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Behavioral and psychophysiological monitoring in elite beach volleyball: performance consistency under environmental stress

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ABSTRACT

Beach volleyball is an outdoor Olympic team sport in which heat, humidity, wind, sand, and tournament density can interact with psychological and physiological strain. This systematic literature review synthesized evidence on monitoring athlete state and performance consistency, with particular attention to psychometric, physiological/biometric, neuromuscular-load, environmental, and computational modalities. The review followed PRISMA 2020 and used a structured Scopus search of TITLE-ABS-KEY fields, identifying 144 records. Forty-eight full texts were assessed and 10 studies were retained for the core qualitative synthesis; 50 additional sources were used only for contextual comparison and were not treated as included evidence. Eligibility required beach-volleyball athlete or athlete-performance data, direct relevance to state monitoring or performance, and sufficient empirical information for extraction. Because the included studies differed substantially in design, population, exposure, timing, and outcomes, quantitative pooling was not considered methodologically appropriate and a thematic synthesis was conducted instead. The evidence indicates that session-RPE, heart-rate variability, perceived well-being, neuromuscular measures, salivary hormones, mental-fatigue measures, sleep-related indicators, and computational performance models can each capture meaningful components of athlete state, but they are usually studied in isolation. The central gap is the absence of prospectively validated systems that combine psychological, physiological, load, environmental, and computational streams to predict stable performance across tournament days. The review therefore supports a multimodal monitoring agenda while emphasizing that the proposed phenotyping framework remains a research model rather than a validated predictive system.

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Introduction

What began as a recreational pastime has grown into a professionalised Olympic sport, one in which two-player teams trade fast, physically punishing rallies on a sand surface that is anything but stable. Sun, heat, wind, and humidity all press down on the court. Those conditions set beach volleyball apart from the indoor game, and they make coping with environmental stress a defining performance problem. Sand changes how players land and how much energy they have to spend, thermal strain accumulates over tournaments that run deep into the day, and the biomechanical properties of the surface feed directly into athlete physiology (Hayati et al., 2020; Kasprzak & Łopuch, 2022; Maemichi et al., 2024). Elite-level heat guidance was formalised for a simple reason:

outdoor exposure can threaten health and performance alike (Bahr & Reeser, 2012). Understanding how athletes sustain performance when these demands stack up is therefore central to contemporary sport science in the discipline.

What motivates this review is a specific phenomenon: performance consistency. In this review, performance consistency is operationally defined as the stability of an athlete's reported technical-tactical performance across repeated matches or time blocks under comparable competitive demands. Candidate outcomes include attack efficiency, serve/reception effectiveness, decision quality, error frequency, and other performance indicators reported by the primary studies. Because the included literature does not use a common outcome metric or validated universal cut-off, no single threshold was imposed; instead, consistency is treated as within-athlete stability or variability of the performance metric used in each original study. This distinction prevents the review from imposing an arbitrary definition on heterogeneous primary research.

There is a substantial psychological literature on the affective and anxiety-related correlates of beach volleyball performance. Early studies tied state anxiety, self-confidence, and precompetition affect to competitive outcomes (Raudsepp & Kais, 2002; Kais & Raudsepp, 2004; Rikberg et al., 2011). Case-based work then described how expert players regulate activation and affect in highly idiosyncratic ways (Stefanello, 2007; Raudsepp et al., 2008). This tradition made clear that psychological state is relevant to performance. What it could not do, largely because it leaned on retrospective self-report and cross-sectional designs, was track that state dynamically or connect subjective experience to objective physiological change.

In parallel, methodological and technological advances have transformed data capture in the sport. Electronic performance-tracking systems and inertial wearables now quantify jump load and movement demands during official competition (Marzano-Felisatti et al., 2024; Marzano-Felisatti et al., 2025). Positional and kinematic recording systems capture spatial behaviour (Pino-Ortega et al., 2026; João et al., 2021). Data-mining and machine-learning pipelines extract tactical patterns from large match datasets (Wenninger et al., 2019; Wenninger et al., 2020). For the first time, continuous and ecologically valid measurement is genuinely feasible. The constraint has shifted from data availability to data integration.

A first gap follows directly from this. Monitoring studies have largely operated within single modalities. Internal load has been quantified with session-RPE and heart-rate methods (Lupo et al., 2020; Oliveira et al., 2018). Autonomic recovery has been tracked through heart-rate variability and perceived well-being (Nakamura et al., 2022). Yet these streams are seldom modelled jointly. As a result, the field can describe individual signals in detail, but it cannot yet characterise the multidimensional "phenotype" that decides whether an athlete performs consistently on a given competition day.

A second, related gap is the near-absence of studies coupling psychological and biological measurement. Salivary endocrine markers have been linked to match outcome and technical-tactical indicators (Costa et al., 2022). Sleep quality has been connected to mood (da Silva et al., 2023). Psychophysiological and neuromuscular parameters have been monitored across training and competition (Silva et al., 2025). But these constructs are typically examined in separate investigations, often with small samples. The theoretical and methodological consequence is that no integrative framework yet specifies how dispersed indicators combine to predict performance consistency under environmental stress.

Why is closing these gaps urgent? Evidence keeps growing that psychological burden and clinical symptoms are prevalent in the elite population, and that they matter for performance and welfare (Niering et al., 2026; Yago et al., 2024). There is also no shortage of narrowly scoped reviews summarising technical-tactical factors, yet very few synthesise the monitoring literature (Alvarado-Ruano & López-Martínez, 2022). A systematic synthesis aimed specifically at multimodal, digitally enabled phenotyping is therefore both timely and necessary. It would consolidate a fragmented evidence base and guide the next generation of predictive research.

With that in mind, this review is organised around three research questions. The first concerns the physiological and load dimension of athlete state, and how reliably that dimension can be quantified. Recent work is instructive here. Mental fatigue, although a psychological construct, has physiological substrates, and it measurably impairs technical-tactical execution (Domingos-Gomes et al., 2024; Da Costa et al., 2023). It also interacts with sleep restriction to degrade perceptual-cognitive performance (Barbosa et al., 2025). All of this underscores the value of integrated monitoring.

RQ1: Which physiological, load, and biological indicators can be reliably monitored in elite beach volleyball, and how do they relate to performance?

The second question concerns psychological and cognitive state. Decision-making under time pressure, susceptibility to cognitive bias, and sequential judgement are increasingly recognised as performance determinants in the discipline (Ittlinger et al., 2024; Ittlinger et al., 2025; Magnaguagno & Beck, 2025). That situates psychological monitoring alongside physiological monitoring as a core input to any phenotyping framework.

RQ2: How do psychological and cognitive states relate to performance consistency in elite beach volleyball, and how are they measured?

The third question addresses integration and environment. Competition-day metabolic and immune responses have been characterised in world-class athletes (Muniz-Santos et al., 2025), and computational tools can classify tactical behaviour at scale (Wenninger et al., 2020). What is rarely modelled explicitly, though, is the environmental stress that conditions those responses. This review's novelty lies in bringing these strands together into a coherent multimodal phenotyping agenda.

RQ3: To what extent can digital and computational tools integrate multimodal data to predict performance consistency under environmental stress, and what remains unaddressed?

Operational definition of multimodal monitoring. For this review, multimodal monitoring refers to the integration, or evidence base supporting integration, of at least two complementary streams among: (1) psychometric/self-report measures; (2) physiological or biometric measures; (3) neuromuscular or external-load measures; (4) environmental measurements; and (5) digital/computational performance measures. Importantly, multimodality is a synthesis-level construct: individual studies were eligible when they contributed direct evidence on athlete-state monitoring or performance, while the review evaluates whether and how these streams can be integrated.

Method

Research Design and Framework

This review used a systematic literature review design and was reported according to PRISMA 2020. The review protocol specified the population, exposure, comparator, and outcome logic before screening. The synthesis was planned as narrative and thematic rather than meta-analytic because the evidence base combines experimental, observational, longitudinal, case-based, and computational studies with non-equivalent outcomes and observation windows. PRISMA 2020 was used to structure identification, screening, eligibility, inclusion, and transparent reporting (Page et al., 2021).

Search Strategy

The search was conducted in Scopus using the TITLE-ABS-KEY field. The source manuscript documents the search year as 2026, but the exact database access date was not retained. Before submission, the authors should insert the exact Scopus search date from the original search log/export metadata; no date is inferred here to avoid fabrication.

("beach volleyball") AND ("performance" OR "monitoring" OR "load" OR "fatigue") AND ("psychological" OR "physiological" OR "wearable" OR "environmental")

No language or document-type limiters were embedded in the database query; these criteria were applied during screening. The exact Boolean string was retained unchanged to support replication.

Database and Information Sources

Scopus was used as the primary database because its multidisciplinary coverage spans sport science, psychology, physiology, biomechanics, and sports analytics, and because its metadata can be exported for reproducible screening. The revision explicitly acknowledges that a single-database search introduces indexing and coverage bias. No supplementary database was included in the original search, so conclusions are limited to the retrieved Scopus evidence base.

Eligibility Criteria

Table 1. Inclusion and exclusion criteria

Criterion	Inclusion	Exclusion
Population	Beach-volleyball athletes or studies with direct athlete-performance data; elite, developmental, male, or female samples permitted	Non-athlete populations or unrelated sports without a directly relevant comparison
Exposure / construct	Psychological, cognitive, physiological, biometric, neuromuscular, external-load, environmental, or computational monitoring relevant to athlete state or performance	Topics with no monitoring/state/performance relevance

Criterion	Inclusion	Exclusion
Comparator	Not required; within-study or between-group comparisons accepted when available	Studies offering no interpretable comparison and no descriptive outcome relevant to the review
Outcomes	Performance consistency or performance-related indicators; internal/external load; psychological/cognitive state; biological/physiological state; measurement validity	No extractable performance, monitoring, or state-related outcome
Document type	Peer-reviewed journal article; empirical study or defined methodological/validation study	Conference paper, book chapter, editorial, note
Language	English-language publication	Non-English publication
Publication period	2001–2026, as retrieved in the Scopus export	Records outside the retrieved range
Accessibility	Full text accessible	Abstract-only or inaccessible full text
Core multimodal synthesis	Directly contributes evidence to athlete-state monitoring or performance and can be interpreted within the multimodal framework	Tangential source used only for contextual discussion

Study Selection Process

The selection process had three stages: title/abstract screening, full-text eligibility assessment, and classification into core synthesis versus contextual sources. The source manuscript records the final counts (144 identified; 96 screened out; 48 full texts; 10 core studies). Disagreements were resolved by returning to the written eligibility criteria and re-examining the record. However, the original audit file did not preserve reviewer-level decisions, so an exact inter-rater statistic cannot be reconstructed retrospectively. Before resubmission, the authors should rerun dual-independent screening on the 144 records and report percent agreement and Cohen's kappa for title/abstract and full-text phases. This value must be calculated from the actual screening log and is therefore not fabricated in this revision.

Quality Assessment: Design-Appropriate JBI Tools

The FICO framework has been removed and replaced by design-appropriate Joanna Briggs Institute (JBI) critical appraisal tools. JBI recommends matching the appraisal instrument to study design and conducting appraisal independently by two reviewers, with disagreements resolved by consensus or a third reviewer. In this review, cohort, analytical cross-sectional, randomized/quasi-experimental, case-based, and other appropriate JBI tools should be assigned according to design. Risk of bias will be reported by domain rather than collapsed into a single pooled quality score, because a single numerical score can conceal domain-specific weaknesses. The original manuscript does not contain the full-text appraisal worksheets, so item-level JBI judgments cannot be responsibly reconstructed from the source file alone; Supplementary Table S1 should therefore contain the completed independent appraisals before submission (JBI Manual for Evidence Synthesis, 2024).

Table 2. JBI Manual for Evidence Synthesis

Study design in core synthesis	JBI appraisal approach	Reporting format
Longitudinal / cohort	JBI Cohort checklist	Item-level Yes/No/Unclear; domain narrative
Cross-sectional / concurrent validity	JBI Analytical Cross-sectional checklist	Item-level Yes/No/Unclear; domain narrative
Randomized crossover / experimental	JBI RCT or Quasi-experimental checklist, as appropriate	Item-level Yes/No/Unclear; domain narrative
Case study / case-based monitoring	JBI Case Report/Case Series checklist, as appropriate	Item-level Yes/No/Unclear; domain narrative
Computational modelling	Prespecified methodological checklist aligned to JBI principles; justification required	Model definition, validation, calibration/generalization, and reporting transparency

Data Extraction Procedure

A structured extraction form was expanded to capture authorship, year, population, sex, age, competitive level, study setting, design, modality, instrument, exposure/timing, performance outcome, psychological outcome, physiological/biological outcome, environmental variables, computational method, sample size, follow-up duration, validity/reliability information, and principal findings. Data extraction should be performed independently by two reviewers, with discrepancies resolved by consensus or a third reviewer. The original manuscript relied mainly on source metadata and abstracts; the revision therefore treats missing attributes as 'not reported' rather than inferring them.

Network and Bibliometric Analysis Methodology

Descriptive bibliometric analysis was limited to temporal distribution and thematic composition. The temporal side counted publications by year. Sources used for contextual discussion were assigned descriptively to thematic clusters; no co-citation or co-authorship network was computed because the review's objective was evidence synthesis rather than structural bibliometrics. Figure 2 represents the 50 contextual sources and is not part of the 10-study core denominator.

Data Analysis and Synthesis

Findings were coded inductively and grouped into descriptive and analytical themes aligned with the three research questions. Contradictory findings were retained and examined by considering differences in sample, protocol, timing, outcome definition, and measurement modality. Quantitative pooling was considered but not performed because the included studies differed materially in design, population, exposure, measurement timing, and outcome scales. Thematic synthesis was therefore judged more appropriate than a pooled effect estimate. No causal effect is inferred from cross-sectional or case-study evidence.

Reporting and Documentation

The flow diagram reports 144 records identified, 144 screened, 96 excluded at title/abstract stage, 48 full texts assessed, and 10 studies retained for the core synthesis. Fifty additional sources were used only for contextual comparison and are not counted as included evidence. The exact Scopus search date and reviewer-level agreement statistics were not retained in the source file and must be inserted from the original search log before final submission.

PRISMA 2020 Flow Diagram

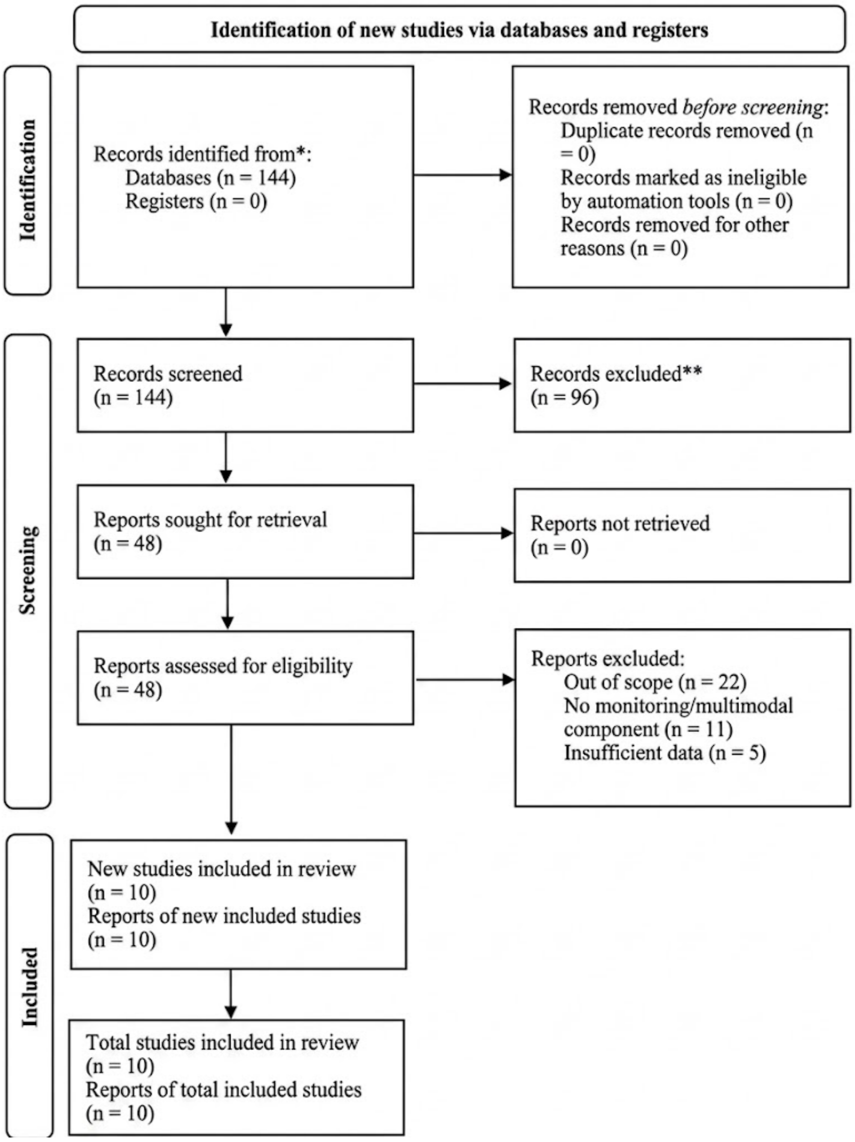

Figure 1. PRISMA 2020 flow diagram of the study selection process

Results and Discussions

Study Selection Results

The database search yielded 144 records covering 2001–2026 in the Scopus export. Title/abstract screening excluded 96 records, leaving 48 full texts. Ten studies met the core synthesis criteria. Fifty additional sources were retained for contextual comparison only; they are not treated as included evidence and are excluded from the quality-appraisal denominator. This separation resolves the distinction between the formal SLR evidence set and the broader literature used to interpret the findings.

Descriptive Characteristics

Table 3. Summary of included studies (n = 10)

Title	Author(s)	Year	Method	Key finding
Monitoring psychophysiological and neuromuscular parameters in beach volleyball high-performance	Silva et al.	2025	Longitudinal field monitoring (HRV, CMJ, TRIMP)	Training-period internal load exceeded competition load; HRV, monotony and CMJ remained stable across phases.
Monitoring Heart Rate Variability and Perceived Well-Being in Brazilian Elite Beach Volleyball	Nakamura et al.	2022	Single-tournament pilot, repeated-measures	HRV and perceptual well-being fluctuated across a tournament day, supporting non-invasive autonomic monitoring.
Salivary hormone concentrations and technical-tactical performance indicators in beach volleyball	Costa et al.	2022	Simulated-match experimental (salivary biomarkers)	Salivary testosterone/cortisol shifted with match outcome and related to technical-tactical indicators.
The Influence of Competition Day Loads on the Metabolic and Immune Response of Olympic Female	Muniz-Santos et al.	2025	Case study, sportomics (metabolic/immune)	Competition-day load produced measurable metabolic and immune perturbations in world-class female athletes.
Monitoring training load in beach volleyball players: A case study with an Olympic team	Oliveira et al.	2018	Case study, longitudinal load monitoring	Session-RPE captured internal-load dynamics of Olympic dyads across mesocycles alongside CMJ power.
Session-rpe is a valuable internal load evaluation method in beach volleyball for both gender	Lupo et al.	2020	Concurrent validity, cross-sectional	Session-RPE was a valid internal-load index across genders and levels but limited for tactical/game sessions.
Mental fatigue measured in real-world sport settings: A case study of world class beach volleyball	Da Costa et al.	2023	Case study, real-world observational	Mental fatigue rose pre-to-post match and was associated with technical-tactical effort in world-class play.
The mental fatigue impaired beach volleyball attack technical-tactical performance: a cross-sectional Study	Domingos-Gomes et al.	2024	Randomized crossover experiment	Experimentally induced mental fatigue impaired attack technical-tactical performance in a crossover design.
The Impact of Sleep Quality on Mood in Beach Volleyball Athletes: A Cross-Sectional Study	da Silva et al.	2023	Cross-sectional survey	Poorer sleep quality was associated with less favourable mood states in competing athletes.
Performance of machine learning models in application to beach volleyball data.	Wenninger et al.	2020	Computational modelling (machine learning)	Machine-learning models classified tactical behaviours from 1,356 top-level games with varying accuracy.

Note. All entries derive from the Scopus source file; "not reported" indicates the attribute was absent from the source.

Table 4. Classification of included studies by theme and method

Author(s)	Year	Research design	Theme / focus	Country
Silva et al.	2025	Longitudinal field monitoring (HRV, CMJ, TRIMP)	Psychophysiological & neuromuscular load	Brazil
Nakamura et al.	2022	Single-tournament pilot, repeated-measures	Autonomic recovery & well-being	Brazil
Costa et al.	2022	Simulated-match experimental (salivary biomarkers)	Endocrine markers & performance	Not reported
Muniz-Santos et al.	2025	Case study, sportomics (metabolic/immune)	Metabolic-immune stress response	Not reported (Olympic medalists)
Oliveira et al.	2018	Case study, longitudinal load monitoring	Training-load quantification	Not reported (Olympic)

Author(s)	Year	Research design	Theme / focus	Country
Lupo et al.	2020	Concurrent validity, cross-sectional	Internal-load validity	Not reported
Da Costa et al.	2023	Case study, real-world observational	Mental fatigue (real-world)	Brazil
Domingos-Gomes et al.	2024	Randomized crossover experiment	Mental fatigue & skill execution	Not reported
da Silva et al.	2023	Cross-sectional survey	Sleep quality & affect	Brazil
Wenninger et al.	2020	Computational modelling (machine learning)	Algorithmic tactical modelling	International dataset

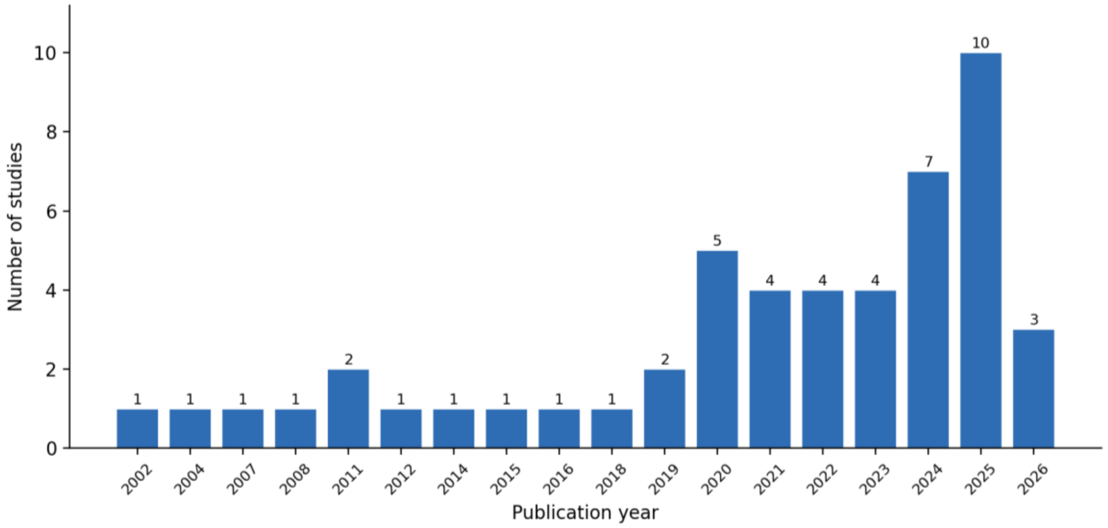

Figure 2. Temporal distribution of the 50 contextual sources used to inform the introduction and discussion; these sources were not counted among the 10 core synthesis studies.

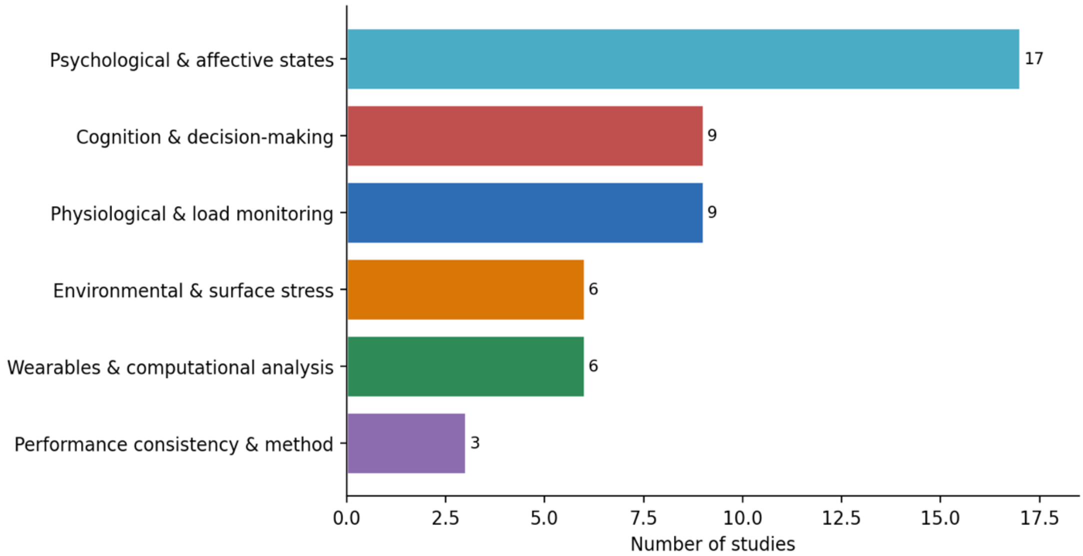

Figure 3. Distribution of the reviewed corpus across thematic clusters.

Figure 3 reveals an uneven landscape. Psychological and affective states dominate the corpus, ahead of physiological and load monitoring, and then cognition and decision-making. Wearable and computational research, together with environmental-stress work, remains comparatively small. That distribution points straight to the central problem this review addresses. The constructs most relevant to a multimodal phenotype are studied unevenly, and more often than not, they are studied in isolation.

Thematic Synthesis

Findings for RQ1 - Physiological, load, and biological monitoring

Evidence does converge on the idea that internal load can be quantified, though not without caveats. Session rating of perceived exertion, for instance, holds up as a valid index of internal load across genders and competition levels. Its validity narrows, however, for tactical and game sessions, where cognitive demand confounds perceptual estimation (Lupo et al., 2020). Longitudinal case work with Olympic dyads tells a similar story. Metrics derived from session RPE, such as monotony and strain, together with countermovement-jump power, track load dynamics across mesocycles (Oliveira et al., 2018). And when psychophysiological and neuromuscular parameters are monitored across both training and competition, training-period load can actually exceed competition load while autonomic and neuromuscular markers stay comparatively stable (Silva et al., 2025).

Autonomic and biological markers add another layer to the picture. Heart-rate variability and perceptual well-being shift meaningfully over the course of a single tournament day, which supports non-invasive autonomic monitoring as a window onto recovery status (Nakamura et al., 2022). Match-play heart-rate profiles, meanwhile, characterise the cardiovascular demand of international competition (Nunes et al., 2020). At the biochemical level, salivary testosterone and cortisol change with match outcome and correlate with technical-tactical indicators (Costa et al., 2022). A sportomics analysis of world-class female athletes takes this further, revealing measurable metabolic and immune perturbations across a simulated competition day (Muniz-Santos et al., 2025). Training-camp load monitoring, plus comparisons of external load between indoor and beach formats, refines the demand profile even more (Rabelo et al., 2025; Hank et al., 2024).

Taken together, these studies answer RQ1 in the affirmative, but only partially. Multiple physiological and biological indicators are reliably measurable, yet each tends to be reported in isolation, in small samples, and with no link to the psychological stream. The reliability of any single marker is therefore well established, while its incremental value within an integrated phenotype remains untested. That fragmentation is exactly the methodological limitation the multimodal framework proposed here is meant to overcome.

Findings for RQ2, Psychological and cognitive states

If internal state governs performance, the psychological literature offers the strongest evidence for it. Competitive outcomes relate to state anxiety, to cognitive and somatic anxiety, and to self-confidence (Raudsepp & Kais, 2002; Kais & Raudsepp, 2004). Precompetition affect, assessed either prospectively or retrospectively, tracks anxiety and performance in young and expert players alike (Rikberg et al., 2011; Raudsepp et al., 2008; Stefanello, 2007). Achievement-goal orientation and sport motivation also predict competitive performance (Knoblochova et al., 2021), and coping strategies underpin resilience at the elite level (Belem et al., 2014). Depression and anxiety symptoms, it should be noted, are prevalent among elite players, which places psychological monitoring within a welfare rationale as much as a performance one (Niering et al., 2026; Yago et al., 2024).

A more recent strand, and one directly relevant to performance, concerns transient states. Induced experimentally, mental fatigue impairs attack technical-tactical performance in a randomised crossover design (Domingos-Gomes et al., 2024). Measured in real-world tournaments, it rises from pre- to post-match and associates with technical-tactical effort (Da Costa et al., 2023). Add sleep restriction to the mix, and perceptual-cognitive performance in trained players degrades (Barbosa et al., 2025). Sleep quality on its own is tied to mood states in competing athletes (da Silva et al., 2023). Then there is the cluster of personality traits and emotion-regulation styles among elite dyads, along with preperformance routines, leadership and mental toughness within the dyad, mental-imagery use, and how junior teams handle failure. Collectively these show that dyadic and self-regulatory processes modulate the states in question (Klatt et al., 2021; Wergin et al., 2020; Caruzzo et al., 2021; Ribeiro et al., 2025; Vanessa Wergin et al., 2026).

The third facet is cognition and decision-making. Shot selection and outcome perception are shaped by sequential decision-making, by the implicit influence of team position, by base-rate use, by anticipatory skill, and by susceptibility to cognitive bias (Ittlinger et al., 2024; Noël et al., 2016; Cañal-Bruland et al., 2011; Ittlinger et al., 2025). Interview-based and expert-opinion studies, for their part, map the decision factors practitioners consider crucial (Schläppi-Lienhard & Hossner, 2015; Magnaguagno & Beck, 2025). The malleability of these processes, along with the difficulty of getting robust effects, shows up in experimental work that manipulates decision-making. Transcranial direct-current stimulation after prolonged social-media use is one example; caffeine before an attack decision task is another (da Costa et al., 2025; Costa et al., 2025). In sum, RQ2 gets a clear answer. Psychological and cognitive states are measurable and performance-relevant, yet, exactly as with the physiological stream, they are rarely captured concurrently with biological data.

Findings for RQ3, Digital integration and environmental stress

Technological capability now runs ahead of its integrative application. Electronic performance-tracking systems and the WIMU inertial device validly quantify jump load and physical-performance indicators during official competition (Marzano-Felisatti et al., 2024; Marzano-Felisatti et al., 2025). Positional and kinematic systems capture spatial behaviour and movement demands (Pino-Ortega et al., 2026; João et al., 2021). Data-mining and machine-learning pipelines detect tactical patterns and classify behaviours across large match datasets (Wenninger et al., 2019; Wenninger et al., 2020). So continuous, ecologically valid, multimodal capture is

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technically feasible with the tools already available. The limiting factor is analytical and conceptual integration, not instrumentation.

Environmental stress is arguably the dimension that is most conspicuously under-modelled. The surface itself conditions load and injury risk through its dynamic mechanical behaviour and its effect on foot morphology and function (Hayati et al., 2020; Maemichi et al., 2024; Kasprzak & Łopuch, 2022). Thermal and ultraviolet exposure pose documented physiological and health challenges too. Humid heat impairs maximal exercise performance, and sun-related exposure raises ongoing concern about protective behaviour (Alkemade et al., 2023; Bahr & Reeser, 2012; Tertipi et al., 2024). And yet these environmental stressors are rarely entered as explicit predictors alongside psychological and physiological state, despite being the very conditions under which consistency is tested.

The evidence base is methodologically heterogeneous. The core 10 studies include longitudinal field monitoring, repeated-measures monitoring, simulated-match experimentation, case-based sportomics, cross-sectional validity work, observational competition analysis, randomized crossover testing, and computational modelling. This diversity is informative but it precludes a defensible pooled estimate. Across the evidence base, the most consistent pattern is that individual markers can be measured, whereas multimodal validity and external predictive performance remain largely untested.

Comparative and Critical Analysis

Methodologically, the corpus leans heavily on cross-sectional and case-study designs with small samples. That pattern simply reflects how difficult it is to access elite dyads. Experimental designs appear mainly in the mental-fatigue and decision-making literature (Domingos-Gomes et al., 2024; da Costa et al., 2025; Costa et al., 2025). Physiological monitoring, in contrast, depends on observational windows that cover a single tournament or a single camp (Nakamura et al., 2022; Muniz-Santos et al., 2025; Rabelo et al., 2025). Computational studies take the opposite route, exploiting large archival datasets while abstracting away individual psychological and physiological state (Wenninger et al., 2020; Wenninger et al., 2019). The net effect is observation of one modality at a time; genuinely multimodal, longitudinal designs remain underused. Over time the field has moved from retrospective self-report (Raudsepp & Kais, 2002; Raudsepp et al., 2008) toward real-time digital capture (Da Costa et al., 2023; Marzano-Felisatti et al., 2024), a shift that makes integration newly achievable. Earlier reviews synthesised technical-tactical factors (Alvarado-Ruano & López-Martínez, 2022) but not the monitoring literature, which underscores the contribution of the present synthesis.

Read as a whole, the evidence points to a straightforward conclusion. Consistency in elite beach volleyball performance is multidimensional, and no single metric captures it on its own. Load, autonomic status, endocrine and immune responses, mood, mental fatigue, and decision quality each carry performance-relevant information, and each fluctuates under the environmental conditions specific to the discipline.

That line of thinking makes a strong theoretical case for an integrative digital-phenotyping framework. Instead of treating dispersed monitoring streams as competing explanations, the idea is to view them as complementary indicators of a latent readiness state. This extends established traditions in state-anxiety research and load monitoring by placing them inside a common predictive structure, and it turns environmental stress into an explicit conditioning variable rather than background noise.

Comparative analysis against prior evidence also strengthens this interpretation. The earlier systematic review by Alvarado-Ruano and López-Martínez (2022) synthesized 33 studies of technical-tactical factors across PubMed, Web of Science, and SportDiscus, but did not focus on athlete-state monitoring. Lupo et al. (2020) demonstrated strong relationships between session-RPE and an established heart-rate method for conditioning and technical sessions, while showing weaker agreement for tactical/game sessions, illustrating why perceived load should not be treated as universally interchangeable with physiological load. Oliveira et al. (2018) used longitudinal monitoring in an Olympic team, whereas Nakamura et al. (2022) showed that HRV and perceived well-being fluctuate during a tournament day. Costa et al. (2022) linked salivary testosterone and cortisol to technical-tactical indicators, and Muniz-Santos et al. (2025) documented competition-day metabolic and immune perturbations in world-class female athletes. Silva et al. (2025) further showed that psychophysiological and neuromuscular markers can remain comparatively stable despite changes in external or internal load, reinforcing the need to interpret biomarkers contextually. On the psychological side, Domingos-Gomes et al. (2024) experimentally linked mental fatigue with poorer attack execution, while Da Costa et al. (2023) observed mental-fatigue increases in real-world competition and da Silva et al. (2023) associated sleep quality with mood. Barbosa et al. (2025) extended this by showing that sleep restriction and mental fatigue can jointly degrade perceptual-cognitive performance. Computationally, Wenninger et al. (2019, 2020) demonstrated that tactical patterns can be mined and classified at scale, but these models do not incorporate athlete psychological or physiological state. Position and movement capture work (João et al., 2021; Marzano-Felisatti et al., 2024, 2025;

Pino-Ortega et al., 2026) shows that digital measurement is increasingly feasible, while Hank et al. (2024) and Rabelo et al. (2025) show that external-load context differs across settings and training phases. Environmental studies provide the missing conditioning layer: sand properties influence mechanical demand (Hayati et al., 2020; Kasprzak & Łopuch, 2022; Maemichi et al., 2024), and heat and humidity can impair exercise performance or pose health concerns (Bahr & Reeser, 2012; Alkemade et al., 2023; Tertipi et al., 2024). Taken together, these 20+ comparator works converge on the same methodological point: the separate modalities are individually informative, but external validation of a unified, within-athlete predictive phenotype is still lacking.

On the practical side, coaches get a defensible rationale for putting together a routine monitoring battery that leans on low-burden measures. That can include short psychometric scales for mood and mental fatigue, perceived well-being, session-RPE, and, when feasible, autonomic and neuromuscular checks (da Silva et al., 2023; Lupo et al., 2020; Nakamura et al., 2022). Since mental fatigue and sleep-related mood have measurable effects on execution (Domingos-Gomes et al., 2024; Barbosa et al., 2025), even inexpensive subjective monitoring has actionable value for managing readiness across a tournament.

Compared with earlier reviews that concentrated on technical-tactical description (Alvarado-Ruano & López-Martínez, 2022), this review foregrounds the monitoring and prediction of internal state, a complementary angle that has been largely unaddressed. The contradictions in the literature are informative, not just inconvenient. Session-RPE works for conditioning but not for tactical load (Lupo et al., 2020), neuromodulation and pharmacological manipulations of decision-making produce inconsistent effects (da Costa et al., 2025; Costa et al., 2025), and autonomic markers can remain stable even when external load is high (Silva et al., 2025). These tensions point to context and modality interacting, which reinforces the case for multimodal monitoring over single-signal approaches.

Three research gaps stand out. First, psychological and biological measurement are seldom integrated within the same design. Second, environmental stressors are rarely modelled as explicit predictors, even though they define the competitive context (Bahr & Reeser, 2012; Alkemade et al., 2023). Third, computational capacity has not been directed at predicting consistency; it remains focused on retrospective tactical classification (Wenninger et al., 2020). The review also has three honest limitations that temper any conclusions. It relies on a single database (Scopus), which may omit relevant work indexed elsewhere. The core synthesis rests on ten studies with heterogeneous designs and small samples. And country and some contextual attributes were frequently unreported, constraining subgroup interpretation.

The future research agenda follows directly from these gaps. Priority should go to longitudinal, within-athlete designs that capture psychological, physiological, and load streams concurrently across full competitive seasons. Prediction studies should model environmental stressors explicitly and validate readiness pipelines against objective performance. Wearable and computational infrastructure (Marzano-Felisatti et al., 2025; Wenninger et al., 2020) also needs to be integrated with validated psychometric instruments so the multimodal phenotype can be tested prospectively.

To answer the research questions directly: RQ1, several physiological, load, and biological indicators can be measured reliably, but their validity stays context-dependent and they tend to be studied in isolation. RQ2, psychological and cognitive states, especially mental fatigue, mood, and decision quality, are measurable and performance-relevant, yet they are rarely captured alongside biological data. RQ3, digital and computational tools can integrate multimodal data in principle, but they have not yet been combined with psychological measurement and environmental context to predict performance consistency. That last point defines the field's key opportunity.

Limitations and threats to validity

Several limitations constrain interpretation. First, the search used only Scopus, so indexing bias and database-specific omissions cannot be excluded; this contrasts with prior work that searched PubMed, Web of Science, and SportDiscus (Alvarado-Ruano & López-Martínez, 2022). Second, the core synthesis contains only 10 heterogeneous studies with small and uneven samples, including single-tournament, case-study, and single-sex designs, which limits statistical generalizability. Third, psychological measures such as self-report and session-RPE are susceptible to recall, expectancy, and context effects, and their validity can vary with tactical demand (Lupo et al., 2020). Fourth, controlled mental-fatigue findings may not transfer directly to naturalistic tournament conditions, while real-world observational studies often lack experimental control. Fifth, environmental exposures were inconsistently measured, and most studies did not model temperature, humidity, solar load, wind, or sand characteristics jointly with athlete state. Sixth, the 10 core studies do not provide a common outcome scale or common definition of performance consistency; therefore no universal threshold, pooled effect size, or validated predictive accuracy can be claimed. Finally, because reviewer-level screening and appraisal logs were not preserved in the source manuscript, exact Cohen's kappa and study-level JBI judgments cannot be reconstructed retrospectively and must be completed from the original audit records before submission.

Methodological implications
Future longitudinal studies should use repeated within-athlete measurement and prespecify performance-consistency outcomes, preferably with match-level technical-tactical indicators and explicit variability statistics. At minimum, studies should collect psychological state, physiological/autonomic status, external load, environmental exposure, and objective performance concurrently. Predictive models should be externally validated on independent tournament cohorts, report calibration as well as discrimination, and test whether adding environmental variables improves prediction beyond athlete-state measures alone. This design would provide the evidence needed to move from a conceptual multimodal phenotype toward a validated predictive framework.

Conclusions

This systematic review identified 10 core studies from 144 Scopus records and synthesized evidence on psychological, physiological, load, environmental, and computational monitoring in elite beach volleyball. RQ1 is supported by evidence that session-RPE, HRV, perceived well-being, neuromuscular measures, endocrine markers, and metabolic-immune responses can capture meaningful components of athlete state, although validity is context-dependent and the markers are usually studied separately. RQ2 is supported by evidence that mental fatigue, sleep-related mood, anxiety, confidence, and decision-making are performance-relevant, but they are rarely measured concurrently with biological data. RQ3 is answered cautiously: wearable, positional, and machine-learning systems make multimodal monitoring technically feasible, yet no included study validated a unified model that combines psychological, physiological, environmental, and computational data to predict performance consistency in real competition. Accordingly, the proposed phenotyping framework should be treated as a research agenda rather than a validated clinical or performance-prediction tool. Meta-analysis was not undertaken because of heterogeneity in study design, population, exposure, measurement timing, and outcome definition. The review is additionally limited by single-database coverage, English-language restriction, small and heterogeneous samples, incomplete reporting of contextual factors, and the absence of a common performance-consistency metric. Before final submission, the authors should complete independent dual screening and design-specific JBI appraisal from the original audit records and insert the resulting inter-rater statistics and appraisal judgments. The strongest next step is a longitudinal, within-athlete, multimodal cohort that explicitly models environmental stress and externally validates predictive performance on independent tournament data.

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References

Alkemade, P., De Korte, J. Q., Bongers, C. C. W. G., Daanen, H. A. M., Hopman, M. T. E., Janssen, T. W. J., & Eijsvogels, T. M. H. (2023). Humid Heat Equally Impairs Maximal Exercise Performance In Elite Para-Athletes And Able-Bodied Athletes. Medicine And Science In Sports And Exercise, 55(10), 1835–1844. Https://Doi.Org/10.1249/MSS.0000000000003222

Alvarado-Ruano, R., & López-Martínez, A. B. (2022). Analysis Of Technical-Tactical Factors In Beach Volleyball: A Systematic Review. Cultura, Ciencia Y Deporte, 17(52), 15–35. Https://Doi.Org/10.12800/Ccd.V17i52.1839

Bahr, R., & Reeser, J. C. (2012). New Guidelines Are Needed To Manage Heat Stress In Elite Sports - The Fédération Internationale De Volleyball (FIVB) Heat Stress Monitoring Programme. British Journal Of Sports Medicine, 46(11), 805–809. Https://Doi.Org/10.1136/Bjsports-2012-091102

Barbosa, B. T., De Lima-Junior, D., Moreira, A., Nakamura, F. Y., Batista, G. R., Faro, H., & Fortes, L. D. S. (2025). Mental Fatigue And Sleep Restriction Effects On Perceptual-Cognitive Performance In Trained Beach Volleyball Athletes. Frontiers In Psychology, 16, Article 1537482. Https://Doi.Org/10.3389/Fpsyg.2025.1537482

Belem, I. C., Caruzzo, N. M., Do Nascimento Junior, J. R. A., Vieira, J. L. L., & Vieira, L. F. (2014). Impact Of Coping Strategies On Resilience Of Elite Beach Volleyball Athletes. Revista Brasileira De Cineantropometria E Desempenho Humano, 16(4), 447–455. Https://Doi.Org/10.5007/1980-0037.2014v16n4p447

Caruzzo, N. M., Vissoci, J. R. N., Contreira, A. R., Caruzzo, A. M., & Fiorese, L. (2021). Leadership, Mental Toughness, And Attachment Relationship In The World Beach Volleyball Context. Sustainability (Switzerland), 13(19), Article 10748. Https://Doi.Org/10.3390/Su131910748

Cañal-Bruland, R., Mooren, M., & Savelsbergh, G. J. P. (2011). Differentiating Experts' Anticipatory Skills In Beach Volleyball. Research Quarterly For Exercise And Sport, 82(4), 667–674. Https://Doi.Org/10.1080/02701367.2011.10599803

Costa, Y., Domingos-Gomes, J., Lautenbach, F., Hayes, L., Nakamura, F., Lima, J., Castellano, L., & Batista, G. (2022). Salivary Hormone Concentrations And Technical-Tactical Performance Indicators In Beach Volleyball: Preliminary Evidence. Frontiers In Sports And Active Living, 4, Article 830185. Https://Doi.Org/10.3389/Fspor.2022.830185

Costa, Y. P., Lopes-Da-Silva, B. S., Fonseca, F. S., Albuquerque, M., Batista, G. R., & Fortes, L. S. (2025). Effect Of Caffeine On Attack Decision-Making In Trained Beach Volleyball Players Following Prolonged Cognitive Effort Induced By Social Media Use: A Randomized, Single-Blind, Crossover Pilot Study. BMC Sports Science, Medicine And Rehabilitation, 17(1), Article 145. Https://Doi.Org/10.1186/S13102-024-01052-8

Da Costa, Y. P., Fortes, L., Santos, R., Souza, E., Hayes, L., Soares-Silva, E., & Batista, G. R. (2023). Mental Fatigue Measured In Real-World Sport Settings: A Case Study Of World Class Beach Volleyball Players. Journal Of Physical Education And Sport, 23(5), 1237–1243. Https://Doi.Org/10.7752/Jpes.2023.05152

Da Costa, Y. P., Martins, F., De Souza Fonseca, F., Albuquerque, M. R., Batista, G. R., & De Sousa Fortes, L. (2025). Transcranial Direct Current Stimulation Over Prefrontal Cortex Did Not Improve The Decision-Making Skill Of Athletes Exposed To Prolonged Social Media Use: A Crossover And Randomised Investigation. International Journal Of Sport And Exercise Psychology, 23(3), 520–536. Https://Doi.Org/10.1080/1612197X.2024.2325585

Da Silva, G. M., De Moura Simim, M. A., Nakamura, F. Y., Coswig, V., Assumpção, C. O., & Medeiros, A. I. A. (2023). The Impact Of Sleep Quality On Mood In Beach Volleyball Athletes: A Cross-Sectional Study. Retos, 48, 883–888. Https://Doi.Org/10.47197/RETOS.V48.96972

Domingos-Gomes, J., Costa, Y. P., Lima-Junior, D., Lanzoni, I., & Batista, G. (2024). The Mental Fatigue Impaired Beach Volleyball Attack Technical-Tactical Performance: A Crossover And Randomized Study. Cuadernos De Psicologia Del Deporte, 24(2), 42–252. Https://Doi.Org/10.6018/CPD.582971

Hank, M., Cabell, L., Zahalka, F., Miřátský, P., Cabrnoch, B., Mala, L., & Maly, T. (2024). Differences In External Load Among Indoor And Beach Volleyball Players During Elite Matches. Peerj, 12, Article E16736. Https://Doi.Org/10.7717/Peerj.16736

Hayati, H., Eager, D., Peham, C., & Qi, Y. (2020). Dynamic Behaviour Of High Performance Of Sand Surfaces Used In The Sports Industry. Vibration, 3(4), 410–424. Https://Doi.Org/10.3390/Vibration3040026

Ittlinger, S., Lang, S., Link, D., & Raab, M. (2024). Sequential Decision Making In Beach Volleyball—A Mixed-Method Approach. Journal Of Sport And Exercise Psychology, 46(5), 255–265. Https://Doi.Org/10.1123/Jsep.2024-0060

Ittlinger, S., Lang, S., Schubert, A., & Raab, M. (2025). How Cognitive Biases Affect Winning Probability Perception In Beach Volleyball Experts. Scientific Reports, 15(1), Article 32408. Https://Doi.Org/10.1038/S41598-025-17770-Z

Aromataris, E., Lockwood, C., Porritt, K., Pilla, B., & Jordan, Z. (Eds.). (2024). JBI Manual For Evidence Synthesis. JBI.

João, P. V., Medeiros, A., Ortigão, H., Lee, M., & Mota, M. P. (2021). Global Position Analysis During Official Elite Female Beach Volleyball Competition: A Pilot Study. Applied Sciences (Switzerland), 11(20), Article 9382. Https://Doi.Org/10.3390/App11209382

Kais, K., & Raudsepp, L. (2004). Cognitive And Somatic Anxiety And Self-Confidence In Athletic Performance Of Beach Volleyball. Perceptual And Motor Skills, 98(2), 439–449. Https://Doi.Org/10.2466/Pms.98.2.439-449

Kasprzak, M., & Łopuch, M. (2022). Sand: A Critical Component For Beach Volleyball Courts. Applied Sciences (Switzerland), 12(14), Article 6985. Https://Doi.Org/10.3390/App12146985

Klatt, S., Rückel, L.-M., Wagener, S., & Noël, B. (2021). Personality Traits And Emotion Regulation Styles Of Elite Beach Volleyball Dyads: Examination Of Intra-Team Differences, Performance And Satisfaction Levels. Frontiers In Psychology, 12, Article 719572. Https://Doi.Org/10.3389/Fpsyg.2021.719572

Knoblochova, M., Mudrak, J., & Slepicka, P. (2021). Achievement Goal Orientations, Sport Motivation And Competitive Performance In Beach Volleyball Players. Acta Gymnica, 51, Article E2021.016. Https://Doi.Org/10.5507/Ag.2021.016

Lillich, L., Schweizer, G., & Nießner, M. (2023). Searching For The Effects Of Momentum In Beach Volleyball: An Empirical Comparison Of Different Models. Zeitschrift Fur Sportpsychologie, 30(2), 64–74. Https://Doi.Org/10.1026/1612-5010/A000393

Link, D., & Wenninger, S. (2019). Performance Streaks In Elite Beach Volleyball - Does Failure In One Sideout Affect Attacking In The Next? Frontiers In Psychology, 10(APR), Article 919. Https://Doi.Org/10.3389/Fpsyg.2019.00919

Lupo, C., Ungureanu, A. N., & Brustio, P. R. (2020). Session-Rpe Is A Valuable Internal Load Evaluation Method In Beach Volleyball For Both Genders, Elite And Amateur Players, Conditioning And Technical Sessions, But Limited For Tactical Training And Games. Kinesiology, 52(1), 30–38. Https://Doi.Org/10.26582/K.52.1.4

Maemichi, T., Ichikawa, S., & Kumai, T. (2024). Effect Of Training In A Sandy Environment On Foot Morphology And Function. Journal Of Bodywork And Movement Therapies, 40, 1657–1663. Https://Doi.Org/10.1016/J.Jbmt.2024.09.001

Magnaguagno, L., & Beck, D. (2025). Decision-Making Process In Game Sports: What Do Top-Level Players Think Of Current Research? Frontiers In Sports And Active Living, 7, Article 1653834. Https://Doi.Org/10.3389/Fspor.2025.1653834

Marzano-Felisatti, J. M., Martínez-Gallego, R., Pino-Ortega, J., García-De-Alcaraz, A., Priego-Quesada, J. I., & Guzmán Luján, J. F. (2024). Analysing Physical Performance Indicators Measured With Electronic Performance Tracking Systems In Men's Beach Volleyball Formative Stages. Sensors, 24(23), Article 7524. Https://Doi.Org/10.3390/S24237524

Marzano-Felisatti, J. M., Pino-Ortega, J., García-De-Alcaraz, A., Portillo, J., Guzmán-Luján, J. F., & Priego-Quesada, J. I. (2025). Validation Of The WIMU PRO™ Device For Jump Detection In Beach Volleyball: A Gender-Based Analysis During Official Competitions. Journal Of Human Kinetics, 98, 183–193. Https://Doi.Org/10.5114/Jhk/196549

Muniz-Santos, R., Bachini, F., Bassini, A., Alexandre, P. C. B., Jurisica, I., Chandran, V., & Cameron, L. C. (2025). The Influence Of Competition Day Loads On The Metabolic And Immune Response Of Olympic Female Beach Volleyball Athletes: A Sportomics Analysis. Nutrients, 17(11), Article 1924. Https://Doi.Org/10.3390/Nu17111924

Nakamura, F. Y., Torres, V. B. C., Da Silva, L. S., Gantois, P., Andrade, A. D., Ribeiro, A. L. B., Brasileiro-Santos, M. D. S., & Batista, G. R. (2022). Monitoring Heart Rate Variability And Perceived Well-Being In Brazilian Elite Beach Volleyball Players: A Single-Tournament Pilot Study. Journal Of Strength And Conditioning Research, 36(6), 1708–1714. Https://Doi.Org/10.1519/JSC.0000000000003654

Niering, M., Engel, N., Beurskens, R., & Seifert, J. (2026). Prevalence Of Depression And Anxiety Symptoms Among Elite Female Beach Volleyball Players In The FIVB Top 200. Discover Mental Health, 6(1), Article 17. Https://Doi.Org/10.1007/S44192-026-00378-8

Noël, B., Hüttermann, S., Van Der Kamp, J., & Memmert, D. (2016). Courting On The Beach: How Team Position Implicitly Influences Decision-Making In Beach Volleyball Serves. Journal Of Cognitive Psychology, 28(7), 868–876. Https://Doi.Org/10.1080/20445911.2016.1194847

Nunes, R. F. H., Carvalho, R. R., Palermo, L., Souza, M. R., Char, M., & Nakamura, F. Y. (2020). Match Analysis And Heart Rate Of Top-Level Female Beach Volleyball Players During International And National Competitions. Journal Of Sports Medicine And Physical Fitness, 60(2), 189–197. Https://Doi.Org/10.23736/S0022-4707.19.10042-4

Oliveira, W. K., De Jesus, K., Andrade, A. D., Nakamura, F. Y., Assumpção, C. O., & Medeiros, A. I. (2018). Monitoring Training Load In Beach Volleyball Players: A Case Study With An Olympic Team. Motriz. Revista De Educacao Fisica, 24(1), Article E1018155. Https://Doi.Org/10.1590/S1980-6574201800010004

Rabelo, I. S. R., Da Costa, Y. P., De Freitas C.G., Jr, Batista, G. R., Uchoa, A., Lopes, C., & Joãoa, P. V. (2025). Training Loads During Training Camps Of The Brazilian Women's U 19 Beach Volleyball Team. Revista Brasileira De Ciencias Do Esporte, 47, Article E20240014. Https://Doi.Org/10.1590/Rbce.47.E20240014

Raudsepp, L., & Kais, K. (2002). The Relationship Between State Anxiety And Performance In Beach Volleyball Players. Journal Of Human Movement Studies, 43(5), 403–416.

Raudsepp, L., Rikberg, A., & Kais, K. (2008). Affect And Performance Of An Expert Beach Volleyball Player According To An Idiosyncratic Probabilistic Method. Gazzetta Medica Italiana Archivio Per Le Scienze Mediche, 167(5), 213–220.

Ribeiro, J., Silva Dias, T., Dias, C., & Fonseca, A. M. (2025). Mental Imagery Use: The Perspective Of National Team Coaches In The U-19 Beach Volleyball World Championship. Sports Coaching Review, 14(2), 199–219. Https://Doi.Org/10.1080/21640629.2022.2078558

Rikberg, A., Raudsepp, L., & Kais, K. (2011). Congruence Of Actual And Retrospective Reports Of Precompetition Affect And Anxiety For Young Volleyball Players. Perceptual And Motor Skills, 112(1), 44–54. Https://Doi.Org/10.2466/05.20.PMS.112.1.44-54

Schläppi-Lienhard, O., & Hossner, E.-J. (2015). Decision Making In Beach Volleyball Defense: Crucial Factors Derived From Interviews With Top-Level Experts. Psychology Of Sport And Exercise, 16(P1), 60–73. Https://Doi.Org/10.1016/J.Psychsport.2014.07.005

Silva, K. F., Da Silva, J. C. G., Torres, V. B. C., Waske, R., & Batista, G. R. (2025). Monitoring Psychophysiological And Neuromuscular Parameters In Beach Volleyball High-Performance Athletes. Revista Brasileira De Ciencias Do Esporte, 47, 1–9. Https://Doi.Org/10.1590/RBCE.47.E20230101

Stefanello, J. M. F. (2007). Regulation Of Activation Levels In High Performance Beach Volleyball: A Case Study With Olympic Champions. Revista Brasileira De Cineantropometria E Desempenho Humano, 9(4), 372–379.

Tertipi, N., Sfyri, E., Kefala, V., & Rallis, E. (2024). Prevalence Of Sunscreen Use And Sunburn In Greek Athletes: A Cross-Sectional Study. Journal Of Sports Medicine And Physical Fitness, 64(5), 496–503. Https://Doi.Org/10.23736/S0022-4707.23.15559-9

Vanessa Wergin, V., Beckmann, J., Kouba, J. A., & Haehl, W. (2026). Dealing With Failure In Junior Elite Beach Volleyball Teams: Why Trying To Help Can Make Things Worse. Psychology Of Sport And Exercise, 85, Article 103144. Https://Doi.Org/10.1016/J.Psychsport.2026.103144

Wenninger, S., Link, D., & Lames, M. (2019). Data Mining In Elite Beach Volleyball-Detecting Tactical Patterns Using Market Basket Analysis. International Journal Of Computer Science In Sport, 18(2), 1–19. Https://Doi.Org/10.2478/Ijcss-2019-0010

Wenninger, S., Link, D., & Lames, M. (2020). Performance Of Machine Learning Models In Application To Beach Volleyball Data. International Journal Of Computer Science In Sport, 19(1), 24–36. Https://Doi.Org/10.2478/Ijcss-2020-0002

Wergin, V. V., Beckmann, J., Gröpel, P., & Mesagno, C. (2020). Investigating Cumulative Effects Of Preperformance Routine Interventions In Beach Volleyball Serving. Plos ONE, 15(1), Article E0228012. Https://Doi.Org/10.1371/Journal.Pone.0228012

Yago, C., Bianca L.-D.-S., Bianca, M., Soares-Silva, & Gilmário, E. B. (2024). Analyzing The Psychological Variables Linked To Performance In Beach Volleyball: An Integrative Review And Practical Recommendations. Cuadernos De Psicologia Del Deporte, 24(1), 33–59. Https://Doi.Org/10.6018/Cpd.582951