation of calf muscles, quadriceps muscles, hamstring muscles, hip flexor muscles, groin muscles, hip and lower back muscles (6 items, each item 4s for each leg/side) | 2 min |
| | **Balance**<br>Forward and backward double leg jumps, Lateral single leg jumps, Forward and backward single leg jumps, Double leg jump with or without ball (optional), (4 items each item Approximately 30s) | 2 min |
| | **Strength**<br>Walking lunges in place, Hamstring curl (in pairs), Single-knee squat with toe raises (3 items each item Approximately 1 min) | 3 min |
| | **Core stability**<br>Sit-ups, Plank on elbows and toes, Bridging (3 items each item Approximately 1 min) | 3 min |

### *Test Procedure*

To measure jumping ability, this study used the standing long jump test, which also measures leg muscle power. Participants stood behind a starting line and were instructed to push off as hard as possible and jump as far as possible. Participants were instructed to land with their feet together and remain upright. The jump distance was measured from the starting line to the back of the heel. After two familiarisation tests, participants performed three repetitions. The best score of the three repetitions was selected for analysis.

### *Data Analysis*

Shapiro-Wilk was used to test for data normality in this study. Paired T-tests were used to test the effect of the intervention. Comparisons of the two exercises used independent t-tests. A two-way ANOVA test was used to test for interactions between Group (FIFA 11+ and HarmoKnee) × Time. If an interaction was found, further testing was performed using the Tukey test. Decision-making was based on a significance level of 5% or 0.05. The calculation of effect size in this study refers to Cohen's d analysis. Data analysis was assisted by IBM SPSS Version 26.

## Result

After 6 weeks of intervention, there were changes in participants' jumping performance. Both exercises appeared to have an impact on players' standing long jump performance. This can be seen in Table 4.

***Table 4.*** *Changes in participants' jumping performance.*

| Group | n | Pre-Test Standing Long Jump (cm) | Post-test Standing Long Jump (cm) | Paired-T | Group >< Time |
|---|---|---|---|---|---|
| | | M ± SD | M ± SD | | |
| FIFA 11+ | 12 | 193.4 ± 15.1 | 200.1 ± 14.9 | 0.000* | 0.484 |
| HarmoKnee | 12 | 190.7 ± 13.6 | 191.8 ± 13.1 | 0.000* | |

***Note:*** **significance $p < 0.05$*

There was a significant main effect between pre- and post-test on the long jump ($p = 0.000$). Both effects were found in both intervention groups (FIFA 11+ and HarmoKnee). Other findings did not reveal an interaction between Group (FIFA 11+ and HarmoKnee) × Time ($p > 0.05$). The comparison between the two groups is presented in Table 5.

***Table 5.*** *The comparison between the two groups*

| Group | n | Mean Difference | Cohen's d | Percentage of improvement | Independent T |
|---|---|---|---|---|---|
| FIFA 11+ | 12 | 7.3 | 0.45 | 2.5% | 0.963 |
| HarmoKnee | 12 | 1.1 | 0.08 | 0.8% | |

Table 5 data shows that there was no significant difference between the two groups with a significance value ($p > 0.05$). However, the percentage change value for the FIFA 11+ group appears to be superior to the HarmoKnee value. Cohen's d effect size value for FIFA 11+ is in the medium category, while for HarmoKnee it is in the low category. Therefore, although both affect jumping ability, the FIFA 11+ group actually has a more significant influence on the jumping ability of amateur female soccer players compared to HarmoKnee.

## Discussion

While the FIFA 11+ Injury Prevention Programme has been highly successful, in practice, it is difficult to persuade coaches and players to implement it regularly solely for injury prevention, so the goal was to demonstrate that it also has a direct, positive impact on player performance. While the FIFA 11+ program is superior to HarmoKnee, both can improve jumping ability in female soccer players.

Jumping performance is essential in soccer to support movements such as heading, avoiding tackles, and during duels (De Oliveira et al., 2023). The results of this study illustrate the importance of developing high-level strength to improve jumping performance in soccer players. Stronger athletes tend to perform better in jumping, while weaker athletes perform worse in sprinting and jumping. Importantly, strength training has also been shown to reduce injury incidence in college soccer players (Street & Kaminski, 2021). Therefore, it is intriguing that FIFA 11+ and HarmoKnee can help improve players' muscular strength while simultaneously developing jumping skills.

The reason for this can be found in the fact that the FIFA 11+ program includes plyometric exercises in addition to neuromuscular training (Trajković et al., 2020), and includes the HarmoKnee. Furthermore, the focus in the FIFA 11+ program is on correct technique through jumping, landing, and cutting movements by providing feedback on incorrect movement patterns (Akbari et al., 2020). This improvement may be partly due to the increase in muscle temperature during the application of both programs (Ayala et al., 2017). Our findings are in line with programs that develop motor competence in early childhood, which is important for models of adolescent physical development (Sander et al., 2013).

Furthermore, studies explain that this development is due to muscle development, as reported by Bobbert and Casius, regarding changes in the length of contractile elements within the muscle-tendon structure. Specifically, the development of tendon length increases its energy storage capacity (Challis, 2000). Tendon energy storage capacity

is important in movements that utilise the stretch-shortening cycle, such as the long jump. It has been reported that in children between the ages of 12 and 16, this increase occurs naturally through maturation-related adaptations such as increased androgen concentrations, muscle fibril differentiation, and changes in resting adenosine triphosphate and creatine phosphate levels (Lloyd et al., 2015). Anatomical and physiological developments associated with maturation explain the improvements in sprinting and jumping performance that occur regardless of warm-up.

Another study demonstrated that a 10-week training period incorporating a FIFA 11+ warm-up significantly enhanced agility and long jump performance in basketball players (Sahin et al., 2018). Similarly, a study conducted by Shah Hosseini et al. (2019) explored the effects of an 8-week FIFA 11+ training program on the agility and explosive power of male collegiate volleyball players. In one study conducted on cyclists, it was observed that the average post-jump was lower than the pre-jump test, but there was a good correlation (Robert et al., 2020). Studies examining the effects of a FIFA 11+ warm-up program in adult males have shown improved jumping performance. After implementing a FIFA 11+ warm-up program for children, the children showed increased jumping ability (Pomares-Noguera et al., 2018). Akbari et al. (2020) evaluated the effect of FIFA 11+ on the vertical jump of 17-year-old soccer players and suggested that implementing a four-week FIFA 11+ warm-up program improves the physical performance of young individuals. This indicates that the program has a significant effect on jumping ability in individuals.

Limitations of this study include the short timeframe within which the effects of the FIFA 11+ and HarmoKnee programs were investigated, spanning six weeks, and the lack of follow-up. Follow-up assessments of both warm-up programs could have addressed the effects of the warm-up programs on program retention. Generalizability of the results to girls is also a limitation, as the study involved only a small sample size, so it is unknown whether the program can be applied to girls in all categories. Furthermore, the study was conducted at the end of the general and specific preparation periods, meaning some players were more prepared from the start and may have had a good baseline fitness level, potentially influencing performance changes.

However, the strength of this study lies in its ability to demonstrate the plausible effects and suitability of the FIFA 11+ and HarmoKnee warm-up programs in girls. Therefore, both FIFA 11+ and HarmoKnee warm-up programs can be implemented in training sessions for girls aged 18-20 years. This study supports previous findings that traditional routine warm-up programs can be replaced by FIFA 11+ and HarmoKnee in female soccer players based on their superior effects on jumping performance and possibly other physical components. Furthermore, these warm-up programs do not require special equipment and are easy to support the performance development of female soccer players, thus significantly contributing to injury risk reduction.

## Conclusion

The main findings of this study indicate that implementing both the FIFA 11+ and HarmoKnee warm-up programs for 6 weeks can improve jumping performance. However, the magnitude of performance improvement with FIFA 11+ was superior to HarmoKnee. Therefore, the FIFA 11+ program can be considered appropriate for this population, as it appears sufficient to induce significant performance improvements in female soccer players. Ultimately, given the evidence-based health benefits of the FIFA 11+ warm-up program, its primary target population could be expanded to female athletes, both recreational players and schoolchildren, while also aiming to raise awareness of sports injuries. Furthermore, future research should investigate the effects of both programs over a longer duration on several physical performance variables using a randomised controlled trial design.

## References

Akbari, H., Sahebozamani, M., Daneshjoo, A., Amiri-Khorasani, M., & Shimokochi, Y. (2020). Effect of the FIFA 11+ on landing patterns and baseline movement errors in elite male youth soccer players. *Journal of Sport Rehabilitation*, *29*(6), 730–737. https://doi.org/10.1123/JSR.2018-0374

Amiri-Khorasani, M., Osman, N. A. A., & Yusof, A. (2011). Acute effect of static and dynamic stretching on hip dynamic range of motion during instep kicking in professional soccer players. *The Journal of Strength \& Conditioning Research*, *25*(6), 1647–1652.

Ayala, F., Pomares-Noguera, C., Robles-Palazón, F. J., Del Pilar Garcia-Vaquero, M., Ruiz-Pérez, I., Hernández-Sánchez, S., & Croix, M. D. S. (2017). Training effects of the FIFA 11+ and harmoknee on several neuromuscular parameters of physical performance measures. *International Journal of Sports Medicine*, *38*(04), 278–289.

Bizzini, M., Impellizzeri, F. M., Dvorak, J., Bortolan, L., Schena, F., Modena, R., & Junge, A. (2013). Physiological and performance responses to the "FIFA 11+"(part 1): is it an appropriate warm-up? *Journal of Sports Sciences*, *31*(13), 1481–1490.

Brito, J., Figueiredo, P., Fernandes, L., Seabra, A., Soares, J. M., Krustrup, P., & Rebelo, A. (2010). Isokinetic strength effects of FIFA's" The 11+" injury prevention training programme. *Isokinetics and Exercise Science*, *18*(4), 211–215.

Carling, C. (2013). Interpreting physical performance in professional soccer match-play: should we be more pragmatic in our approach? *Sports Medicine*, *43*, 655–663.

Challis, J. H. (2000). Muscle-Tendon Architecture and Athletic Performance. *Biomechanics in Sport*, 33–55. https://doi.org/10.1002/9780470693797.ch3

Daneshjoo, A., Mokhtar, A. H., Rahnama, N., & Yusof, A. (2012). The effects of comprehensive warm-up programs on proprioception, static and dynamic balance on male soccer players. *PloS One*, *7*(12), e51568.

Daneshjoo, A., Mokhtar, A. H., Rahnama, N., & Yusof, A. (2013). Effects of the 11+ and Harmoknee warm-up programs on physical performance measures in professional soccer players. *Journal of Sports Science \& Medicine*, *12*(3), 489.

De Oliveira, F., Corrêa Neto, V. G., Barbosa, R. J. S., de Jesus, I. R. T., Novaes, J. da S., & Monteiro, E. R. (2023). Power and anaerobic capacity in female soccer: A comparison between different age-categories. *Apunts Sports Medicine*, *58*(220). https://doi.org/10.1016/J.APUNSM.2023.100421

Fletcher, I. M., & Jones, B. (2004). The effect of different warm-up stretch protocols on 20 meter sprint performance in trained rugby union players. *Journal of Strength and Conditioning Research*, *18*(4), 885–888. https://doi.org/10.1519/14493.1

Fradkin, A. J., Zazryn, T. R., & Smoliga, J. M. (2010). Effects of warming-up on physical performance: a systematic review with meta-analysis. *The Journal of Strength \& Conditioning Research*, *24*(1), 140–148.

Holm, I., Fosdahl, M. A., Friis, A., Risberg, M. A., Myklebust, G., & Steen, H. (2004). Effect of Neuromuscular Training on Proprioception, Balance, Muscle Strength, and Lower Limb Function in Female Team Handball Players. *Clinical Journal of Sport Medicine*, *14*(2), 88–94. https://doi.org/10.1097/00042752-200403000-00006

Impellizzeri, F. M., Bizzini, M., Dvorak, J., Pellegrini, B., Schena, F., & Junge, A. (2013). Physiological and performance responses to the FIFA 11+(part 2): a randomised controlled trial on the training effects. *Journal of Sports Sciences*, *31*(13), 1491–1502.

Leetun, D. T., Ireland, M. L., Willson, J. D., Ballantyne, B. T., & Davis, I. M. C. (2004). Core stability measures as risk factors for lower extremity injury in athletes. *Medicine and Science in Sports and Exercise*, *36*(6), 926–934. https://doi.org/10.1249/01.MSS.0000128145.75199.C3

Lloyd, R. S., Oliver, J. L., Faigenbaum, A. D., Howard, R., De Ste Croix, M. B. A., Williams, C. A., Best, T. M., Alvar, B. A., Micheli, L. J., Thomas, D. P., Hatfield, D. L., Cronin, J. B., & Myer, G. D. (2015). Long-term athletic development, Part 2: Barriers to success and potential solutions. *Journal of Strength and Conditioning Research*, *29*(5), 1451–1464. https://doi.org/10.1519/01.JSC.0000465424.75389.56

Paterno, M. V., Myer, G. D., Ford, K. R., & Hewett, T. E. (2004). Neuromuscular training improves single-limb stability in young female athletes. *Journal of Orthopaedic and Sports Physical Therapy*, *34*(6), 305–316. https://doi.org/10.2519/jospt.2004.34.6.305

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. (2018). Training effects of the FIFA 11+ kids on physical performance in youth football players: A randomized control trial. *Frontiers in Pediatrics*, *6*, 40. https://doi.org/10.3389/fped.2018.00040

Reilly, T., Bangsbo, J., & Franks, A. (2000). Anthropometric and physiological predispositions for elite soccer. *Journal of Sports Sciences*, *18*(9), 669–683.

Robert, P., Cirer-Sastre, R., López-Laval, I., Matas-García, S., Álvarez-Herms, J., Julià-Sánchez, S., & Corbi, F. (2020). Relationship between jump capacity and performance in BMX cycling. In *Apunts. Educacion Fisica y Deportes* (Issue 140). https://doi.org/10.5672/apunts.2014-0983.es.(2020/2).140.06

Sahin, N., Gürses, V. V., Baydil, B., Akgül, M. S., Feka, K., Iovane, A., & Messina, G. (2018). The effect of comprehensive warm up (fifa 11+ program) on motor abilities in young basketball players: A pilot study. *Acta Medica Mediterranea*, *34*(3), 703–708. https://doi.org/10.19193/0393-6384_2018_3_108

Sander, A., Keiner, M., Schlumberger, A., Wirth, K., & Schmidtbleicher, D. (2013). Effects of functional exercises in the warm-up on sprint performances. *Journal of Strength and Conditioning Research*, *27*(4), 995–1001. https://doi.org/10.1519/JSC.0b013e318260ec5e

Shah Hosseini, M., Rajabi, R., Minoonejad, H., & Hossein Barati, A. (2019). Effect of Eight Weeks of FIFA 11+ Training on the Agility and Explosive Power of Male College Volleyball Players. *Annals of Military and Health Sciences Research*, *17*(3), e97233. https://doi.org/10.5812/amh.97233

Škof, B., & Strojnik, V. (2007). The effect of two warm-up protocols on some biomechanical parameters of the neuromuscular system of middle distance runners. *Journal of Strength and Conditioning Research*, *21*(2), 394–399. https://doi.org/10.1519/R-18055.1

Sotiropoulos, K., Smilios, I., Christou, M., Barzouka, K., Spaias, A., Douda, H., & Tokmakidis, S. P. (2010). Effects of warm-up on vertical jump performance and muscle electrical activity using half-squats at low and moderate intensity. *Journal of Sports Science and Medicine*, *9*(2), 326–331.

Street, S. B., & Kaminski, T. (2021). Does the FIFA 11+ program prevent hamstring injuries in college-aged male soccer players? A critically appraised topic. *Journal of Sport Rehabilitation*, *30*(1), 158–160. https://doi.org/10.1123/jsr.2019-0390

Subasi, S. S., Gelecek, N., & Aksakoglu, G. (2008). Effects of different warm-up periods on knee proprioception and balance in healthy young individuals. *Journal of Sport Rehabilitation*, *17*(2), 186–205. https://doi.org/10.1123/jsr.17.2.186

Trajković, N., Gušić, M., Molnar, S., Mačak, D., Madić, D. M., & Bogataj, Š. (2020). Short-term FIFA 11+ improves agility and jump performance in young soccer players. *International Journal of Environmental Research and Public Health*, *17*(6), 1–9. https://doi.org/10.3390/ijerph17062017

Zarei, M., Abbasi, H., Daneshjoo, A., Barghi, T. S., Rommers, N., Faude, O., & Rössler, R. (2018). Long-term effects of the 11+ warm-up injury prevention programme on physical performance in adolescent male football players: a cluster-randomised controlled trial. *Journal of Sports Sciences*, *36*(21), 2447–2454.

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