

# INPLASY PROTOCOL

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None declared.

## The Effect of Application of Asymmetry Evaluation in Competitive Sports: A Systematic Review

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**Review question / Objective:** The purpose of this review is to promote a more refined understanding of asymmetry in competitive sports and to explore the application of asymmetric assessment to performance, injury and rehabilitation. A systematic review of the literature was undertaken using the PubMed, Web OF Science and ScienceDirect databases, with all articles required to meet a specified criterion based on a quality review. The study quality scoring system developed was used by two evaluators to assess the grading article quality, and 22 articles fulfilled our eligibility criteria. The average quality assessment rate for selected articles in this systematic review is 94.4±6.3% (from 0.78 to 1.00). Asymmetry appears to promote physical performance in athletes engaged in upper limb movements, but it may lead to potential injuries and adversely affect performance in gait-related movements. When quantifying limb asymmetries among athletes in different sports, they were primarily used to examine the relationship between injury and return to sport, with mixed findings. Individual differences, experience, age, sex, measurement methods and different motor tasks have been shown to be the underlying causes of asymmetric measurement. Further research is necessary to determine the possible injury-inducing threshold of asymmetry in different sports and the specific relationship between asymmetry and performance.

**INPLASY registration number:** This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 05 August 2022 and was last updated on 05 August 2022 (registration number INPLASY202280023).

### INTRODUCTION

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understanding of asymmetry in competitive sports and to explore the application of asymmetric assessment to performance, injury and rehabilitation. A systematic

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**Condition being studied:** This review provides a comprehensive profile of the application of asymmetric assessment in Different types of competitive sports and its relationship with sports performance and injury. Although asymmetric monitoring may be implemented in low-level sports Settings, some studies of asymmetric assessment of non-athletes may have been excluded as this study only included peer-reviewed literature. However, from the studies identified, Currently, In the absence of higher consistency and validity of the conclusions of the included studies, confidence in the understanding of the relationship between asymmetry and performance, injury and function remains limited. Although the results highlight that asymmetry is detected in motion dominated by gait-related cycles and associated with motion injury, a specific critical threshold of asymmetry may cause injury has not been identified. Asymmetry

seems to positively affect athletic performance, as demonstrated in upper limb athletes, although conclusions have remained inconsistent. The cumulative body of literature indicates large individual differences exist in asymmetrical measurement between athletes' limbs, experience, age, gender and different sports tasks have also been proved to be the potential causes of asymmetrical measurement. The results of this systematic review emphasize the complexity of inter-limb asymmetries and the relationship between the asymmetrical application and sports performance and injury. Future studies should aim to report specific asymmetric thresholds that may cause injury in different motor tasks and to assess the effect of symmetry on motor performance.

## METHODS

**Participant or population:** The specific athlete categories of sports studies include: sprinting players (6), different sports players (4), soccer (2), Walking race players (1), Long-distance running players (1), Rowing players (1), archers (1), overhead sports player (1), cricket (1), Racing wheelchair player (1), paralympic powerlifting (1), pole vault player (1), rugby player(1).

**Intervention:** SA was used as an assessment tool for asymmetry in 8 studies and 6 studies used the method of SI (3 studies) and two side differences (3 studies), respectively. 5 studies used general statistical check approaches to identify asymmetries, ANOVA (2 studies), N-K procedures (1 study), FANOVA (1 study), W M-Pairs Signed (1 study) and Separate analyses of variance (1 study).

**Comparator:** A more refined understanding of asymmetry in competitive sports and to study their correlation with sports performance measurement and sports injuries. It also analyzes the evaluation methods of athletes' asymmetry in competitive sports.

**Study designs to be included:** This method is commonly used to evaluate studies conducted in an exercise-based training environment. The study quality scoring system developed by Black et al., 2016 was used by two evaluators (Zixiang Gao and Chengyuan Zhu) to assess the grading article quality.

**Eligibility criteria:** We set up two independent authors to perform and complete the abstract and text screening process (Zixiang Gao and Chengyuan Zhu). Another author as an independent arbitrator in the event that an opinion can not be reached (Gusztáv Fekete). Studies that meet the following criteria were excluded: (1) Participants were included in recreational sports groups rather than competitive athletes; (2) The athletes had a physical injury during the test. (3) Studies that scored less than 75%. Endnote X9 (Thomson Reuters, Carlsbad, California, USA) was used to perform article collation, and duplicate articles delete functions.

**Information sources:** This review was conducted based on the Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines (PRISMA). A thorough computer-aided literature search of the database of PubMed(all years), Web OF Science(1960-present) and ScienceDirect (all years) were performed until 19 February 2022, to identify all relevant studies, using the keywords ('biomechanics' OR 'kinetics' OR 'kinematics') AND ('symmetry' OR 'asymmetry' OR 'symmetric') AND ('athlete' OR 'player' OR 'competition' OR 'match'). The effects of symmetry assessment on different modes of competitive performance and injury.

**Main outcome(s):** The study quality scoring system developed was used by two evaluators to assess the grading article quality, and 22 articles fulfilled our eligibility criteria. The average quality assessment rate for selected articles in this systematic review is 94.4±6.3% (from 0.78 to 1.00). Asymmetry appears to promote physical performance in athletes engaged in upper

limb movements, but it may lead to potential injuries and adversely affect performance in gait-related movements. When quantifying limb asymmetries among athletes in different sports, they were primarily used to examine the relationship between injury and return to sport, with mixed findings. Individual differences, experience, age, sex, measurement methods and different motor tasks have been shown to be the underlying causes of asymmetric measurement.

**Quality assessment / Risk of bias analysis:** The articles were evaluated using 9 different criteria(Score: 0-2), and total(Score: 0-18): (1) Inclusion criteria stated(Score: 0-2); (2) Subjects assigned appropriately (random/equal baseline); (3) Intervention described;(4) Dependent variables defined; (5) Assessments practical; (6) Training duration practical (acute vs. long term);(7) Statistics appropriate (variability, repeated measures); (8)Results detailed (mean, standard deviation, percent change, effect size); (9) Conclusions insightful(clean concise, future directions). Where each criterion is graded from 0(no) to 1(maybe) or 2(yes).

**Strategy of data synthesis:** In order to ensure the fairness of the quality assessment of the included studies, we evaluated the scores as a percentage (Range:0-100%). We set up two independent authors to perform and complete the abstract and text screening process (Zixiang Gao and Chengyuan Zhu). Another author as an independent arbitrator in the event that an opinion can not be reached (GusztávFekete).

**Subgroup analysis:** The average quality assessment rate for selected articles in this systematic review is 94.4±6.3%. Each of these studies stated the inclusion criteria and the dependent variables tested in their respective studies. The best-reported criterion was" Results detailed (mean, standard deviation, percent change, effect size)" and" Conclusions insightful (clean concise, future directions)" and the least reported criterion was "Inclusion criteria

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stated". As shown in figure 2(A), the grade of average quality assessment of "Training Duration practical", "Statistics appropriate", and "Results Detailed" was 2 (yes). The grade of "Inclusion criteria stated" and "Intervention described" in ball sports is the lowest (averagequality=1.33).

**Sensitivity analysis:** we identified 8 studies related to the asymmetry in gait related sports. Moreover, seven of 22 articles describing the assessment of asymmetry in upper limb sports were included in the systematic review. In addition, 4 studies involved participants in different competitive sports. We identified 3 (2 soccer and 1 rugby) studies related to the asymmetry in ball sport athletes. As shown in figure 2(B), we identified 6 studies on the variables of asymmetry on sprinter performance, 4 studies on different sports and 2 on soccer. The number of analyzed kinetic and kinematics asymmetries was the highest among all the included studies, 14 and 13, respectively. 9 studies analyzed the spatiotemporal asymmetry in athletes (figure 2(C)). In addition, SA was used as an assessment tool for asymmetry in 8 studies and 6 studies used the method of SI (3 studies) and two side differences (3 studies), respectively. 5 studies used general statistical check approaches to identify asymmetries, ANOVA (2 studies), N-K procedures (1 study), FANOVA (1 study), W M-Pairs Signed (1 study) and Separate analyses of variance (1 study), as shown in figure2(D).

**Country(ies) involved:** China, Hungary.

**Keywords:** Asymmetry, Athletes, Competitive sports, Gait, Upper limb.

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