OPEN WATER SWIMMING RESEARCH: A COMPREHENSIVE BIBLIOMETRIC REVIEW OF TRENDS, GAPS, AND FUTURE DIRECTIONS

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Review
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Abstract:

This bibliometric review examines the scientific literature on open water swimming, aiming to identify key themes and research trends up to December 2024. A comprehensive search was conducted across several databases, including SciELO, PubMed, Scopus, and Web of Science, using descriptors such as *athletes*, *swimming*, *open water*, *marathon swimming*, and *ultra-distance*. The review focused on full-text articles published in English, specifically analysing studies involving athletes competing in official 5, 10 and 25 km race distances at world championships and the Olympic Games, while excluding research on pool-based swimming, triathlon, and literature reviews. The analysis reveals a predominance of quantitative, observational studies, with a clear emphasis on performance monitoring and pacing strategies. These studies predominantly involve elite athletes (concentrated in the early-to-mid-twenties age range). Within the studies included in this review, topics such as hypothermia and probiotics appeared less frequently, possibly reflecting the challenges of conducting experimental studies in real open-water settings. Despite the growing popularity of open water swimming, as evidenced by the increasing number of registered competitions, research has been disproportionately focused on elite athletes, leaving a gap in the understanding of amateur participation. This review highlights critical gaps in research, particularly in the areas of sports psychology, physiology, biomechanics, nutrition, and safety of athletes. Among the studies conducted in real-world open-water settings included in this review, the limited number of experimental investigations presents an opportunity for future research to develop interventions aimed at enhancing both performance and safety while addressing the diverse needs of swimmers across competitive levels.

Keywords: *marathon swimming, literature review, sports discipline*

Introduction

Open water swimming can be defined as the act of swimming in oceans, lakes, or rivers, conducted in either circuit or straight-line courses over varying distances (World Aquatics, n.d.). Its origins date back to antiquity, and over the years, it has evolved into a competitive and structured sport. In the competitive realm, open water swimming was propelled by several historical milestones, such as the crossing of the English Channel (33.7 km), one of the first classic races, and the introduction of the event at the 2008 Beijing Summer Olympics with the 10-kilometre marathon swim (IOC, n.d.). Currently, the official distances in world championships and the Olympic Games are 5, 10, and 25 km. The increased visibility and recognition of open water swimming has resulted in significant growth in the number of participants, primarily driven by greater involvement of athletes of different age-ranges and a substantial rise in female participation (Rodríguez-Adalia, Veiga, Santos Del Cerro, & González-Ravé, 2021).

The existing literature on this sport is diverse, covering a broad range of topics that reflect its complexity. In addition to studies on the historical context (Gerrard, 1999), there is a vast amount of research focused on the physiology and health of practitioners, investigating cardiovascular aspects (Martinez, et al., 2019), thermoregulation (Chalmers, Shaw, Mujika, & Jay, 2021), nutrition (Shaw, Koivisto, Gerrard, & Burke, 2014) and the prevention of infections and waterborne diseases (Chamberlain, Marshall, & Keeler, 2019). There are also studies investigating physical performance and sports training, which have garnered significant attention from researchers, whether in analysing

efficient techniques (Rodríguez, Veiga, García, & González-Ravé, 2021), training programmes (Baldassarre, Bonifazi, Meeusen, & Piacentini, 2018a) or the use of innovative technologies to enhance athletes' physical and sporting performance (Pla, et al., 2021). Additionally, safety and accident prevention are a critical area, with studies addressing the risks associated with practicing sport in natural environments and strategies to mitigate them (Di Masi, Costa e Silva, Mello, Szpilman, & Tipton, 2022). Sports psychology also presents studies on topics of interest, exploring the well-being of practitioners (Massey, et al., 2020), stress, and other psychological variables (Overbury, Conroy, & Marks, 2023).

Considering the growing number of participants, numerous benefits, and the representation in the global sports arena, it becomes crucial to understand the current state of scientific production in the sport. From this knowledge, it is possible to establish proposals aimed at the continuous development and improvement of the sport. In this sense, a bibliometric review emerges as a systematic and quantitative method to evaluate and analyse the existing scientific production (Ball, 2018). Its main goal is to provide a comprehensive overview of the state-of-the-art, identifying trends, patterns, or gaps that may guide future research. Widely recognised by researchers, this approach uses specific methods, including temporal, authorship, thematic, or keyword analyses (Romanelli, et al., 2021).

Some bibliometric reviews have already been conducted in other water sports, such as surfing (Pérez-Gutiérrez & Cobo-Corrales, 2020), artistic swimming (Rincón, Trinidad, & López-Valenciano, 2023), swimming (Morais, et al., 2024) and swimming from a medical perspective (Demir, et al., 2022). However, when specifically analysing open water swimming, no study with this design was found, especially when focusing on the distances of world championships and Olympic Games' official races (5, 10, and 25 km). Thus, this study aimed to conduct a bibliometric review of the scientific literature on open water swimming, identifying and analysing the main subjects and research topics addressed.

Method

Data collection

The search was conducted in the following databases: Scientific Electronic Library Online (SciELO), PubMed, Scopus, and Web of Science. The following descriptors were used: athletes; swimming; swimmer; open water; marathon swimming; ultra-distance. These descriptors were explored in the title, abstract, and keyword fields, without setting a temporal starting point for the search, which concluded in December 2024. The complete database-specific search strategies, including Boolean operators and exclusion terms, are presented in the Supplementary Material.

Study eligibility

As inclusion criteria, the study considered only full articles published in English, whose studied population was explicitly composed of practitioners and/or athletes competing in official World Aquatics open water events (5, 10 and 25 km). Exclusion criteria included literature review studies, studies not available in full, studies where pools were used (either for training, evaluation, or competitions), and those addressing open water swimming in conjunction with other sports modalities, such as triathlon.

The search results were transferred to the Rayyan application (Ouzzani, Hammady, Fedorowicz, & Elmagarmid, 2016). After identifying possible duplicate articles, they were analysed based on the aforementioned criteria by two independent reviewers (GTO and RMF), who were previously trained. Initially, the reviewers analysed the titles and abstracts of the selected articles. Subsequently, pertinent articles were subjected to a full-text review. In cases of disagreement between the initial evaluations, the third reviewer (ERS) was consulted.

For the analysis, relevant information was identified and extracted, such as the year of publication, journal name, and publication location (state, country, and institution according to the corresponding authors' research centres). Additionally, the studies were categorised according to the following areas of knowledge: Motor Learning and Development, Biomechanics, Exercise Physiology, Sport Psychology, Sports Training, and Health and Aquatic Safety. Other recorded information included the specific theme addressed (determined *a posteriori* based on the title, abstract, and study objective), participant profile (sex, age, population type, athlete level), and race characteristics (distance, location, temperature, wetsuit requirement).

Furthermore, the study's nature (qualitative, quantitative, or mixed-methods), adopted design (experimental or observational), and type of study were documented. Quantitative studies were further classified following the study-design taxonomy described by Thomas, Nelson, and Silverman (2015). Observational designs were categorised as descriptive (cross-sectional) or analytical (case-control and cohort), and experimental (interventional) designs as randomised controlled trials, non-randomised controlled trials, and single-group pre-post designs.

Cluster analysis and world map drawing

A term co-occurrence analysis (also termed co-word analysis) of the keywords assigned by the

authors of the included articles was performed using the R software. This analysis processes bibliometric data and generates distance-based maps that visualise relationships between terms, facilitating the interpretation of results (Luther, Tiberius, & Brem, 2020).

The website (paintmaps.com) was used to create the world map. The country of the corresponding author's research centre was considered to calculate the number of publications by country, which was then highlighted in grey on the map.

Results

Figure 1 presents the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart, detailing the study selection process. Out of the 2,912 records initially identified from the databases, only 17 studies (0.58%) met all the inclusion criteria and were included in the review.

Table 1 provides an overview of the studies selected based on the inclusion criteria. In this study, 17 articles were classified as eligible. Temporally, these publications spanned the period from 2004 to 2024. Regarding the methodological approach used, it was observed that only one study (5.88%) adopted a quantitative approach with an experimental design and 16 studies (94.12%) used a quantitative approach with an observational design. Overall, the main areas of investigation included performance analysis and pacing strategy, with the study problem being related, respectively, to performance monitoring and analysis, and the optimisation of pacing strategies during competitions.

Table 2 describes the characteristics of the selected studies, detailing the population, instruments used, measurements, and distances analysed in the races. Most studies involved elite athletes with mean age-range approximately from 18 to 29 years, with the majority of samples concentrated in the early-to-mid-twenties, although some studies did not report specific age ranges. Regarding the sex of the sample, most studies included both male and female athletes, while some predominantly involved male participants. The instruments used ranged from anthropometric methods, such as scales and stadiometers, to performance measurements through the analysis of pacing and tracking. The race distances covered ranged from 5, 10, and 25 km, with several studies investigating multiple distances.

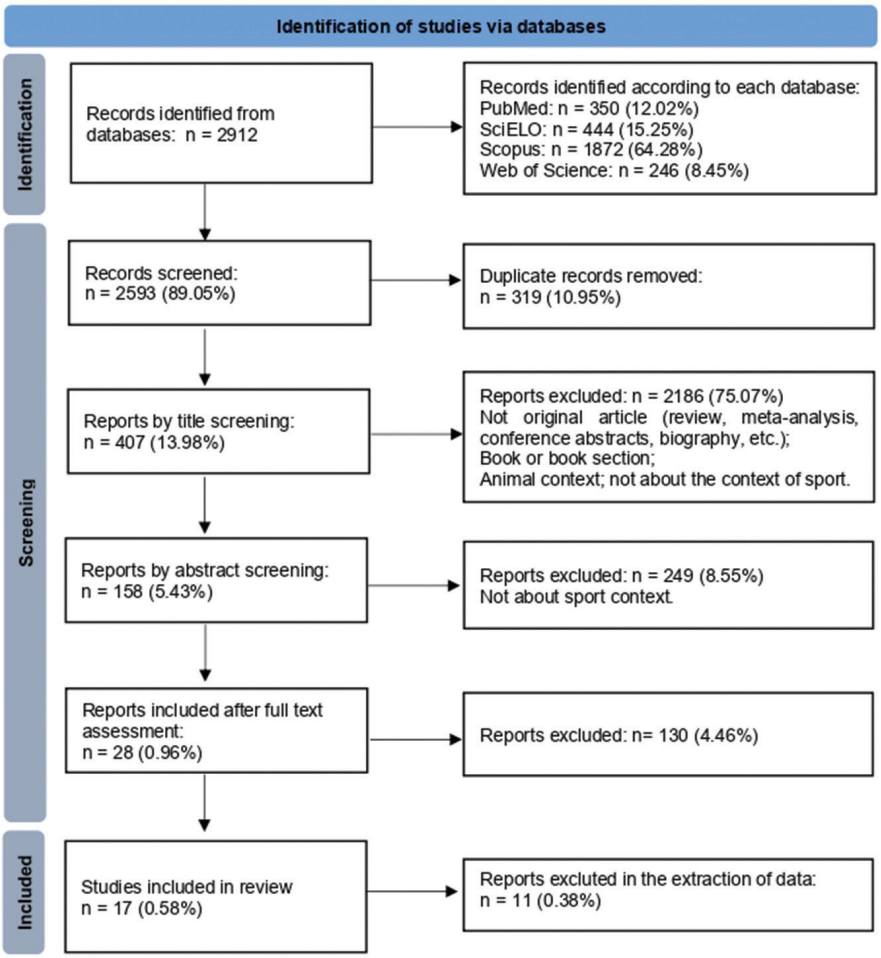


Figure 1. Process of identification, screening, eligibility and inclusion of the studies analysed.

Table 1. Overview of the studies selected based on the inclusion criteria

Year of publication	Name of the journal	Corresponding author's country	Nature and design of the study	Knowledge area
Matarazzo et al., 2024	International Journal of Morphology	Italy	Quantitative – Observational	Anthropometry / Morphology
Li et al., 2023	Heliyon	China	Quantitative – Experimental	Nutrition / Exercise Physiology
Rodriguez et al., 2021	International Journal of Environmental Research and Public Health	Spain	Quantitative – Observational	Performance Analysis / Pacing Strategy
Rodriguez-Adalia et al., 2021	Journal of Functional Morphology and Kinesiology	Spain	Quantitative – Observational	Longitudinal Performance Analysis
Seffrin et al., 2021	International Journal of Environmental Research and Public Health	Switzerland	Quantitative – Observational	Longitudinal Performance Analysis / Talent identification
Baldassarre et al., 2019	Journal of Functional Morphology and Kinesiology	Italy	Quantitative – Observational	Performance Analysis
Baldassarre et al., 2018b	European Journal of Sport Science	Italy	Quantitative – Observational	Pacing Strategy / Performance Analysis
Veiga et al., 2019	Frontiers in Psychology	Spain	Quantitative – Observational	Race Strategy / Pacing Strategy / Performance Analysis
Rodriguez and Veiga, 2018	International Journal of Sports Physiology and Performance	Spain	Quantitative – Observational	Pacing Strategy / Race Strategy / Performance Analysis
Shaw and Mujika, 2018	International Journal of Sports Physiology and Performance	Australia	Quantitative – Observational	Anthropometry / Performance Analysis
Saavedra et al., 2018	Kinesiology	Iceland	Quantitative – Observational	Pacing Strategy Analysis
Nikolaidis et al., 2018	Research in Sports Medicine	Switzerland	Quantitative – Observational	Sex Differences / Nationality Analysis / Performance Analysis
Zingg et al., 2014b	Extreme Physiology and Medicine	Switzerland	Quantitative – Observational	Longitudinal Performance Analysis
Zingg et al., 2014a	BMC Sports Science, Medicine and Rehabilitation	Switzerland	Quantitative – Observational	Sex Differences / Performance Analysis
Vogt et al., 2013	SpringerPlus	Switzerland	Quantitative – Observational	Longitudinal Performance Analysis / Sex Differences
Castro et al., 2009	Clinics	Brazil	Quantitative – Observational	Physiology / Health / Aquatic Safety
VanHeest et al., 2004	Journal of Strength and Conditioning Research	United States	Quantitative – Observational	Exercise Physiology / Anthropometry / Performance Analysis

Table 2. Characteristics of the selected studies, detailing the population, instruments used, measurements, and distances analysed in the races

Year of publication	Participants	Age (years)	Athlete Level	Data Source / Instruments	Outcome Measures	Race Distance
Matarazzo et al., 2024	15 M / 0 F	28.93±3.67	Elite swimmers	Scale, stadiometer, tape measure	Hand anthropometry	Not reported

Continuation of Table 2

Li et al., 2023	8 M / 7 F	18.32±4.41 (M) / 18.04±2.96 (F)	Elite swimmers	Faecal microbiota laboratory analysis	Gut microbiota composition	10 km
Rodriguez et al., 2021	10 km: 73 M / 64 F; 25 km: 22 M / 16 F	10 km: 23.90±4.19 (M); 23.35±3.96 (F); 25 km: 25.12±4.76 (M); 23.64±2.69 (F)	Elite swimmers	Official race results	Stroke rate and pacing	10 km / 25 km
Rodriguez-Adalia et al., 2021	738 M / 639 F	Not reported	Elite swimmers	Official race results	Longitudinal performance analysis	10 km
Seffrin et al., 2021	5 km: 740 M / 835 F; 10 km: 3,227 M / 4,249 F; 25 km: 323 M / 445 F	Not reported	Elite swimmers	Official race results	Nationality trends and performance analysis	5 km / 10 km / 25 km
Baldassarre et al., 2019	252 M / 232 F	Not reported	Elite swimmers	Official race results	Performance comparison	10 km
Baldassarre et al., 2018b	5 km: 242 M / 196 F; 10 km: 322 M / 255 F; 25 km: 114 M / 66 F	Not reported	Elite swimmers	Official race results	Split pacing and race performance	5 km / 10 km / 25 km
Veiga et al., 2019	5 km: 10 M / 10 F; 10 km: 10 M / 10 F; 25 km: 10 M / 10 F	Not reported	Elite swimmers	Official race results	Race strategy and pacing analysis	5 km / 10 km / 25 km
Rodriguez and Veiga, 2018	69 M / 51 F	Not reported	Elite swimmers	Official race results	Pacing strategy analysis	10 km
Shaw and Mujika, 2018	8 M / 7 F	22.90±3.20 (M) / 23.30±4.00 (F)	Elite swimmers	Scale, stadiometer, skinfold caliper	Anthropometric	5 km / 10 km
Saavedra et al., 2018	257 M / 180 F	Not reported	Elite swimmers	Official race results	Pacing strategy analysis	10 km
Nikolaidis et al., 2018	5 km: 1,342 entries (M:F ratio = 1.13); 10 km: 5,508 entries (M:F ratio = 1.32); 25 km: 618 entries (M:F ratio = 1.34)	Not reported	Elite swimmers	Official race results	Sex differences and nationality analysis	5 km / 10 km / 25 km
Zingg et al., 2014b	5 km: 521 M / 454 F finishes; 10 km: 643 M / 545 F finishes; 25 km: 298 M / 229 F finishes	M: ~25–27 years; F: ~22–24 years (age of peak performance)	Elite swimmers	Official race results	Longitudinal age-related performance analysis	5 km / 10 km / 25 km
Zingg et al., 2014a	5 km: 521 M / 454 F finishes; 10 km: 643 M / 545 F finishes; 25 km: 298 M / 229 F finishes	M: ~25–27 years; F: ~22–24 years (age of peak performance)	Elite swimmers	Official race results	Sex-difference and performance analysis	5 km / 10 km / 25 km
Vogt et al., 2013	1,471 M / 1,120 F race entries	Not reported	Elite swimmers	Official race results	Longitudinal performance analysis	10 km
Castro et al., 2009	7 M / 5 F	21.00±7.00	Elite swimmers	Thermometer, anthropometric assessment, glucometer	Core temperature and blood glucose responses	10 km
VanHeest et al., 2004	4 M / 4 F	18.60±1.50 (M) / 17.80±1.50 (F)	Elite swimmers	Metabolic cart, heart rate monitor, skinfold calliper, stadiometer	VO_{2peak}, lactate threshold, anthropometric assessment	5 km / 10 km / 25 km

Note. M = male; F = female; M:F ratio = male-to-female ratio of race entries. Race distances were considered according to either the population of the sample studied or the race times reported in the study.population of the sample studied or the race times reported in the study.

Table 3. Scientific descriptors and databases

Databases	Descriptors
Scopus	(TITLE-ABS-KEY (athletes) AND TITLE-ABS-KEY (swimming) OR TITLE-ABS-KEY (swimmer) AND TITLE-ABS-KEY (sports) OR TITLE-ABS-KEY (open AND water) OR TITLE-ABS-KEY (open AND water AND swim) OR TITLE-ABS-KEY (marathon AND swimming) OR TITLE-ABS-KEY (ultra AND distance) AND NOT TITLE-ABS-KEY (cycling) AND NOT TITLE-ABS-KEY (triathlon) AND NOT TITLE-ABS-KEY (athletics) AND NOT TITLE-ABS-KEY (soccer)) AND (LIMIT-TO (DOCTYPE , "ar"))
Pubmed	((athlete) OR (swimming) OR (Sport)) AND ("Open water " [All Fields] OR "Open water swim" [All Fields] OR "Open-water swimmers" [All Fields] OR "Ultra-distance" [All Fields] OR "Marathon swimming" [All Fields])
Scielo	(((atletas) OR (athletes) OR (swimming) OR (swimmer) OR (nadador) OR (nadadores)) OR (open water) OR (águas abertas) OR (open water swim) OR (marathon swimming) OR (ultra-distance) OR (maratona aquática) OR (ultradistância)) AND (sports) OR (esportes) AND in:("scl")
Web of Science	#1: (ALL=(Athletes) OR ALL=(Swimming) OR ALL=(Swimmer)) AND #2: (ALL=(Open water) OR ALL=(Open water swim) OR ALL=(Marathon swimming) OR ALL=(Ultra-distance)) AND #3: (ALL=(Sports) NOT ALL=(triathlon) NOT ALL=(athletics) NOT ALL=(cycling)) AND (DT==("ARTICLE") AND DT==("ARTICLE"))

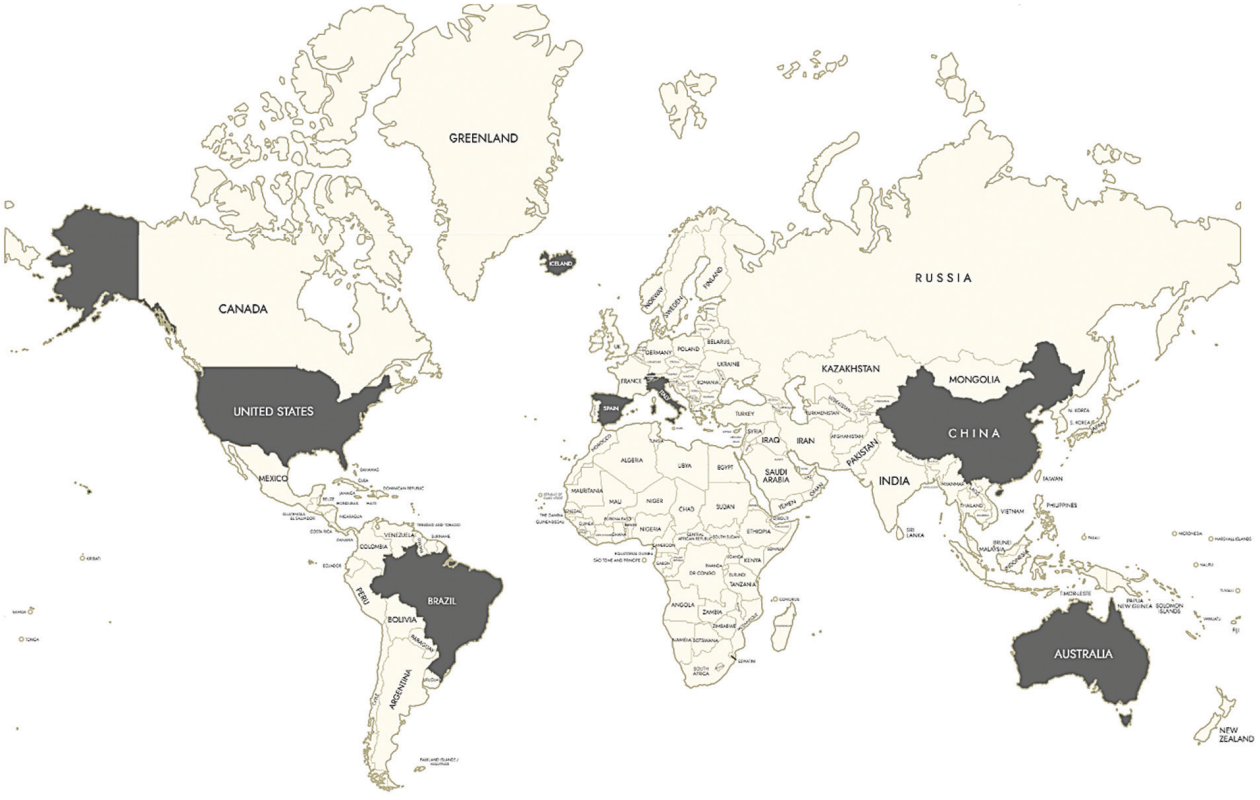


Figure 2. Location of the corresponding authors' research centres, according to the inclusion criteria adopted. Made with ultimaps.com.

When considering the inclusion criteria of this study and the country of the corresponding author's affiliation, it was observed that different research centres worldwide have investigated open water swimming. Most of the articles have corresponding authors affiliated with European countries, such as Italy (n=3), Switzerland (n=5), and Spain (n=4). Other contributions come from countries like Brazil (n=1), the United States of America (n=1), Australia (n=1), Iceland (n=1), and China (n=1). Figure 2 illustrates the geographical distribution of the studies included in the analysis.

Figure 3 presents the co-occurrence network of 68 keywords found in the field of analysis for this study. The size of the nodes corresponds to the number of occurrences of each keyword assigned

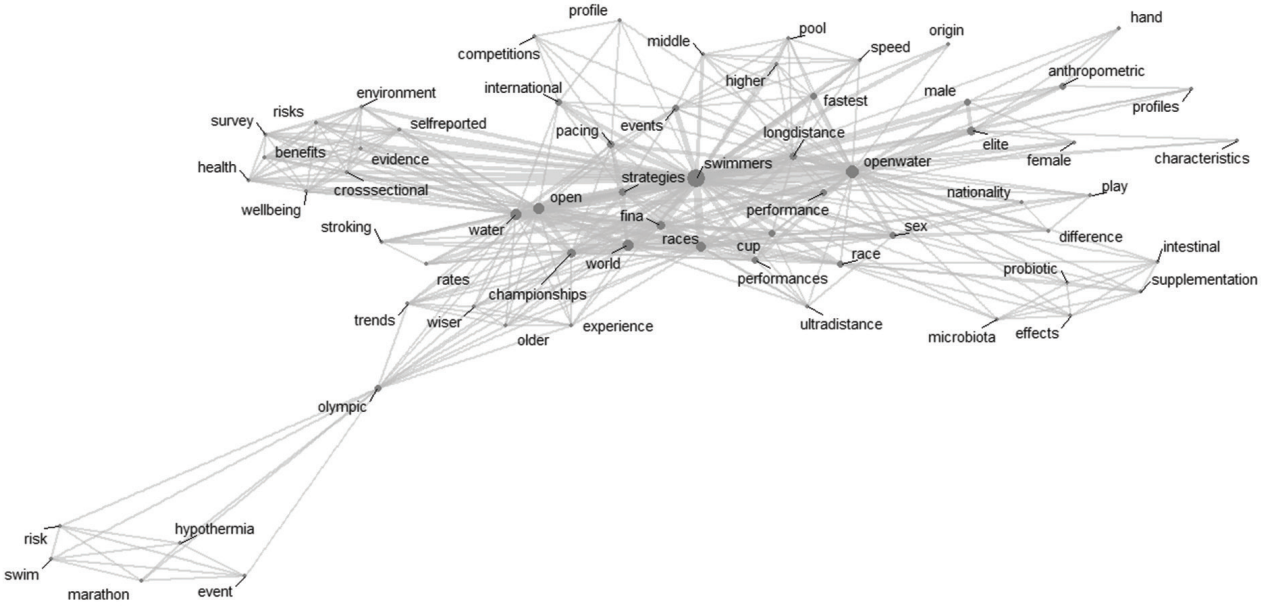


Figure 3. Co-occurrences of keywords found in the field of analysis of this study.

by the authors, which ranged from one to 10 occurrences. Thematic patterns were observed within the literature on open water swimming, highlighting an emphasis on topics such as performance, race strategies, and swimmer characteristics. High-frequency terms, such as *pacing*, *strategies*, and *performance*, occupied central positions in the network and exhibited numerous connections, indicating that these were key concepts widely discussed in the selected studies. The proximity between terms such as *tracking*, *pacing*, and *race* suggested that many studies focused on competition strategies and performance monitoring during races. Additionally, within the studies included in this review, terms such as *hypothermia* and *probiotic* appeared more isolated, reflecting specific topics with lower co-occurrence frequencies.

As regards water temperature and the use of suits in open water swimming competitions, in studies where temperature was reported, it ranged from 16.67 to 23.8°C. Furthermore, most studies did not provide information about the use of suits, though some indicated that neoprene suits were used when permissible, according to the World Aquatics guidelines (World Aquatics, n.d.)

Discussion and conclusions

The objective of this study was to conduct a bibliometric review of the scientific production on open water swimming, aiming to identify and analyse the main topics and areas of investigation addressed up to December 2024. The analysis selected a total of 17 studies, which revealed a predominance of quantitative and observational approaches, with a focus on tracking and pacing topics. These studies were temporally distributed from 2004 to 2024, with the sample profile mostly comprising elite athletes concentrated in the early-to-mid-twenties age range.

Within studies conducted in real-world open-water competitive settings, the predominance of quantitative and observational designs may be explained by the environmental and logistical characteristics of this sport. One of the main differences between open water swimming and pool swimming is that, in open water, the environment in which athletes compete is highly dynamic and unpredictable (Baldassarre, Bonifazi, Zamparo, & Piacentini, 2017). The authors further highlight in that review that factors such as visibility, weather conditions, and even the behaviour of other swimmers can significantly impact athletic performance. Conducting experimental studies in this context requires complex and specific logistics, such as the use of boats to individually monitor the performance of each athlete during experimental tests, a requirement that distinguishes it from other modalities.

If an experimental study must have a random distribution of subjects among treatments and a control group (Creswell & Creswell, 2018), it is believed that the difficulties are also related to logistics, such as transporting participants to the test site, ensuring safety by addressing risks such as drowning (Di Masi, et al., 2022), hypothermia, and contamination and managing other challenges. Furthermore, the requirement for advanced swimming skills complicates the participation of inexperienced individuals, those with low fitness levels, or those lacking swimming proficiency, which may explain the identification of studies involving athletes. These factors are believed to represent

significant barriers to conducting experimental studies.

On the other hand, observational studies allow researchers to analyse the actual behaviour of athletes during competitions without the need to manipulate race conditions or tests (Creswell & Creswell, 2018). The predominant focus of research on the topics of tracking and pacing highlights an emphasis on competition strategies and performance monitoring during races, suggesting that studies are strongly directed toward analysing how athletes manage their performance throughout the races and the strategies they use to optimise their results.

The term tracking refers to performance monitoring (Costa, et al., 2010), whereas pacing is related to the strategic management of swimming intensity (McGibbon, Pyne, Shephard, & Thompson, 2018). Tracking and pacing are fundamental concepts in cyclic and aerobic endurance sports, such as open water swimming. The interrelationship between tracking and pacing suggests that many studies focus on understanding how continuous monitoring can influence pace adjustment and, consequently, race strategy. The term race, in turn, is closely tied to these two aspects, as pacing strategies and tracking data are practically applied to improve performance in competitions (Baldassarre, et al., 2017).

Within the selected studies, the terms hypothermia and probiotic appeared more isolated in the keyword network, reflecting specific topics with lower frequency among the included articles. Although hypothermia is highly relevant in open water swimming, particularly in cold-water events, it appeared less frequently among the studies included in this review because experimental studies on the subject are challenging due to practical and ethical limitations (Castro, Mendes, & Nobrega, 2009; Keatinge, Khartchenko, Lando, & Lioutov, 2001; Nuckton, Claman, Goldreich, Wendt, & Nuckton, 2000). Controlled induction of hypothermia in experimental environments is difficult to simulate accurately, as real competition conditions are often unpredictable, involving swimmer interaction with turbulent water, unpredictable currents, varying depths, and the duration of cold exposure during races. Moreover, the health risks associated with inducing hypothermia in humans make these studies complex and ethically challenging to approve. The term probiotic, on the other hand, relates to nutritional supplementation, and alterations in the gut microbiota of athletes after competition appear to be an emerging field of study (Li, et al., 2023).

Regarding the studied population, the research focused on elite athletes, generally in their early-to-mid-twenties. This is a significant point, as it suggests that the conclusions drawn from these studies are more applicable to high-performance contexts, where rigorous control over training and race strategy is essential for success in competitions. Furthermore, the observed age variability reflects the sport's broad appeal, indicating that open water swimming attracts participants across a wide age range, involving individuals at different life stages and with varying levels of experience (Oliver, et al., 2023).

Finally, the fact that most studies are recent (from 2018 to 2024) highlights the growing interest in open water swimming as an expanding research field. In recent years, there has been an increase in the number of competitions, the visibility of the discipline, and investments in performance monitoring technology. For example, in 2005, only one competition was registered in the World Aquatics calendar. By 2020, despite the advent of the pandemic and the cancellation of some events, 15 competitions were registered, indicating significant growth over time (World Aquatics, n.d.). The increasing relevance of open water swimming can be interpreted as part of a global trend, where endurance sports and outdoor competitions, such as running, have gained prominence in the sports scene, driven by participants' interest in spending more time in nature and improving physical and mental health (Bowler, Buyung-Ali, Knight, & Pullin, 2010; Overbury, et al., 2023).

The authors chose to investigate studies analysing open water swimming in its real environment, which implies a greater focus on official competitions. While this choice was valid for understanding performance in its most authentic context, certain limitations need to be noted. By restricting inclusion to articles in English and studies on official distances (5, 10, and 25 km), the study may have overlooked valuable contributions from research in other languages or amateur swimmers, who also face unique challenges in the discipline. Additionally, excluding studies that utilized pools for training or assessment, as well as those that addressed open water swimming within interdisciplinary contexts such as triathlon, limited the scope of the research on the performance of multidisciplinary athletes.

Nonetheless, despite these limitations, this approach highlighted a significant gap and a vast research field in open water swimming. By focusing on studies conducted in real competitive environments, many authors underscored the complexity and unique nature of this discipline but also revealed a lack of investigation into numerous aspects. The scarcity of controlled experimental studies, such as those analysing the physiological, nutritional, or even psychological variables of athletes, highlights a research area that is still in its early stages. Furthermore, among the studies meeting the eligibility criteria adopted in this review, safety-related

topics such as hypothermia and water quality were less frequently investigated, which underscores the existence of many critical points that require further exploration. This scenario creates a significant opportunity to expand knowledge about the discipline, addressing the needs of both elite and amateur athletes and investigating strategies and interventions that could enhance performance and safety in competitions.

The results indicate that studies related to open water swimming have primarily focused on investigating the race strategies adopted by athletes and monitoring performance through competition results. These topics, often explored in observational research based on public data, reflect a predominant trend in the field. Based on the eligibility criteria adopted in this review, the included studies revealed important gaps in several areas of knowledge, such as sports psychology, applied physiology, biomechanics, sports nutrition, and the impact of environmental conditions on performance. Furthermore, within real open water competitive contexts, there is a limited number of robust experimental studies capable of providing deeper insight into the factors influencing performance and athlete safety.

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