

Beyond the Jump: A Comprehensive Scoping Review of External Training Load Metrics in Volleyball

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Rebelo, A¹; Pereira, JR²; Nakamura, FY³; Valente-dos-Santos, J⁴.**ADMINISTRATIVE INFORMATION****Support** - N/A.**Review Stage at time of this submission** - The review has not yet started.**Conflicts of interest** - None declared.**INPLASY registration number:** INPLASY202360059**Amendments** - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 19 June 2023 and was last updated on 19 June 2023.**INTRODUCTION**

Review question / Objective What methods and metrics are being used in the existing literature to measure the external training load (ETL) in different positions of volleyball players across various performance levels?

- Population: Volleyball players across various positions (such as libero, setter, hitter, and middle blocker)
- Concept: Methods and metrics for measuring external training load
- Context: Various performance levels (such as amateur, collegiate, and professional)

Thus, the intent of the present review was to deliver a thorough, lucid, and detailed overview of ETL measurement in volleyball. The review aimed to highlight the voids in the current knowledge, and offer insights that may benefit researchers, practitioners, and stakeholders in the sport of volleyball.

Background Volleyball is a globally cherished sport, attracting players from diverse skill levels, ranging from amateurs to high-performing professionals. The sport is intrinsically multifaceted, encapsulating a variety of high-intensity actions including lateral movements, jumps, spikes, blocks, and more. Consequently, managing and optimizing training load has surfaced as a pivotal element in enhancing athletic performance, minimizing injury risk, and tailoring recovery strategies.

Training load in sports is broadly bifurcated into external and internal categories. The external training load (ETL) encapsulates the quantifiable work done by athletes, and it's typically monitored using technological aids such as accelerometers, inertial measurement units (IMUs), and GPS devices. Internal training load (ITL), on the other hand, portrays the physiological and psychological reactions elicited by the external load.

A considerable body of research has been dedicated to exploring ITL in volleyball. However, studies elucidating the facets of ETL are relatively

scarce. The limited research that does exist tends to focus on sagittal plane movements, primarily quantifying jumps. This presents an incomplete understanding of ETL as the dynamic nature of volleyball calls for a multitude of planar movements. For instance, positions like the libero frequently necessitate lateral and diagonal movements, which aren't effectively encapsulated by current ETL measurement strategies.

Rationale Given these considerations, the current review sought to comprehensively map the existing evidence regarding ETL measurements in volleyball. This encompassed an array of aspects including the range of applied metrics, the utilization of various measurement technologies, the consideration of player positions, and the attention given to different levels of play. Critically, this review endeavored to underscore the potential gaps in our understanding of ETL, particularly the measurement of movements outside the sagittal plane, and the unique load profile of positions like the libero.

The decision to conduct a scoping review was grounded in its inherent suitability for comprehensively mapping a broad body of literature. Scoping reviews facilitate an extensive overview of the evidence available, allowing the identification of principal concepts, evidence sources, and potential gaps in the research. Given the exploratory nature of the research question posed, a scoping review was identified as an optimal approach to assemble a broad spectrum of information related to ETL measurement in volleyball. Unlike a systematic review, a scoping review is less concerned with synthesizing high-quality evidence to guide practice or policy, but rather emphasizes providing a detailed overview of the evidence available.

METHODS

Strategy of data synthesis The literature search for this review will be undertaken across four electronic databases: PubMed/Medline, Scopus, Web of Science, and SPORTDiscus. Additionally, 'grey' literature sources such as conference abstracts, theses, and reports will be searched through Google Scholar and relevant professional networks. Beyond the database searches, the reference lists of discovered articles and pertinent reviews will be manually scrutinized for additional studies. Also, leading journals in the field will be hand-searched for relevant articles.

The development and execution of the search strategy will be the responsibility of the lead researcher, informed by contributions from the entire research team. To ensure the

comprehensiveness and robustness of the search, the strategy will align with the Peer Review of Electronic Search Strategies (PRESS) checklist.

The search strategy will include both controlled vocabulary (like MeSH terms in PubMed/Medline) and free-text terms to ensure all pertinent literature is captured. Key search terms will include "volleyball", "external training load", "physical demands", "measurement", and "libero", along with their synonyms, related terms, and suitable variations. The search strategy will be adapted to the syntax and subject headings of each database to guarantee thoroughness and reproducibility. For instance, the search in PubMed/Medline will be carried out as follows: ("volleyball"[MeSH Terms] OR "volleyball"[All Fields]) AND ("training load"[All Fields] OR "physical demands"[All Fields]) AND "measurement"[All Fields].

Eligibility criteria Inclusion In this review will be determined by several criteria: (1) the research should focus on volleyball players, irrespective of age or competitive level; (2) the research should provide data on ETL, its measurement methods, and ideally its connection with performance, injury frequency, or other pertinent results; (3) the research should disclose ETL measurements that surpass the examination of sagittal plane movements or explicitly specify that it focuses solely on sagittal plane movements; (4) the research can be either observational or interventional in nature.

The selection of these criteria aims to encompass a wide array of studies investigating ETL in volleyball. The intention of including players across all age brackets and performance levels is to yield a thorough understanding of ETL measurement across varied groups.

Language of publication will be a restrictive factor. Only studies that have been published in English will be included to ensure that the research team can effectively comprehend and summarize the results. There will be no restrictions related to the publication date to provide a complete overview of all pertinent research.

Source of evidence screening and selection The process for selecting sources of evidence to be included in this review will unfold in several steps. Following the implementation of the search strategy across PubMed/Medline, Scopus, Web of Science, and SPORTDiscus, all discovered citations will be compiled within the CADIMA software. This tool has been selected due to its utility in streamlining the screening and data extraction phases, thus ensuring a methodical and structured review approach. Its functionality in

eliminating duplicate citations will also be crucial in the initial screening phase.

Next, a structured form will be created to facilitate the screening of titles and abstracts. This form will consist of questions relevant to the eligibility criteria, such as the focus of the study on volleyball players, its reporting on external training load, and the inclusion of measurements beyond the sagittal plane. To ensure consistency and understanding, the form will be piloted by the four authors on a small subset of 10 citations. This calibration exercise will support the clarification of the eligibility criteria and their consistent application. Any discrepancies arising will be discussed and resolved by consensus, aiding the refinement of the form and contributing to a clearer mutual understanding of the eligibility criteria.

Following the calibration phase, each title and abstract will be reviewed by two authors, with any conflicts being resolved by a third author. This double screening method will be employed to reduce the risk of bias and ensure that no pertinent studies are overlooked. A similar method will be applied to the full-text screening of articles identified as potentially relevant during the title and abstract screening stage. For this in-depth screening, a comprehensive form will be used, collecting data on study design, participant characteristics, and outcome measures.

Should disagreements emerge that can't be resolved through discussion, a third author will act as an arbitrator to reach consensus. The CADIMA software will assist in managing this process, including keeping track of which authors have reviewed each article and recording decisions related to study inclusion and reasons for exclusion.

Data management The process of data charting will be conducted with stringent attention to detail to facilitate the precise and insightful extraction of information from the selected sources of evidence. A form for data charting will be crafted to standardize the extraction of pertinent information from every study included. This form will be designed to collect a variety of data relevant to the research question, such as study characteristics (like the author, year, country, and study design), participant characteristics (such as age, performance level, and player position), and specifics regarding the measurement of external training load (including the specific metrics used, any measurement tools or technologies, and key findings).

The items for charting will be chosen based on the research question and the guiding principles of a scoping review. To ensure uniformity and accuracy in data charting, the team will undertake a

calibration exercise, akin to the one conducted during the study selection phase. A subset of five studies included will serve as the calibration set. Each author will independently chart the data from these studies, and the team will then compare and discuss their charting to identify and rectify any discrepancies.

Upon finalization of the charting form, the data extraction phase will commence. Each study included will be independently charted by two authors, utilizing the CADIMA software. This tool will be instrumental in administering the extraction process and fostering collaboration among the team. In the event of inconsistencies, they will be discussed and resolved through consensus, with the input of a third author if necessary. To further ensure the accuracy of the data extracted, a random sample of 10% of the charted data will be verified by a third author, checking for potential errors or omissions.

Language restriction This review will be limited to studies written in English.

Country(ies) involved Portugal.

Keywords Load Monitoring; Performance Analysis; Training Quantification; Multi-planar Movements; Libero Position.

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