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Unveiling biophysical characteristics in triathlon: a systematic review

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ADMINISTRATIVE INFORMATION

Support - There was no financial support.

Review Stage at time of this submission - The review has not yet started.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 28 January 2025 and was last updated on 28 January 2025.

INTRODUCTION

Review question / Objective This review aims to systematically summarize the available literature on the biophysical assessment of a continuous triathlon effort, whether in isolated disciplines or full race simulations.

Rationale Triathlon is a growing sport composed of many race distances varying from super sprint (400m swim, 10km bike and 2.5km run) to ultra-triathlons. Regardless of the distance, a triathlon race is a multidisciplinary endurance event requiring a continuous effort of swimming, cycling and running. Although there are studies across different disciplines, there is a lack of consolidated and detailed information about biomechanical and physiological assessment of triathlon events. Therefore, the aim of this review is to summarize all scientific evidence about biomechanics and

physiology within the spectrum of triathlon events, triathlete's characteristics and disciplines, to understand in more detail the biophysical effort of a such demanding sport.

Condition being studied The biophysical responses of healthy mature competitive triathletes during different triathlon events.

METHODS

Search strategy This systematic review will follow the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement. The Boolean search method (including AND/ OR) will be used to search literature related to the biophysical assessment of triathlon athletes combining several terms (triathlon, discipline, swim, cycle, run, athlete, biomechanics, physiology, kinematics, kinetics, biophysics, performance). The terms in database search

(PubMed, Scopus and Web of Science) must be present in the title, abstract or keywords. Search lines selected will contain: (1) (“triathlon”); AND (2) (“biomech*”); AND (3) (“physiology”); AND (4) (“kinetics”); AND (5) (“kinematics”) AND (6) (“effort”); AND (6) (“perform*”).

Participant or population The population will include healthy mature competitive triathletes, with an age of ≥ 15 years old, and will exclude all spectrum of disabled triathletes and athletes from other disciplines (e.g., swimmers, cyclists, runners).

Intervention The intervention will include biomechanical or physiological assessment of a continuous triathlon effort in isolated disciplines or a full race.

Comparator Comparison will be provided with triathlete’s characteristics (e.g., age, sex), triathlon events (e.g., distances and conditions) and disciplines (i.e., type of triathlon duration). Comparisons between different sports, environmental conditions, equipment and training methods will be excluded.

Study designs to be included The study designs to be included are experimental cross-sectional and longitudinal. Retrospective and prospective studies will be excluded.

Eligibility criteria Peer-reviewed articles searching the current review scope will be eligible, without restrictions on language (as long as the studies include the title and abstract written in English). Nonpeer-reviewed articles/ journals, reviews (qualitative review, systematic review, meta-analysis), books, book chapters, commentaries, editorials, letters to the editor, overviews, conference abstracts, dissertations, thesis or trial registrations will be excluded from the analysis. According to PRISMA 2020 guidelines, eligibility criteria will be designed with PICOS (population, intervention, comparison, outcome and study design) framework.

Information sources The initial search will be conducted in three electronic databases (PubMed, Scopus, Web of Science). There will be no restrictions on language (as long as the title and abstract of the studies are written in English) or publication date, and no filtering application to increase the chances of identifying appropriate studies. After data extraction, an additional search will be performed through manual search and expert consultation.

Main outcome(s) The outcomes will include effects on energetics, cardiovascular demands, aero/hydrodynamics and technical profile (e.g. biomechanical variables, heart rate, lactate levels, VO₂max). Temporal analysis (e.g., race times) or other domains will be excluded.

Additional outcome(s) None declared.

Data management Database screening will be realized by two reviewers using a manual search method. Duplicate removal will be performed automatically using EndNote 20.6 for Windows (Clarivate™, Philadelphia, PA, USA). Two reviewers will complete an independent initial data extraction, and, in case of disagreements, a third reviewer will provide arbitrage and meet with reviewers until consensus. Records will be extracted into a tailored Microsoft® Excel 2016 worksheet (Microsoft Corporation Redmond, WA, USA) created for data summary.

Quality assessment / Risk of bias analysis Two independent reviewers will perform the quality assessment. The Downs and Black Quality Assessment Checklist will be used based on the following criteria: (1) reporting; (2) external validity; (3) internal validity (bias and confounding); and (4) power. When necessary or appropriate, disagreements between reviewers will be solved by including a third reviewer.

Strategy of data synthesis Data will be grouped by the biomechanical or physiological outcomes and information will be synthesized by: (i) author(s) and year of publication; (ii) discipline(s); (iii) sample characteristics (e.g., age, age-group, sample size, sex); (iv) intervention characteristics (e.g. context, duration, session duration or distance); (v) assessments (number of assessments, aim and variables); (vi) main results.

Subgroup analysis We will not perform subgroup analysis.

Sensitivity analysis No analysis to report.

Language restriction There will be no restrictions on language (as long as the title and abstract of the studies are written in English), imposed on inclusion criteria.

Country(ies) involved Portugal - Centre of Research, Education, Innovation and Intervention in Sport (CIFI2D), Faculty of Sport, University of Porto, Porto, Portugal; Porto Biomechanics Laboratory (LABIOMEPE), Faculty of Sport, University of Porto, Porto.

Keywords Triathlon; biophysics; biomechanics; physiology; effort; performance.

Dissemination plans The systematic review will be submitted and published in an international peer-reviewed journal with impact factor and disseminated in sport sciences related scientific conferences, if appropriate.

Contributions of each author

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