Effects of a Numerical Superiority and Inferiority Tactical Training Program Compared to Conventional Training on Procedural Tactical Knowledge and Executive Functions in Soccer Players. A Randomized Controlled Trial

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Protocol

There is a great need to establish reliable evaluation and intervention protocols to improve the tactical component, decision making (TD) and procedural tactical knowledge (PTK) in Soccer.

Objectives

To determine the effects of a tactical training program of numerical superiority and inferiority during 12 weeks of follow-up on the PTK, which will be evaluated by calculating offensive, defensive and global effectiveness indices (EI) of 24 male amateur soccer players, as well as the effect on their executive functions.

Type of study

The study corresponds to a predominantly quantitative approach. According to Friedman et al., (2010) it is a prospective, experimental study, in parallel, with 2 randomized groups (experimental and control). The study is a repeated measures design because measurements of the most important outcomes (primary and secondary) will be performed at four times: pretest (week 1), intermediate test 1 (week 6), intermediate test 2 (week 11) and posttest (week 16).

Site Selection (Context and Access)

The study is being carried out with soccer players from a club that competes in the Antioquia Soccer League who train on fields in the city of Medellín, which are made of synthetic grass and natural grass. These fields are in good condition and offer adequate technical conditions and security for soccer players.

Population

The investigation is being carried out with amateur soccer players, male, in the First B departmental category.

Selection criteria

Inclusion criteria

Soccer players belonging to a soccer club.

Soccer players playing roles of outfield (all except goalkeepers).

They compete in the First B category of the Antioquia Football League in the 2023 season.

Players aged between 17 and 26 years.

Players with at least six months of experience in federated soccer.

Players who do not present cognitive disorders that make learning difficult, which can be identified through monitoring by the coaches and/or tests carried out by the Neuropsychology staff.

They must be affiliated to the health system of the contributory or subsidized regime.

They must agree to participate in the study after knowing and signing the consent or informed assent as appropriate.

Exclusion criteria

Players with musculoskeletal disorders at the time of sample selection.

Players recovering from injury.

Sample Size Calculation

A systematic probabilistic sampling of permuted blocks was carried out, for which the Epidat software, V. 4.2, was be used. Taking into account the study by Sierra-Ríos et al., (2020) in which they report a mean difference of 1.13 and a standard deviation of 0.81, 5 scenarios were established to calculate the sample size (with powers of 80, 85, 90, 95 and 99%). Based on these five scenarios, the samples found are:

Scenario 1 (80% power): (20 soccer players. GE = 10 and GC = 10).

Scenario 2 (85% power): (22 soccer players. GE = 11 and GC = 11).

Scenario 3 (90% power): (24 soccer players. GE = 12 and GC = 12).

Scenario 4 (95% power): (30 soccer players. GE = 15 and GC = 15).

Scenario 5 (99% power): (40 soccer players. GE = 20 and GC = 20).

Based on these results of the calculation of different sample sizes, it decided to work with scenario 3 described above.

Randomization Process

To carry out the randomization sequence generation method, a sequence of permuted blocks of 4, 6 was generated. The relationship between groups is 1:1, for which the random assignment software (simulation) was used https://www.sealedenvelope.com/simple-randomiser/v1/lists.

The allocation was concealed by means of sealed and opaque envelopes, for which the 24 envelopes were available for each one of the participants. The envelopes were numbered from 1 to 24, the name of each research participant was added to them along with a sheet of carbon paper and the name of each research participant was marked for each intervention experimental group (GE) and control group (GC). This process of randomization sequence generation, allocation concealment, and allocation was performed by someone other than the research staff.

Variables

The study's variables, their operationalization, function, nature, measurement scales, units of measurement and instruments used are described in Table 1.

Table 1. Variables and their operationalization

Variable	Function	Nature	Scale	Unit of measurement/values	Instrument
PTK (Offensive IE)	Dependent	Quantitative	Discrete, interval	Volumen (N° of times the action is performed)	FOCOS
			Continuos, Ratio	IE (*formula)	
PTK (IE Defensive)	Dependent	Quantitative	Discrete, interval	Volumen N° of times the action is performed)	FOCOS
			Continuos, Ratio	IE (**formula)	
PTK (IE global)	Dependent	Quantitative	Continuos, Ratio	IE (***formula)	FOCOS
Executive functions "component" 1 Problem solving	Dependent	Quantitative	Discrete, interval	Number of Hits/Errors	Tower of Hanoi
			Continuos, Ratio	Time (sec, min)	
"component" 2	Dependent	Quantitative	Discrete, interval	Number of Hits/Errors	Tower of Hanoi

Variable	Role	Type	Scale	Value/Units	Instrument
Cognitive flexibility			Continuos, Ratio	Time (sec, min)	
"Component" 3 Impulse control	Dependent	Quantitative	Discrete, interval	Number of Hits/Errors	Stroop test
"component" 4 Visuospatial working memory	Dependent	Quantitative	Discrete, interval	Number of Hits/Errors	Corsi Cubes
			Continuos, Ratio	Time (sec, min)	
"Component" 5 Executive Attention	Dependent	Quantitative	Continuos, Ratio	Time (sec, min)	Trail Making Test (TMT)
"component 6" Sustained attention	Dependent	Quantitative	Discrete, interval	Number of Hits/Errors	Crossing out boxes
			Continuos, Ratio	Time (sec, min)	
Age	Confounding	Quantitative	Continuos, Ratio	Years and months	Survey
Sports age	Confounding	Quantitative	Continuos	Years	Survey
Playing position	Confounding	Qualitative	Nominal	Lateral, Central, Midfielder, Winger, Forward	Survey
Socioeconomic	Confounding	Qualitative	Ordinal	Scale from 1 to 6	Bill of public services of the house
Educational level	Confounding	Qualitative	Ordinal	School grade	Survey
Mass	Confounding	Quantitative	Continuos, Ratio	(kg)	Scale
Height	Independent	Quantitative	Continuos, Ratio	(cm)	Stadiometer
IMC	Confounding	Quantitative	Continuos, Ratio	(kg/m^2)	Equation
Mental fatigue	Confounding	Qualitative	Ordinal	Scale from 0 to 100	Question

Notes:

*Offensive effectiveness indices (IE) = Sum of the IE of the offensive tactical behaviors/Number of categories in which the soccer player developed offensive tactical behaviors.

** Defensive IE = Sum of the IE of the defensive tactical behaviors/N° of categories in which the Soccer players developed defensive tactical behaviors

*** Global IE = Offensive IE + Defensive IE/2

Masking

People who carry out the assessments are masked (they do not know which group the athletes were assigned to). In order to carry out an adequate strategy to control information biases, the professionals who carry out the evaluations are masked (blinding). Consequently, the evaluators of the primary, secondary, and exploratory outcomes were masked as follows:

PTK (offensive, defensive, and global IE) (expert soccer coach, licensed A soccer coach from the Colombian Federation, video analyst with excellent knowledge and management of videoanalysis's software such as Nacsport and he is an expert of observation categories and trained in the FOCOS (Football Competence Observation System) evaluation instrument, as well as in the management of the LINCE PLUS software).

Executive functions (problem solving, cognitive flexibility, impulse control, visuospatial working memory, executive attention, and sustained attention). These evaluations are developed by the neuropsychologist.

Professional who carry out the anthropometric evaluations is masked, she is researcher with training in sports training and use of scales and height rods.

Person who applies the survey to the soccer players to inquire about the sociodemographic characteristics of the population is masked too.

In the same way, the professional who asking to the research participant are masked too, which inquiries about the level of mental fatigue that they perceive just before the evaluations of executive functions and the FOCOS test.

The evaluations are carried out by expert professionals, with training and experience in each of the areas as described in the previous section, which guarantees their reliability. The evaluators of each of the areas mentioned above only carry out the tests (pretest and posttest) and intermediate tests 1 and 2 for the offensive, defensive, and global IE. These evaluators will report the results to the principal researcher, who in turn will file them on a personal computer with a password so that no one else has access to the information and will make backup copies in the cloud. In this way, this level of the investigation will be masked. Subsequently, the principal researcher will send the data to the statistician to proceed with data processing and information analysis.

In the same way, the statistician who will analyze the data will be masked, in this sense, the statistician will not know the identity of the participants he is analyzing, he will process data from coded subjects. The statistician will also not know to which comparison

group the data of the participants he will analyze belongs. In this way, 2 levels of the study will be masked (evaluators and data analysis).

Ethical aspects

The guidelines of the Declaration of Helsinki (updated at the 64th general assembly in Fortaleza in 2013) and of the Ministry of Health and Social Protection of Colombia through resolution 8430 of 1993 will be followed. All measures will be provided to guarantee the confidentiality of the data of the participants by assigning codes. All participants and their legal representatives (for minors) were informed of the particularities of the research through informed consent and/or assent regarding exposures, expected results, and contributions to the academic and sports field. The results obtained will be returned to the participants, their relatives and/or legal representatives and the participating soccer club. The endorsement of the research bioethics committee of the Institute of Physical Education and Sport (IUEFD) was obtained (ACEI 39-2023, June 20th, 2023). The present investigation is classified in the category of minimum risk according to article 11 of resolution 8430 of 1993 of the Ministry of Health of Colombia. In any case, the development of this research does not represent an additional risk to the activities, training sessions and competitions in which the soccer players participate daily.

Interventions (GE and GC Training Plans)

GE (Tactical Training in Numerical Superiority and Inferiority)

The participants of the GE will carry out a specific training program, with the objective of improving both offensive and defensive technical and tactical action (ATT) that allow the increase of the IE (offensive and defensive). The formats through which the GE subjects will train are Small Sided Games (SSGs) and ATT 2v1, 3v2 and 4v3, alternating them during the week (SSGs on Tuesdays and ATT on Thursdays). It is important to mention that, in terms of physical demand, the training through these 2v1 and 3v2 formats are similar, and therefore, can be assimilated in part, to those proposed by Casamichana and Castellano (2016) to the SSGs of level 14 and level 16 (on a scale from 1 to 20, with 20 being those with the greatest physical demand), in which the JER of 1v1 and 2v2 present the following specifications: Level 14: 2 series X 6 repetitions X 1'30" of

exercise X 1' 30" pause (total 12 repetitions of SSGs) and Level 16: 2 series X 7 repetitions X 1'30" of exercise X 1'30" of rest (total 14 repetitions of SSGs).

Regarding the game area in which the training sessions will be carried out through SSGs, the classification made by García et al., (2019) will be used as a reference, in which they state that for a game to be considered reduced, 34m^2 must be allocated to each player (approximately 7m X 5m). These authors suggest that the 3v2 SSGs should be developed in an area of approximately 168.75m^2 to 170m^2 (12.5m X 13.5m). In the same way, they propose that the SSGs of 4v3 should be carried out in an area of approximately 238m^2 to 240m^2 (15m X 16m). Although these authors do not propose a specific area for the SSGs 2c1, a space correspondence can be made following these same guidelines; In this way, the JER 2c1 can be developed in an area of approximately 102m^2 to 100m^2 (10m X 10m). In this study, SSGs training will be carried out in the following areas:

2v1: 11.5m long and 9m wide (total: 103.5m^2), equivalent to 34.5m^2 for each player.

3v2: 14m long and 12m wide (total: 168m^2), equivalent to 33.6m^2 for each player.

4v3: 17m long and 14m wide (total: 238m^2), equivalent to 34m^2 for each player.

The characteristics of this training program are training frequency 5 times/week, plus 1 competition on weekends, frequency of stimulation of the SSGs and ATT of numerical superiority and inferiority 2 times/week, the specific training time assigned to the development of these formats and exercises will be from 30 to 42 minutes/training session and will be carried out after the set-up (warm-up). The total volume of the program is 920 minutes.

The SSGs (2v1, 3v2 and 4v3) that will take place on Tuesdays have a specific duration and can be easily controlled. However, the executions of the ATT (2v1, 3v2 and 4v3) that will be carried out on Thursdays, do not have a specific duration because it will depend on the dynamics of each repetition, which normally do not exceed 20 seconds. It is important to mention that, during the application of the stimuli (SSGs and ATT) no one from the coaching staff will provide feedback, or corrections to the soccer players in order to feedback does not become confusing variables. In addition, during the executions of the

SSGs, there will be balls and personnel around them to supply balls when they leave the pitch and, in this way, guarantee their continuity so that the training time is effective.

In the event that one of the subgroups is missing player(s) to perform the repetitions set out in the protocol, due to any circumstance (non-attendance to the session, physical discomfort, momentary bruises, injury or unexpected situations), their replacement will be arranged with other soccer players who are not part of any of the comparison groups (GE and GC), they can be students of the IUEFD of the University of Antioquia (UdeA) with experience as soccer players and who previously know the ATT to be developed and also soccer players who are on trial within the team. For the registration, quantification and monitoring of the number of repetitions, a coach will be arranged so that each time the soccer players in each of their subgroups execute a repetition, he will write it down on forms designed for that purpose. Once the participants have completed the number of repetitions stated in the protocol, this coach will finish this part of the training.

After the specific stimuli oriented to actions and situations of numerical superiority and inferiority, the coaches will possibly perform other training stimuli not considered in the study; however, they will be asked not to perform additional JER or ATT training in numerical superiority and inferiority, nor ATT 1v1, 2v2, or 3v3 during the duration of the experiment to avoid co-interventions that could generate bias. It is important to mention that the coach who will execute the EG training program will be different from the one who will execute the CG training program to avoid intervention bias.

GC (Conventional Training of ATT in numerical equality)

The CG participants will perform conventional training. In the present study, ATTs that are performed in numerical equality in 1v1, 2v2 and 3v3 formats are called conventional training. Similarly, coaches will be asked not to carry out additional specific training with these formats, nor offensive or defensive SSGs or ATT in numerical superiority or inferiority, specifically in 2v1, 3v2, or 4v3 formats, during the duration of the study, to avoid confounding biases due to possible co-interventions. This GC training program will include individual, pair and trio ATTs.

The characteristics of this training program are training frequency 5 times/week, 1 official competition on weekends, ATT stimulation frequency in 1v1, 2v2 and 3v3 formats is 2 times/week, the specific training time assigned it will be 40 minutes per training session and will be done after the set-up (warm-up). The total volume of the program is 960 minutes. As mentioned above, the coach that will execute the CG training program will be different from the one that will execute the GE training program. As with the provisions of the GE, for the CG a coach will also be assigned to register, quantify, and monitor the training stimuli of this group, who will record it in forms designed for this purpose.

The training sessions, both for the GE and CG, will take place on synthetic and natural grass pitches, which are in good condition to guarantee the normal development of the practices. If for some reason of force majeure, the training session cannot be carried out on the day assigned within the protocol, an attempt will be made to carry it out the following day, that is, Tuesday session would be performed on Wednesday and Thursday session would be performed on Friday, thus guaranteeing the weekly specific stimulation frequency (FEES). The exercises will be carried out with GOLTY N°5 balls.

Information Collection Instruments

To evaluate the primary, secondary, exploratory outcomes and the confounding variables, a battery of tests and protocols will be carried out, which are described below.

PTK (Offensive IE, Defensive IE, Global IE)

The PTK will be evaluated through the FOCOS test. This test evaluates all the actions in attack (21 actions) and all the actions in defense (10 actions) through which the offensive score, defensive score and total score are obtained and with these scores the IE is calculated (offensive, defensive and global) of each participant and each group.

Likewise, strengths, weaknesses, aspects to improve in each tactical behavior and/or phase of play can be determined according to the role (attacker with the ball, attacker without the ball in the center of the play, attacker without the ball outside the center of the play, defender to intervene in space, defender in the center of the play and defender outside the center of the play). Likewise, the actions are evaluated according to the subrole, in attack: ball control, driving, dribbling, passing, shooting, ball circulation and positioning

and in defense: tackle, interception, deterrence and relocation. In the same way, the operational principles are evaluated, in attack: maintaining possession of the ball, progressing towards the rival goal and scoring a goal, and in defense: recovering possession of the ball, avoiding the progression of the opponent and protecting the goal. Similarly, the specific principles are evaluated, in attack: penetration, offensive coverage, mobility in depth, width and length, and in defense: retardation, defensive coverage, balance, concentration and defensive unity. In addition, the result of the action can be established, both in defense and in attack, it is determined if the action in general was successful or wrong. If there are doubts in the valuation for any reason, it is qualified as improbable or that there are doubts.

FOCOS is a field test that allows evaluating soccer players in their natural and contextual environment through specific soccer situations, which guarantees its ecological validity. 2 goalkeeper teams (P) + 4 v 4 + P are formed. There are 2 games of 4 minutes X 1 minute pause between each game. The authors of FOCOS propose 2 formats with different playing areas depending on the age of the players. For children under 12 years old (25mt X 30mt and 6mt X 2mt goals) and for people over 12 years old (33mt X 40mt and 7.32mt X 2.44mt goals). In this research the format for over 12 years will be used.

It is important to indicate that the test is controlled and monitored by an expert coach, who has academic training at the doctoral level in the area of sports training, with practical experience as a former soccer player at a professional level, with more than 20 years of experience as a soccer coach and Licensed as a CONMEBOL PRO soccer coach, also trained in the FOCOS evaluation protocol, carried out by means of previous readings of the protocol, conversations with the author of the test, and carrying out three pilot tests, which allowed to refine, standardize, and modify the test looking for better performance of the soccer players.

To obtain the data, the games must be filmed with a camera and later, carry out the respective analyzes and evaluations. In the present investigation, a DJI Fly drone is used, which is positioned 20m high just behind one of the goals, this location guarantees complete visibility of the ATTs executed by the participants and full coverage of the pitch. Once all the corresponding games have been filmed, the videos are downloaded, which are

sent to the video analyst who will carry out the respective analysis and data report in the database created for this purpose. For the analysis, the video analyst will use the LINCE PLUS video analysis software (Soto et al., 2019), which is available and freely accessible.

The FOCOS units of measure are:

Volume, which corresponds to the number of times the soccer player develops tactical behaviors in each category.

The IE is determined through the following formula:

$$IE = Volume\ of\ successful\ tactical\ behaviors/Number\ of\ tactical\ behaviors\ developed\ in\ each\ category\ of\ analysis$$

$$Offensive\ IE = Sum\ of\ the\ IE\ of\ offensive\ tactical\ behaviors/Number\ of\ categories\ in\ which\ the\ soccer\ player\ developed\ offensive\ tactical\ behaviors$$

$$Defensive\ IE = Sum\ of\ the\ IE\ of\ defensive\ tactical\ behaviors/Number\ of\ categories\ in\ which\ the\ soccer\ player\ developed\ defensive\ tactical\ behaviors$$

$$Global\ IE = Offensive\ IE + Defensive\ IE/2$$

The global IE represents the PTK of each soccer player.

The authors of FOCOS report that the design of the instrument was carried out in six stages: review of the literature and provisional development of the observation system, reconfiguration of the instrument, content validity, simplification of the instrument, reliability, and construct validity. The content validity was obtained through a qualitative approach through consensus agreement of three experts, who had to meet at least two of the following three characteristics: having more than 10 years of experience in training, being a graduate in physical activity sciences and sports with a specializing in soccer, being active coaches with a professional level qualification. To do this, they applied a Likert-type scale (from 1 to 10) through the Delphi Methodology using the content validity coefficient. Similarly, the instrument was quantitatively analyzed calculating intra-observer reliability, for which Cohen's Kappa was used. Similarly, to establish inter-observer reliability, the

Kappa Fleiss index was used. In addition, the construct validity was calculated through the Student t test for independent samples.

To calculate the content validity coefficient, the averages of the two factors used with the group of experts were calculated following the Delphi methodology, the degree of agreement obtained was 8.74 out of 10 (very high content validity) in relation to the clarity of the language, established through the question, to what extent do you consider that the definition is well developed and exclusive with respect to the other categories of the criterion?, on the other hand, the degree of adequacy that represents the practical and theoretical relevance obtained it was 9.3 out of 10 (very high), which was determined through the question, to what extent do you think the category should form part of the criterion? from these two factors, the validity of the total content of the test was obtained 9.02 out of 10 (very high). Consequently, the authors report very high total content validity. Following the same procedure, they determined the content validity of "general tactical behavior", obtaining a score of 9.4 out of 10 (very high).

The construct validity of the instrument was calculated from its perspective of discriminant validity, which allows measuring the degree of the instrument to differentiate between groups of soccer players that are expected to be different. To do this, they compared two independent samples (semi-professional soccer players and amateur soccer players). The data were analyzed using the student t test for independent samples and the results showed significant differences ($p \leq 0.05$). In addition, they calculated the effect size (ES) using Cohen's d to assess the magnitude of the difference between groups of soccer players (Cohen, 1988). According to the Hopkins et al. (2009) established the ES as (very large: d = >2; large: d = 1.2 to 2.0; moderate: d = 0.6 to 1.2; small: d = 0.2 to 0.6 and trivial: d = 0 to 0.2). The results showed values between 1.08 and 2.32 in favor of the group of semi-professional soccer players, except for 1 variable that showed differences in favor of the group of amateur soccer players.

The calculation of the intra-observer stability index was carried out through test-retest reliability, for which Cohen's Kappa (*k*) was applied to the data extracted with a difference of five weeks in the evaluation of both records. The results showed an agreement index of $K = 0.747$ considered as a good agreement (Altman, 1991).

For the present research, the calculation of the intra-observer stability index will be carried out through the test-retest reliability with a difference of five weeks between both observations. For this, the videos and ATT of two soccer players will be observed and the results will be compared through the Kappa index (k). When the evaluator (video analyst) obtains an agreement considered good (0.61 - 0.80) or very good (0.81 – 1.00) (Altman, 1991, slightly adapted from Landish and Koch, 1977), the videos will be evaluated and record the respective data.

The inter-observer reliability of FOCOS was calculated using the inter-observer agreement coefficient for more than two observers (n = 3). In this case, the Kappa Fleiss was applied. The results showed a concordance coefficient of $K = 0.766$ considered as a good agreement.

The PTK evaluations will take place on the synthetic grass field of the UdeA.

Executive functions

Problem Solving (Component 1). This component is evaluated through the Tower of Hanoi test, which evaluates people's planning, control, and organization capacity. The evaluator takes into account the number of movements that the subject must make to achieve the final configuration, as well as the number of errors made, and the time spent to solve the problem. The application of the test lasts approximately 15 minutes.

Cognitive Flexibility (Component 2). Like problem solving, cognitive flexibility is assessed through the Tower of Hanoi test as described above.

Impulse Control (Component 3). This component is evaluated through the Stroop test, which is an attentional test that evaluates the ability to resist verbal interference, in the same way, it evaluates the ability to classify information from the environment and react selectively to it. The evaluator takes into account the number of hits of the participant. The application of the test lasts approximately 10 minutes.

Visuospatial Working Memory (Component 4). This component is evaluated through the Corsi Cube test, which evaluates short-term visuospatial memory and consists of remembering increasing sequences of cube touches. The number of hits of the sequences

performed by the participants and the execution time are recorded. The application of the test lasts approximately 15 minutes.

Executive Attention (Component 5). This component is evaluated through the Trail Making Test (TMT). This test assesses visual attention and task switching, as well as visual search speed, scanning and processing speed, mental flexibility, and executive functioning. The time to complete the test is recorded. The application of the test lasts approximately 7 minutes.

Sustained Attention (Component 6). It is evaluated through the Crossing Out of Boxes with non-verbal stimulation, it consists of presenting to the participant a matrix of 140 squares with a line placed in different positions on one of the sides or angles of each box. The participants must cross out as quickly as possible the figures that were equal to three stimuli placed at the top of the sheet. There is an example, in which the evaluator must make sure that the participant has understood the instructions. The number of correct answers (maximum 48), the number of errors due to omission, the errors due to commission and the time are scored. The application of the test lasts approximately 5 minutes.

All the previously mentioned tests to evaluate executive functions are carried out both at the beginning and at the end of the interventions, they last approximately between 50 and 60 minutes and they are coordinated by the neuropsychologist, applying the protocols of each one of them. All these tests will be carried out at the IUEFD of the UdeA.

To evaluate the sociodemographic characteristics of the population, a survey is applied with simple questions to determine age, sporting age, playing position, socioeconomic stratum, and educational level. This survey is carried out by one of the researchers at the beginning and at the end of the interventions and is carried out at the IUEFD. If necessary, supporting documents will be requested such as an identity document, study certificate or degree certificate, and utility bill for the home.

Anthropometric Variables

Mass. It was measured using a bioelectrical impedance balance, brand Omron® HBF-510 (Bannockburn, IL, USA), which has a sensitivity of 100 grams. The participants were

measured in resting conditions, free of clothes and shoes (shorts only) and without carrying any metallic object (electronic devices, keys, jewelry, watches, piercing).

Size. It was measured using a stadiometer, Seca 213, with a sensitivity of 1 millimeter. The participants were measured in resting conditions, free of clothes and shoes (only in shorts). The mass and height evaluations were carried out by a researcher trained in sports training and familiar with the use of scales and stadiometers. The measurements are made both at the beginning and at the end of the interventions and they are carried out in the Integrated Laboratory of Physical Activity and Sports Sciences (LICAFDE).

Body Mass Index (BMI). It will be found by calculating the formula mass/height^2 (kg/mt^2). The BMI calculations will be made both at the beginning and at the end of the interventions with the respective data that shows the mass and height.

Pilot Testing Procedures

Several pilot tests were carried out to familiarize and sensitize all the people involved in the study (soccer players, coaches, researchers, and assistants). Likewise, it is important that everyone knows the people with whom they are going to interact, the places of training and evaluation, the contexts, norms, and regulations that must be complied, procedures and protocols for evaluation and intervention, equipment, technology, software, materials, and clothing to use.

Regarding the training plans (intervention protocols) to be compared, pilot tests of the training sessions were implemented in the same way as established in the protocols and with the same people responsible of each activity. The coaches will carry out the exercises and sessions of the GE and GC following the parameters of the stimuli, repetitions, volume, order, sequence, behavior, registration, and verification of compliance established in the protocol.

Participants will carry out the exercises and sessions as indicated by the coaches. Three weeks of training were carried out simulating the conditions described in the protocols (GE and GC). In week 1, the 2v1 JER and ATT formats were taking place, in week 2 the 3v2 SSGs and ATT formats were developed, and in week 3 the 4v3 SSGs and

ATT formats were taking place. These pilot tests were carried out with the same group under investigation during the last month prior to the start of the research.

Similarly, pilot tests of the FOCOS evaluation protocol were carried out. In this sense, the tests were carried out under the same conditions as set out in the protocol described above, on the same field, at the same time and with the people in charge of carrying out each of the activities (coaches, filming the test and assistants), in the same way, these pilot tests were carried out with the same participants with which the research will be carried out to familiarize the soccer players. Regarding the equipment, the procedures were also standardized with the same drone to be used and with the same person who will handle the drone during the investigation and, in addition, with the same implementation and clothing such as balls, demarcation cones and training bibs.

Once the pilot test has been carried out and the videos of the SSGs of the FOCOS test have been obtained, the principal researcher will deliver them to the ATT and PTK evaluator (video analyst), so that through the LINCE PLUS video analysis software he can carry out the respective evaluations and record the data in the respective information bases. In this phase of the investigation, the evaluator must be fully familiar and trained in the management of the software and the ATT of the participants to determine their general tactical behavior. To achieve reliability in this process, the evaluator (video analyst) will be calculated the intra-observation stability index, which will be carried out through the test-retest reliability, for which Cohen's Kappa (k) of the data will be applied with a difference of five weeks in the evaluation of both records. When the evaluator obtains an agreement considered good (0.61 - 0.80) or very good (0.81 – 1.00) the videos will be evaluated and record the respective data.

Data Collection Procedures (Assessment Protocols)

To evaluate the PTK (offensive IE, defensive IE and global IE) the FOCOS test will was applied and it was carried out through the following protocol: the groups of soccer players were formed randomly. To randomize the participants and form the groups, the random assignment software https://www.sealedenvelope.com/simple-randomiser/v1/lists was used. In the same way, the teams that face each other were randomized so that it is chance that defines the formation of the groups and the confrontation of these.

The soccer players were undergoing conditioning to start the test, which consists of joint mobility and flexibility exercises for 10 minutes, basic technique exercises (passing, controls, driving, dribbling and shots) for 7 minutes and short sprint, struggles and disputes for the ball for 3 minutes. In total, this set-up phase lasts 20 minutes. Then they were assigned two minutes to finish getting ready, organizing, and getting ready for the execution of the test.

Next, the SSGs goalkeeper (P)+4 v 4+P proposed and validated by Sánchez-López et al., (2021 and 2023) carried out. However, to try to correct some of the limitations declared by these same authors (2023), and with the purpose of guaranteeing better conditions of execution by the participants, some modifications were made to the protocol, specifically in relation to the pause between the 2 games of 4 minutes, they gave to the soccer players one minute. In this study, a four-minute break was given between games to guarantee a greater recovery and that the participants were in better condition to develop their tactical behaviors. In the same way, the limitation related to the time of the training session in which the test was carried out was modified. In this study, it was carried out at the beginning of the session, guaranteeing that the participants were in adequate conditions, without fatigue generated by actions or previous exercises (in the study by Sánchez et al., 2023 they carried out the test in the final part of training session).

The test carried out following the general rules of soccer 11, except for the offside rule, with the purpose of reducing the number of interruptions and that the effective playing time is high, even though this may impact positional behavior of the participants. In addition, there were no throw-ins when the ball goes over the sideline, these were replaced by goal kicks from the team opposite the one that sent the ball out of play to speed up play, just like when the ball goes over the end line. When a participant commits an infraction, it was restarted with a serve by the goalkeeper of the team that received the infraction. Sufficient balls were available around the field of play and auxiliaries to supply them quickly in order to guarantee continuity in the game. The teams wear bibs to distinguish themselves from the rival team. The test carried out with GOLTY N°5 balls.

The test (pretest) was carried out on the synthetic turf field of the UdeA and the same evaluation conditions will be maintained in the four moments proposed in the

research protocol, that is, pretest (week 1), intermediate test 1 (week 6), test intermediate 2 (week 11) and posttest (week 16). Likewise, the groups formed randomly and the confrontation between them determined by chance at all test will be respected. If for any reason a participant cannot take the test due to any circumstance (absence at the session, physical discomfort, momentary bruises, injury or unexpected situations), his replacement will be arranged with IUEFD student with experience as soccer players and who previously know the protocol to complete the gap, or with soccer players who are on trial at the club and who are not part of the comparison groups. The tests will be carried out on Wednesday from 6 to 8 in the morning in the respective weeks (1, 6, 11 and 16).

Once the tests have been completed and duly filmed, the respective videos will be passed on to the evaluator (video analyst) who will download the videos, analyze the different actions and behaviors developed by each of the participants through the LINCE PLUS video analysis software and record the data in Excel files in the database created for this purpose. This database will be created in such a way that a code is generated for the participants and no one can identify who the information registered and consigned there corresponds to (except the main researcher) who will save it on their personal computer, on a hard drive to keep copy and in the cloud. These files will be kept with a password, which only the principal researcher will know.

The information and data resulting from the respective analyzes carried out by the evaluator will be sent to the statistician who will proceed to carry out the respective analysis and application of tests in accordance with the data treatment that appears in the data analysis section.

Prior to carrying out the FOCOS test that evaluates the primary and secondary outcomes and, prior to the execution of the tests that evaluate executive functions (exploratory outcome), the following question will be asked to the participants: from 0 to 100, ¿How mentally fatigued are you? Being 0 (not at all fatigued) and 100 (maximum fatigue).

The evaluations of week 1 were carried out on two different days and in the following order: the first day the survey was carried out, mass, height, mental fatigue and finally, the tests were applied to assess the executive functions, for which participants were

summoned by groups of 4 every hour. Total application time from full battery was approximately 60 minutes. On the second day, the FOCOS field test was carried out and all the participants were summoned at 6 in the morning. In the intermediate tests 1 (week 6) and 2 (week 11) only the evaluations will be carried out through FOCOS. Finally, the post-test evaluations (week 16) will be carried out in the same way as in the pre-test, that is, they will be carried out on two different days and in the following order: the first day the tests will be applied to assess the executive functions and mental fatigue, on the second day, the field test (FOCOS) will be carried out, for which all the participants will be summoned at 6 in the morning.

Bias Control

To control biases in the different stages of the study (planning, execution, and data analysis), different strategies and actions were established to obtain reliable results. Bias control was carried out as follows:

Control of Allocation Biases (Randomization Biases)

To avoid these biases, the participants were randomized to two comparison groups (GE and CG) as previously described in the randomization process.

Control of Information Biases (Systematic Biases)

To avoid these biases, reliable and valid protocols and tests are used, in addition, the evaluation protocols were standardized (pretest, intermediate test 1, intermediate test 2 and posttest), which will be carried out under similar conditions, with the same equipment and by the same evaluators). In the same way, the equipment and instruments were calibrated in accordance with quality norms and standards. It is important to mention that the personnel that carry out the evaluations and interventions are experts in their respective areas and that those necessary for the development of a protocol or intervention were trained. In addition, the evaluator of the actions related to the PTK and the IE (offensive, defensive, and global) must demonstrate and achieve a good stability, which will be obtained and calculated through test-retest, once the evaluator achieves a score for above 0.6 the PTK evaluation process will continue in the research.

Confounding Bias Control

To avoid these biases, confounding variables (age, sporting age, playing position, socioeconomic status, educational level, mass, BMI, and mental fatigue) will be controlled. The study has masking (blinding) at two levels (assessments and data analysis).

Analysis of data

To establish the distribution of the data of the quantitative variables, the Shapiro-Wilk test will be applied. The variables that present a normal distribution will be summarized with means and standard deviation. Variables that present a non-normal distribution will be summarized with medians and interquartile ranges. Likewise, the qualitative variables will be presented in absolute and relative frequency tables.

To establish the behavior of the offensive, defensive, and global IE, a repeated measures design will be carried out that includes 4 evaluations over time (pretest, intermediate test 1, intermediate test 2 and posttest). For this, an ANOVA of repeated measures or the Friedman test will be used according to the normality of the variables, in addition, the assumption of homogeneity of the variances will be evaluated based on the Levene statistic. Since different dependent variables will be evaluated, a multivariate analysis of variance (MANOVA) will also be performed.

For the variables related to executive functions, an intragroup analysis of each of the groups (GE and GC) will be carried out, comparing the pretest and posttest values to establish possible differences, for which the dependent student t test or the Wilcoxon test of according to its distribution. In addition, an intergroup analysis will be carried out to compare the possible differences between the groups (GE and GC), for which the student t test for independent samples or the Mann Whitney U test will be applied according to the distribution of the variables. Similarly, confidence intervals (CI95) and two-tailed effect sizes will be reported, with alpha (α) set to 0.05 and statistical power 0.8 (1-β). The statistical significance value is set at $p \leq 0.05$. An analysis of the information will be carried out using the statistical package SPSS version 27 and the software R free version 4.0. Procedures will be carried out to detect possible inconsistencies in the measurements and to identify outliers and extreme values. Likewise, if necessary, statistical adjustments will be made. Intention-to-treat analysis will be performed.