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Effects of different training methods on soccer players' balance and muscle performance

Submission date
05/03/2025

Recruitment status
No longer recruiting

Registration date
01/04/2025

Overall study status
Completed

Last Edited
01/04/2025

Condition category
Other

[ ] Prospectively registered
[ ] Protocol
[ ] Statistical analysis plan
[ ] Results
[ ] Individual participant data
[ ] Record updated in last year

Plain English summary of protocol

Background and study aims
Interlimb asymmetry in postural control is associated with deficits in athletic performance and an increased injury risk. It has been shown that unilateral balance training (BT) enhances balance and neuromuscular performance in the trained and untrained leg and thus has the potential to reduce side-to-side differences. However, it is unresolved how effective unilateral single-mode BT is compared to unilateral combined balance and plyometric training (BT-PT) in reducing interlimb asymmetry. Thus, this study examines the impact of both training modalities on soccer players' interlimb asymmetry in balance and neuromuscular performance.

Who can participate?
Healthy male sub-elite young soccer players aged between 11 and 16 years old

What does the study involve?
Participants were randomly assigned to a unilateral single-mode BT group, a unilateral combined BT-PT group or an active control group. All groups trained for nine weeks (2 sessions/week, 30 minutes/session) with their non-dominant leg (i.e., stance leg while kicking a ball). Before and after this period, performance in the Y Balance Test – Lower Quarter (YBT–LQ) and the single leg drop landing (SLDL) test as well as leg muscle activity were assessed. The magnitude of interlimb differences was quantified by calculating the limb symmetry index (LSI) and compared using repeated measures analysis of variance.

What are the possible benefits and risks of participating?
The benefits are improvements in dynamic postural control and muscle activation. There are no risks of participating.

Where is the study run from?
University of Duisburg-Essen, Institute for Sport and Exercise Sciences, Germany

When is the study starting and how long is it expected to run for?
April 2020 to October 2024

Who is funding the study?
The German Research Foundation (Deutsche Forschungsgemeinschaft)

Who is the main contact?
Prof Thomas Muehlbauer, thomas.muehlbauer@uni-due.de

Contact information

Type(s)
Public, Scientific, Principal investigator

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Additional identifiers

Study information

Scientific Title
Impact of unilateral single-mode balance training versus combined balance and plyometric training on soccer players' interlimb asymmetry in balance and neuromuscular performance

Study objectives
Both unilateral single-mode BT and unilateral combined BT-PT would lead to improvements in soccer players' interlimb asymmetry in balance and neuromuscular performance. However, the effects would be greater for the latter training modality due to complementary adaptations caused by the combination of balancing and explosive power activities.

Ethics approval required
Ethics approval required

Ethics approval(s)
Approved 04/06/2020, The Human Ethics Committee at the University of Duisburg-Essen, Faculty of Educational Sciences (Universitätsstraße 2, Essen, 45141, Germany; +49 02011837237; ethik-psychologie@uni-due.de), ref: TM_04.06.2020

Primary study design
Interventional

Study design
Interventional randomized controlled trial

Study type(s)
Treatment

Health condition(s) or problem(s) studied
Promotion of physical fitness

Interventions
Single-mode balance training (BT) versus combined balance and plyometric training (BT-PT)
The study employed cluster randomization based on under age category, i.e., U13, U15, and 17. The three groups complete a 9-week (2 sessions/week, 30 minutes per session) in-season intervention period instructed and supervised by the respective athletic coach of the club. The unilateral single-mode BT group performed static and dynamic exercises using balance boards, spinning tops, BOSU balls, and balance pads while standing on the non-dominant leg (i.e., stance leg while kicking a ball). One set of exercises consisted of four repetitions of 60–90 s exercise duration alternated with 30 s rest periods. Difficulty of BT was increased by extending the duration per exercise and by manipulating the sensory input (i.e., transfer from standing on firm /stable to foam/unstable surface). For the unilateral combined BT-PT group, each training session was divided into two parts. The first part consisted of the exercise description mentioned before, but reduced to two repetitions of 60–90 s exercise duration per set of exercise, and the second part included vertical, horizontal, and lateral plyometric tasks (e.g., box, hurdle, squat jumps). Training progression was ensured by an incremental increase of jump height from 10 to 25 cm. The participants of the active control group conducted passive and active stretching exercises for the upper (i.e., core, pectoral, and shoulder muscles) and lower (i. e., calf, quadriceps, hamstring, and hip muscles) body. Each set of exercises involved four repetitions of 30–40 s exercise duration alternated with 30 s rest periods. The stretching programme was intensified by increasing the duration of a single exercise and by changing from static to dynamic movement execution. Additionally, all three groups performed their regular training routine that consisted of soccer-specific training (360–420 minutes/week) and athletic training (90–180 minutes/week) and one game per weekend.

Intervention Type
Behavioural

Primary outcome(s)
Dynamic balance and neuromuscular control in the lower extremities is measured using the Y Balance Test – Lower Quarter (YBT–LQ) and the single leg drop landing (SLDL) test at the pretest and following 9 weeks of training at the posttest.

Key secondary outcome(s)
Leg muscle activity for the tibialis anterior, soleus, gastrocnemius medialis, and peroneus longus muscles is measured using surface electromyography at the pretest and following 9 weeks of training at the posttest.

Completion date
01/10/2024

Eligibility

Key inclusion criteria
All players were free of any musculoskeletal dysfunction, neurological impairment, or orthopaedic pathology within the preceding three months, and they played in the highest league for their age category

Participant type(s)
Healthy volunteer

Healthy volunteers allowed
No

Age group
Child

Lower age limit
11 Years

Upper age limit
16 Years

Sex
Male

Total final enrolment
64

Key exclusion criteria
1. Musculoskeletal dysfunction within the preceding three months
2. Neurological impairment within the preceding three months
3. Orthopaedic pathology within the preceding three months

Date of first enrolment
01/03/2024

Date of final enrolment
20/03/2024

Locations

Countries of recruitment
Germany

Study participating centre
SG Dynamo Dresden e. V.
Lennéstraße 12
Dresden
Germany
01069

Sponsor information

Organisation
Deutsche Forschungsgemeinschaft

ROR
https://ror.org/018mejw64

Funder(s)

Funder type
Research organisation

Funder Name
Deutsche Forschungsgemeinschaft

Alternative Name(s)
German Research Association, German Research Foundation, Deutsche Forschungsgemeinschaft (DFG), DFG

Funding Body Type
Government organisation

Funding Body Subtype
National government

Location
Germany

Results and Publications

Individual participant data (IPD) sharing plan
The dataset generated and/or analysed during the current study will be available upon request from Thomas Muehlbauer, thomas.muehlbauer@uni-due.de.
The type of data that will be shared: behavioral data as *.xlsx file
Timing for availability: 30/06/2025
Whether consent from participants was required and obtained: written informed consent was obtained
Comments on data anonymization: via personal ID
Any ethical or legal restrictions: none (see ethical approval)
Any additional comments: none

IPD sharing plan summary

Available on request

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Participant information sheet			07/03/2025	No	Yes