

# INPLASY

## The Impact of Heading on the Brain in Soccer Players – A Systematic Review

INPLASY202520004

doi: 10.37766/inplasy2025.2.0004

Received: 1 February 2025

Published: 1 February 2025

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### ADMINISTRATIVE INFORMATION

**Support** - None.

**Review Stage at time of this submission** - Completed but not published.

**Conflicts of interest** - None declared.

**INPLASY registration number:** INPLASY202520004

**Amendments** - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 1 February 2025 and was last updated on 1 February 2025.

### INTRODUCTION

**Review question / Objective** Systematize how the impacts associated with heading in soccer may affect the structural and functional integrity of the brain, cognitive performance such as memory, attention, processing speed, as well as motor skills such as balance and coordination in soccer players.

**Rationale** Heading is a fundamental technique in soccer, frequently used in both matches and training sessions. However, there is growing concern about the potential damage caused by repetitive head impacts, which has led to an increased interest in understanding the consequences of these impacts on players health. While head impacts in contact sports such as Rugby, Boxing, and American Football have been widely studied, the specific effects of heading in soccer are still poorly understood.

A systematic review on this topic is essential to assess the available evidence, identify gaps in current knowledge, and provide a scientific basis to inform changes in aspects such as game rules or the development of protective equipment. In summary, this study can help guide strategies for risk prevention and mitigation, promoting safer soccer practices.

**Condition being studied** Studies involving football players of all age groups, genders, and competitive levels (amateur and professional) will be considered, both in recreational and competitive contexts. This includes matches and training sessions where exposure to heading is recorded or monitored. Additionally, laboratory studies simulating heading will be included, provided they assess outcomes aligned with the established criteria.

### METHODS

**Search strategy** The search strategy was used with the following combination of keywords: in Title/ Abstract (Soccer heading and brain injury) or (soccer and head trauma and cognitive effects) or (repetitive brain injury and football) or (repetitive head impacts and football) or heading or (head impact and football) or (soccer and concussion) or brain injury or traumatic brain injury NOT (rugby or boxe or american football or ice hockey).

**Participant or population** Soccer players, no age or gender limitations.

**Intervention** Exposure to heading in soccer.

**Comparator** Disorders in structural and functional integrity of the brain, cognitive performance such as memory, attention, and processing speed, as well as motor skills such as balance and coordination in soccer players.

**Study designs to be included** Without limitation of the studies to be included.

**Eligibility criteria** Inclusion: Healthy soccer players (of any age or gender); Exposure to heading in soccer; Studies related solely to soccer; Studies indicating the effects of heading exposure; Written in English; Original articles.

Exclusion: Players with a clinical history associated with trauma from collisions with other players (neurological disorders, vestibular dysfunction, traumatic brain injury); goalkeepers; non-soccer players; studies that do not present neurological outcomes.

**Information sources** Electronic Database: PubMed; Web of Science; Scopus; SPORTDiscus; Scielo.

**Main outcome(s)** The main outcomes to be analyzed include those related to neurological and physical impacts:

- (i) Outcomes associated with brain and neurological injuries, such as concussions and other brain damage.
- (ii) Outcomes involving cognitive and functional changes, including alterations in cognitive abilities such as memory, attention, information processing, and executive functions.
- (iii) Outcomes affecting physical performance, such as strength, agility, endurance, speed, and reaction time.

**Additional outcome(s)** Other relevant outcomes may include neuropsychiatric symptoms, encompassing potential behavioral changes such

as aggressiveness, irritability, depressive symptoms, anxiety, and mood alterations. Additionally, long-term outcomes will be considered, focusing on the effects of repeated heading throughout players' careers, with particular attention to the early onset of dementia-related signs or other neurodegenerative conditions, such as Alzheimer's or Parkinson's disease. The assessment of long-term risk will be based on longitudinal studies.

**Quality assessment / Risk of bias analysis** The DOWNS AND BLACK CHECKLIST (Downs & Black, 1998) was used to assess the methodological quality of the included studies. This instrument consists of 27 items distributed across five main categories:

- (i) Reporting of results (Items 1 to 10);
- (ii) External validity (Items 11 to 13);
- (iii) Internal validity—bias (Items 14 to 20);
- (iv) Confounding factors (Items 21 to 26);
- (v) Study power (Item 27).

**Strategy of data synthesis** The synthesis will be based on the quantitative data from the studies included in this review, with the aim of integrating and interpreting the results obtained. The extracted information will include details such as sample size, analyzed variables, instruments used, number of headers, and main conclusions. Additionally, complementary data, including the total number of participants (n), age range, competitive level (when available), and gender, will be collected. This information will be organized into tables to facilitate analysis. If comparable data are identified among the studies, a meta-analysis will be conducted to determine the combined effect size.

**Subgroup analysis** Subgroup analyses will be conducted to explore potential variations in the effects of heading among soccer players, considering factors such as age group (young vs. adults), gender (male vs. female), level of experience (amateurs vs. professionals), position on the field (defender, midfielder, forward), and frequency of exposure to heading (high vs. low). The goal of these analyses is to determine whether certain groups are more vulnerable to the impacts associated with heading.

**Sensitivity analysis** A sensitivity analysis will be conducted to assess the robustness of the findings. This will involve excluding studies with high risk of bias and reanalyzing the data to determine whether the results remain consistent.

**Language restriction** English.

**Country(ies) involved** Portugal.

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**Keywords** heading risks; soccer; football and health; concussion; repetitive heading.

**Contributions of each author**

Author 1 - Fábio Santos - FMC lead the project, wrote and revised the original manuscript and RRC analyzed and interpreted the data, wrote the statistical report and revised the original manuscript.

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