



## **MASTER DE ALTO RENDIMIENTO DEPORTIVO Y SALUD**

Universidad Miguel Hernández de Elche

**Training effects of a new injury prevention programme, the  
“FIFA 11+ Kids”, on several physical performance  
measures in children football players**

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TITLE: Training effects of a new injury prevention programme, the “FIFA 11+ Kids”, on several physical performance measures in children football players.

#### ABSTRACT

The main purpose of this research project will be to analyze the impact that FIFA 11+ KIDS warm-up program has on various modifiable injury risk factors of lower limb (lower limb global dynamic stability, and the range of motion in hip and knee flexion, and ankle dorsiflexion) and performance variables (height in vertical jump, v height in vertical jump with fall, length in horizontal jump, agility, sprint and technique with the ball) in children football players. Differentiating the program's impact by age of somatic maturation of players, measure by the formula for estimating the Peak Height Velocity (PHV). A total of 130 soccer players, aged between 10 and 12, will be recruited from 8 different football teams that will be engaged in the Official Amateur Championships of the Spanish Football Federation and randomized into two groups: control group and experimental group. This research will defend a pre-test and posttest quasi-experimental design experimental. Control group will go on with the common training routine, whereas experimental group will follow the FIFA + 11 KIDS program two - three times a week for four weeks. After this interventional period, the data will be analyzed by using a repeated measures ANOVA intergroup.

Keywords: Warm-up, performance, injury, risk factores, FIFA 11+ KIDS.

TITULO: Impacto del un programa de prevención de lesiones “FIFA 11+KIDS”, sobre varios factores de rendimiento físico en niños jugadores de fútbol.

RESUMEN:

El objetivo principal de este proyecto de investigación será analizar los efectos del programa de calentamiento FIFA 11+ KIDS sobre varios factores de riesgo de lesión de la extremidad inferior (estabilidad dinámica global de la extremidad inferior, rango de movimiento de la flexión de cadera, de la flexión de rodilla y dorsiflexión del tobillo) y en variables de rendimiento (altura de salto vertical con caída, altura de salto vertical con contramovimiento, longitud de salto horizontal, agilidad, sprint, y técnica con el balón) en jugadores de fútbol de categoría alevín. Un total de 130 jugadores de fútbol de edades comprendidas entre 10-12 serán reclutados de 8 diferentes equipos de fútbol del campeonato amateur de la federación española de fútbol y distribuidos aleatoriamente en dos grupos: grupo control, y grupo experimental. Este estudio de investigación presentará un diseño cuasi-experimental con doble sesión pre-test y una sesión post-test. El grupo control seguirá con su rutina habitual de entrenamiento, mientras que el grupo experimental realizará el programa FIFA+11 KIDS con una frecuencia de 2-3 veces por semana durante un periodo de 4 semanas. Tras el periodo de intervención, los datos serán analizados empleando una prueba ANOVA de medidas repetidas inter-grupo.

Palabras claves: Calentamiento, rendimiento, lesión, factores de riesgo, FIFA 11+ KIDS.

## 1. INTRODUCTION

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Football (soccer) is by far the world's most popular sport, with more than 270 million of participants playing both at amateur and professional levels; most of them are younger than 18 years (FIFA Big Count 2006). Playing football has a great potential to induce beneficial health effects and to support a healthy lifestyle during the life span (Bangsbo, Junge, Dvorak, Krstrup, 2014; Fuller, Junge, DeCelles, Donald, Jankelowitz & Dvorak, 2010). Football is a physical demanding sport that entails sudden acceleration and deceleration, rapid changes of directions, jumping and landing tasks; as well as many situations in which players are involved in tackling to keep possession of or to win the ball (Faude, Rossler & Junge, 2013; Krstrup, Aagaard, Nybo, Petersen, Mohr & Bangsbo, 2010). In particular, these high-intensity situations result in a notable risk of injuries (Maffulli, Longo, Gougoulas, Loppini & Denaro, 2010; Venturelli, Schena & Zanolla & Bishop, 2011). The increased risk of injury (mainly in the lower extremities) produced by playing football is especially relevant in cases in which growth and maturation are not yet completely developed such as in childhood and adolescence (Bastos, Vanderlei, Vanderlei, Júnior & Pastre, 2013). Furthermore, epidemiology studies have reported that the frequency and severity of injuries among youth football players is striking in comparison to other sports (Fridman, Fraser-Thomas, McFaull & Macpherson, 2013; Hootman, Dick & Agel, 2007; Schiff, Mack, Polissar, Levy, Dow & O'Kane, 2010). Consequently, football-related injuries can counter the beneficial effects of sports participation at a young age if a child or adolescent is unable to continue to participate because of the effects of injury (Longo, Lamberti, Maffulli & Denaro, 2011).

Therefore, it seems important to implement effective injury prevention programs early to counter potential injury-related risks. In this sense, several injury prevention programmes have been designed with the aim of preventing and reducing the number and severity of

football-related injuries in adolescent players, such as the FIFA 11+ (Bizzini, Junge & Dvorak, 2011), Harmoknee (Kiani, Hellquist, Ahlqvist, Gedeberg & Byberg, 2010), KIPP (LaBella, Huxford, Grissom, Kim, Peng & Christoffel, 2011) and PEP (Gilchrist, Mandelbaum, Melancon, Ryan, Silvers, Griffin, Watanabe, Randall & Dvorak, 2008). All of these programmes include running exercises and specific dynamic movements focusing on enhancing the most important and modifiable injury risk factors (e.g. poor physical performance in strength, power, balance, speed, proprioception and joint range of motion) and are based on the injury profile and biological status (i.e. maturation phase) of the target population (> 14 years of age). The effectiveness in reducing non-contact overall and overuse lower extremity injury rates of these above-mentioned injury prevention programmes have been documented in male and female young (aged 13 to 19 years) players (Herman, Barton, Malliaras & Morrissey, 2012).

However, these injury prevention programmes may not be suitable for children players (<13 years of age) since maturation seems to affect the incidence and characteristics of injury. Specifically, injury incidence in youth populations has recently been aligned to peak height velocity, when rapid disproportional growth is evident (Rumpf & Cronin, 2012; van der Sluis, Elferink-Gemser, Brink & Visscher, 2015). Thus, children football players seem to have more fractures and bone stress, fewer strains and sprains, and more injuries of the upper body than older players (Rössler, Junge, Chomiak, Dvorak & Faude, 2015). These considerations have led Rössler, Donath, Bizzini & Faude (2015) to develop a warm-up programme designed to prevent injuries and reduce the number and severity of football-related injuries in children that takes age-specific injury characteristics and physical maturity into account, which has been called “FIFA 11+ Kids”. The FIFA 11+ Kids focuses on: a) spatial orientation, anticipation, and attention, particularly while dual-tasking (to avoid unintended contact with other players or objects); b) body stability and movement coordination (more general than

specific neuromuscular or proprioceptive training); and c) learning appropriate fall techniques (to minimise the consequences of unavoidable falls).

The FIFA 11+ Kids” is currently evaluated with regard to its potential to reduce injuries in a large-scale cluster-randomised controlled trial. The preliminary results have showed that children performing FIFA 11+ Kids had 38% less injuries compared to their counterparts following other warm ups or trainings. Severe injuries were even reduced by more than 50% in those teams performing the FIFA 11+ KIDS programme (data available at <http://f-marc.com/fifa-11-kids/>).

Although the main purpose of the FIFA 11+ Kids is injury prevention, the knowledge of training effects elicited on movement skills and motor performance can help in identifying the potential mechanisms behind the reported reduction in injury incidence. To the best of our knowledge, only Rössler et al. (2015) have examined the pre-exercise effects of the FIFA 11+ Kids on various sports-performance variables in children football players, showing possibly beneficial effects in static and dynamic balance, jumping performance and slalom dribbling. Consequently, there is a clear necessity of studies that analyse the training effects of the FIFA 11+ Kids on physical performance measures in order to understand better the underlying mechanism in its promising injury prevention effects.

Therefore, the main purpose of this study will be to analyse the training effects of the FIFA 11+ Kids on several parameters of physical performance in children amateur football players. We hypothesised that this new program would show beneficial and superior effects on physical performance (particularly in balance and agility measures) in comparison to the traditional practises as they include specific and novel exercises designated to improve it.

## 2. METHOD

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### 2.1 Sample size estimation

The estimation process of the sample size needed to address the purposes of the current study was based on the traditional null hypothesis testing and using the approach of magnitude-based inferences and calculating confidence intervals. A small to moderate training effects ( $f = 0.10$  to  $f = 0.25$ ) of neuromuscular measures and motor coordination skills for the intervention were expected (Logan, Robinson, Wilson, & Lucas, 2012). The sample size was estimated on the basis of a small effect size ( $f = 0.10$ ,  $p = 0.05$ , statistical power = 0.80) for the relevant within-between interaction effect. Sample size estimation revealed a required total sample size of 82 children for final analysis. Assuming a dropout rate of about 35%, about 130 children will be initially recruited.

### 2.2 Participants

A total of 130 children (boys) football players will be contacted to take part in the current study. Participants will be recruited from 8 different football teams that will be engaged in the Official Amateur Championships of the Spanish Football Federation (under 12 local league). The participants will meet 4 inclusion/exclusion criteria: 1) have no history of impairments to the knee, thigh, hip, or lower back in the 6 month prior to the study; 2) all participants should be free of delayed onset muscle soreness (DOMS) at any testing session; 3) participate on 2 supervised training sessions per week (1.5-2 hours per session); and 4) present a maturity index categorized as pre peak height velocity (PHV) (-3 years to -1 years from PHV) through the length of the study. In particular, the maturity index will be calculated using the equation of Mirwald, Baxter-Jones, Bailey, and Beunen (2002). This assessment is a non-invasive and practical method of predicting years from PHV as a measure of maturation using anthropometric variables. In addition, participants will be excluded from the data analysis if

they a) miss more than 2 consecutive or 3 non-consecutive training sessions and/or b) one testing session.

Before any participation, experimental procedures and potential risks will be verbally and written explained fully to the participants, and written informed consent will be obtained from players, their parent/guardian and coaches. The Institutional Research Ethics committee, conformed to the recommendations of the Declaration of Helsinki, will approve the study protocol prior data collection.

### **2.3 Research design**

A parallel, two-group, pre-post, randomised controlled trial with double baseline (two pre-test sessions) will be used to address the purposes of this study.

The study will be conducted in Spain and began in February 2017 and will be completed in April 2017. In Spain, the under 12 local league has two different rest periods (winter [2-3 weeks for Christmas holidays] and spring [2 weeks for Easter holidays] breaks) so the season is divided into three main terms/macrocycles. The three terms have approximately the same number of weeks (from 8 to 10 weeks) and matches (from 8 to 10 matches; one every weekend). The time frame of the study will be selected so that the study could start after the winter break and could be completed before the Easter break. The second term of the season will be chosen rather than the first term in order to be sure that the players selected to each team will be definitive and stable within the testing period. Further, the study will be not carried out in the third term of the season with the aim of reducing the dropout rate of players' that could be expected due to the primary school final exams (this decision was made based on coaches experience).

The independent variables will be the 2 different intervention programmes (control [traditional or regular warm-up] and FIFA 11+ Kids). The dependent variables will include 13 physical performance measures (range of motion [hip, knee and ankle joints], dynamic



postural control [measured throughout the Y-balance test], 20 m sprint time, vertical jumping height [counter movement jump and drop jump], long jump distance, accuracy when volleying a ball [measured throughout the Wall Volley test], slalom dribble and agility).

Prior to the intervention phase, the participants' baseline value for each dependent variable will be determined using 2 identical testing sessions separated by a week rest-interval. Each testing session will be carried out 48-72 hours after finishing the previous competitive match (i.e. Tuesday or Wednesday) so that the players could have enough time for recovery. In addition, players will not carry out any training session throughout this rest-interval. Tests will be conducted within the time frame of a regular training session at the same time of the day (in the late afternoon). All the tests will be carried out on an outdoor training pitch (3G artificial surface) of each team. The total testing procedure will last approximately 2 h for one team. After these 2 pre-test sessions will be completed, participants will be randomised within each team into 2 groups (control vs. FIFA 11+ Kids) using a computer-based software programme. One of the researchers without any contact or knowledge of the players will complete the allocation and randomisation. Therefore, no allocation concealment mechanisms will be necessary.

For the following 4 weeks (intervention phase), the participants will complete only one of the 2 intervention programmes 2 days a week as part of their weekly training sessions. As the FIFA 11+ Kids was initially proposed as training programmes that should be performed during the pre-exercise warm-ups, the participants who will be allocated in the intervention groups will carry out the FIFA 11+ Kids instead of their traditional or regular warm-up routines. However, prior to the matches played every single weekend ( $n = 4$ ), all players will perform their traditional warm-up routines (this situation was imposed by the coaches of both teams).

The training period of 4 weeks was selected: (a) to match the typical duration of each of

the two mesocycle that usually contain the three macrocycles of the regular season in this population; and (b) to ensure that both the testing and intervention phases of this study were developed during the same period of the season in each team.

A trained sport specialist will be assigned to both teams for administrating the FIFA 11+ Kids, and for checking the warm-ups and assisting the coaches during the normal warm-up (control group). All players in the intervention groups will attend a workshop designed to demonstrate how to perform the exercises correctly. In order to prevent contamination of the control groups the training pitch will be divided into two equal parts, so that the players who will belong to the control group will perform their regular warm-up in one part while the players who will belong to the intervention group perform their new warm-up in another part of the pitch.

Two days after the intervention phase, the post intervention assessments will be carried out following the same procedure completed during the baseline-testing phase. Due to organisational reasons, the testers who will conduct the baseline and post intervention assessments will be not blinded to group assignment.

#### **2.4. Testing procedure**

During each testing session, participants began by completing a standardised warm-up routine consisting of 4-5 min of self-paced low- to moderate-intensity running including forward/backwards movements, sidestepping and general mobilization (i.e., arm circles, leg kicks). After this participants performed 6-8 min of dynamic stretching (i.e., straight leg march, forward lunge with opposite arm reach, forward lunge with an elbow instep, lateral lunge, trunk rotations, multidirectional skippings) performing 3 sets, from low to high intensity, with a 15 s rest period between each set. The assessments of the dependent variables were carried out 3-5 min after the standardised warm-up. The order of the tests was consistent through the experimental sessions and is displayed in figure 1.

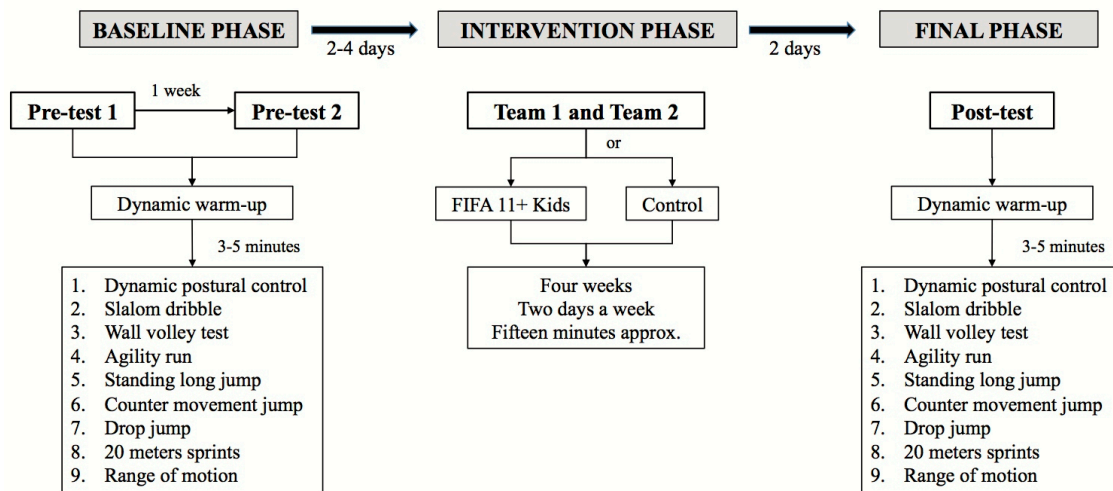


Figure 1. Experimental design

#### 2.4.1. Dynamic postural control

Dynamic postural control will be evaluated using the Y-Balance test and following the guidelines proposed by Shaffer et al. (2013). Players will be allowed a maximum of 5 trials to obtain 3 successful trials for each reach direction (anterior, posteromedial and posterolateral). Trials will be discarded if the player failed to maintain unilateral stance on the platform, failed to maintain reach foot contact with the reach indicator on the target area while the reach indicator is in motion, used the reach indicator for stance support, or failed to return the reach foot to the starting position under control (Shaffer et al. 2013). Specifically, testing order will be completed as dominant anterior, non-dominant anterior, dominant posteromedial, non-dominant posteromedial, dominant posterolateral, and non-dominant posterolateral. The average of the 3 reaches will be normalized by dividing by the previously measured leg length to standardize the maximum reach distance  $((\text{excursion distance}/\text{leg length}) \times 100 = \% \text{ maximum reach distance})$  (Gribble, Hertel & Plisky, 2012). Leg length will be defined as the length measured in centimetres from the anterior superior iliac spine to the most distal portion of the medial tibial malleolus.

#### *2.4.2. Hip, knee and ankle range of motions*

The passive hip flexion (passive straight leg raise test [appendix 2a]), knee flexion (Modified Thomas test [appendix 2b]) and ankle dorsiflexion (weight-bearing lunge with knee extended test [appendix 2c]) range of motions of the dominant and non-dominant extremities will be assessed following the methodology previously described (Cejudo, Sainz de Baranda, Ayala & Santonja, 2015). Participants barefoot will be instructed to perform, in a randomised order and 2 maximal trials of each range of motion test for each extremity. The mean score for each test will be used in the subsequent analyses. The same researchers will perform the ROM testing at all testing sessions.

#### *2.4.3 20 meters sprint*

Time during a 20-m sprint in a straight line will be measured by means of single beam photocell gates placed 0.3 m above the ground level (Time It; Eleiko Sport, Halmstad, Sweden). Each sprint will start from an individually chosen standing position, 30 cm behind the photocell gate, which started a digital timer. Each player will perform 3 maximal 20 m sprints interspersed with 3 min of passive recovery, and the fastest time achieved will be retained. Reliability was reported to be high (ICC = 0.96) (Lockie, Schultz, Callaghan, Jeffriess, & Berry, 2013).

#### *2.4.4. Agility*

The Illinois agility test is commonly used in measuring agility in football (Amiri-Khorasani, Sahebozamani, Tabrizi & Yusof, 2010; Kilding, Tunstall & Kuzmic, 2008; Rössler et al., 2016). The reliability of this test has been reported to be high (ICC = 0.85) (Katis & Kellis 2009). The length of the zone is 10 m, while the width (distance between the start and finish points) is 5m. Four cones will be placed in the centre of the testing area at a distance of 3.3 m from one another. Four cones will be used to mark the start, finish and 2 turning points. The participants will start the test lying face down, with their hands at shoulder

level. The trial will start on the “go” command, and the participants will begin to run as fast as possible. The trial will be completed when the players cross the finish line without having knocked any cones over. Time will be measured using a photocell system (Time It; Eleiko Sport, Halmstad, Sweden). Each player will perform three trials with the best score (time) will be used for analysis.

#### *2.4.5. Slalom dribble*

The slalom dribble course will be 20 m in length. Participants will run with the ball in a zig-zag fashion around five cones placed in a straight line 4.5 m away from one another. The run time will be measured using 2 photoelectric timing gates. Children will start 0.3 m in front of the starting line and will perform 4 repetitions with the best score (time) used for analysis.

#### *2.4.6. Wall volley test*

This test is a standard test with high reliability (ICC = 0.97) in terms of assessing soccer players' skill and accuracy in kicking a ball (Reilly and Holmes, 1983). The wall volley test required players to pass the ball through the air against a wall, control the rebound and make as many direct air-borne passes against the wall as possible, within a time limit of 30 s. The outcome will be the absolute number of correct rebounds (Reilly & Holmes, 1983). The player will be placed in a field which was 2 m wide and 0.5 m away from the wall. Only rebounds accomplished while standing in the sector will be counted. After 2 familiarisation tests, children will accomplish 2 repetitions

#### *2.4.7. Standing long jump*

The participant will stand behind the starting line and will be instructed to push off vigorously and jump as far as possible. The participant will have to land with the feet together and to stay upright. The arms should be used in order to acquire an adequate momentum. Jump distance will be measured from the take off line to the point where the back of the heel

nearest to the take off line landed on the floor. After 2 familiarisation tests, children will accomplish 3 repetitions. The best score of the three repetitions will be selected for the subsequent analysis.

Reliability of manually assessed standing long jump performance will be reported to be high with ICC = 0.94 (Fernandez-Santos, Ruiz, Cohen, Gonzalez-Montesinos, & Castro-Pinero, 2015).

#### *2.4.8. Counter movement jump*

A Counter movement jump (CMJ) without arm swing will be performed on a contact platform (Ergojump1, Finland) according to Bosco et al. (1983). During the CMJ, the participants first will stand upright, then squatted to a self-selected depth of approximately 90° knee flexion, and jumped immediately as high as possible. Players will be asked to keep their hands on their hips to prevent the influence of arm movements on vertical jump performance. In addition, players will be allowed to perform a countermovement with the lower limbs before jumping. Each player will perform 3 to 5 maximal CMJs interspersed with 45 s of passive recovery, and the mean jump height of the best three jumps was recorded.

#### *2.4.9. Drop jump*

A vertical drop jump (DJ) without arm swing will be performed on a contact platform (Ergojump®, Finland) according to Onate, Cortes Welch & Van Lunen (2010). Participants will stand with feet shoulder-width apart on a 28-cm-high step, 30 cm from the contact platform. They will be instructed to lean forward and drop from the step as vertically as possible, in an attempt to standardize landing height. Participants will be required to land with one foot on each of the force plates, then immediately perform a maximal vertical jump, finally landing back on the contact platform. Participants will be asked to keep their hands on their hips to prevent the influence of arm movements on vertical jump performance. Each participant will perform at least 5 maximal jumps starting from a standing position, with at

least 1 minute of recovery between jumps. Participants will be asked to jump as high as possible. The mean jump height of the best three jumps will be used for statistical analysis.

## **2.5. Interventions**

### *2.5.1. Control group*

Coaches will be asked to administer their normal warm-up routines trying to match the duration of the FIFA 11+ Kids (15–20 minutes). The traditional warm-up will differ slightly between teams but will include a combination of running, stretching, technical exercises with the ball and games.

### *2.5.2. FIFA 11+ Kids*

The FIFA 11+ Kids will consist of 7 different exercises: a running game, two jumping exercises, a balance/coordination task, two exercises targeting body stability and an exercise to improve falling technique (Rössler et al., 2016). The programme has a modular structure and consists of three skill levels with progressive load. The players will complete the FIFA 11+ Kids 2 times a week for 4 weeks substituting their normal warm-up routine. All players will be able to perform the level II of difficulty for each exercise in part 2 properly as confirmed during the previous workshop. However, no player will be able to perform the level III of difficulty for each exercise. Therefore, the level II of difficulty will be chosen for this study.

## **2.6. Statistical analysis**

The distribution of raw data sets will be checked using the Kolmogorov-Smirnov test.

Dependent sample t-tests will be carried out to assess differences between limbs (dominant versus non-dominant) in dynamic postural control and range of motions pre-test 1 and pre-test 2 measures. In cases where no significant differences would be found, the mean value of both limbs will be used for the subsequent analyses. Dependent t-tests will be also carried out to assess baseline inter-session differences (pre-test 1 versus pre-test 2) for each dependent

variable. If no significant differences would be found, the mean value of both testing sessions for each variable will be used to assess the effects of the intervention programs. Contrarily, if significant differences would be found, the highest value of both testing sessions for each variable will be used for the magnitude-based inference analysis of the interventions. Independent sample t-tests will be run to evaluate baseline differences between the groups (FIFA 11+ Kids vs. control) for each dependent variable (mean of the two baseline measures).

Magnitude-based inference analysis of the interventions (FIFA 11+ Kids and control) will be estimated using a spreadsheet designed by Hopkins (2007) via Student t-test with unequal-variances computed for change scores between paired sessions (control vs. FIFA 11+ Kids) at each testing moment (pre-test [baseline], post-test) for each variable. Alpha will set at  $p < 0.05$ . Each participant's change score between pre and post-tests will be expressed as a percentage of baseline score via analysis of log-transformed values, to reduce bias arising from non-uniformity of error.

This approach of data analysis uses confidence intervals to calculate the probability that a difference is of practical relevance or trivial when a value for the smallest worthwhile change is entered. A difference score of at least 0.2 of the between-participant standard deviation (representing a small effect) will be considered to be practically worthwhile (Hopkins, Marshall, Batterham, & Hanin, 2009). The qualitative descriptors proposed by Hopkins (2002) will be used to interpret the probabilities that the true affects are harmful, trivial or beneficial: <1%, almost certainly not; 1–4%, very unlikely; 5–24%, unlikely or probably not; 25–74%, possibly or may be; 75–94%, likely or probably; 95–99%, very likely; >99%, almost certainly. This spreadsheet also provides estimates of the effect of an intervention adjusted to any chosen value of the covariate, thereby reducing the possibility for confounding of the effect when a characteristic is unequal in the experimental and control groups: Thus, the baseline pre-test value (mean of the two pre-test measures) of each dependent variable will be



included to avoid the phenomenon of regression to the mean and thereby obtaining a better estimation of the effects of the FIFA 11+ and Harmoknee interventions in comparison with their paired control groups.



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