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Evidence-based warm-up sequencing for athletic performance and injury prevention in youth-to-elite sport: a systematic literature review

Eval Edmizal, Donie Donie^{*}, Tjung Hauw Sin
Faculty of Sport Science, Universitas Negeri Padang, Indonesia

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ABSTRACT

Warm-up is widely used to prepare athletes for exercise and competition, yet consensus is lacking regarding the optimal sequencing of aerobic activity, dynamic stretching and mobility, sport-specific drills, and neuromuscular activation. This systematic review synthesized evidence on effective warm-up sequencing for enhancing athletic performance and preventing injuries across youth-to-elite sporting populations. The review followed PRISMA 2020 guidelines. Scopus was searched on 8 September 2026 for English-language articles and reviews published between 2020 and 2026 using terms related to warm-up, sequencing, exercise preparation, and sports performance. Of 569 records identified, 50 studies met the eligibility criteria, and 30 were included in the qualitative synthesis and quality assessment using the FICO (Focus, Information, Context, and Outcome) framework. Screening, eligibility assessment, and quality appraisal were performed by a single reviewer. Four major themes emerged. Sport-specific programs, particularly FIFA 11+, consistently improved agility, vertical jump performance, and injury-prevention outcomes. Post-activation performance enhancement involving heavy resistance, plyometric, or flywheel exercises improved subsequent jumping, throwing, and sprint performance when appropriate recovery intervals were used. Combining dynamic stretching with foam or vibration rolling produced greater improvements in mobility and strength, whereas excessive static stretching temporarily reduced strength. Psychological, circadian, and environmental factors, including music, time of day, and sleep deprivation, also influenced warm-up effectiveness. Evidence supports an individualized and context-specific approach to warm-up sequencing rather than a universal protocol. Coaches and physical and sports educators should adapt warm-up components to athlete characteristics, sport demands, and contextual conditions. Findings should be interpreted cautiously due to the single-database and single-reviewer design.



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Corresponding Author:

Donie Donie,
Faculty of Sport Science, Universitas Negeri Padang,
Email: donie17@fik.unp.ac.id

Introduction

Exercise and sports competition preparations start off way before the whistle or the start of the competition gun is blowing. The warm-up is commonly seen as the key ingredient for performance and safety of the subsequent training/sport across all sorts of sport disciplines. Systematic and critical reviews on warm-up procedures in

soccer have shown that pre-play and pre-training warm-up exercises can effectively influence not only the physical aspects like sprinting/running, and jumping, but also execution of athletic skills at a significantly higher level later in the session (Palucci Vieira et al., 2021). Team sports aside, practitioners of individual sports such as golfers report that they often depend heavily on personally planned warm-up and preparation routines that they feel help in making them mentally and physically prepare for the competition situation (Wells & Langdown, 2020). Physiological-wise, the main effects of the warm-up are increase in the temperature of muscles, and core body temperature, speeding up the metabolic activities as well as neural processes, and when planned properly, a warm-up can significantly help raise the athlete's performance level, for instance in terms of power output (Kapnia et al., 2023). Since warm-up sessions of one kind or nature are present universally in leisurely, school-related, and top-class sports, learning what sort of components should be carried, and in which order would be a very relevant and meaningful query for practitioners of sports and researchers alike.

The warm-up is more than a simple preparation but an interplay of different physiological activities. It is usually comprised of a general aerobic phase followed by dynamic stretching and mobility exercises, sport-specific movement drills and recently also neuromuscular activation or potentiation components. Research on the phenomenon of post-activation potentiation revealed to what extents a heavier or explosive loading exercise preceding the actual movement, such as blood flow restricted lunges, is able to acutely enhance the performance of a vertical jump through greater utilization of the motor units (Doma et al., 2020). It is also reported that intense flywheel resistance exercising can result in a change in the level of physical activity after the warm-up that would still be able to detect within a few minutes of the conditioning (Maroto- Izquierdo et al, 2020). Heavy-load, velocity-based repetition programs have led to increased bench-press-throw performance of resistance-trained athletes (Tsoukos et al., 2021). All things told, the above results indicate that the last few minutes of a training session sequence can be skillfully tailored in order to optimize the readiness of the neuromuscular system for what is coming up next.

Many studies have explored the effects of warm-up routine protocols and one of the most famous among them was the FIFA 11 plus injury- prevention protocol. After a period of time of training through the use of FIFA 11 +, young players showed increased jump performance and agility (Trajković et al., 2020). In addition, a modified form of that warm-up program combined with additional techniques enhanced both injury-related outcomes and performance of youth male footballers (Asgari et al., 2022). Such kind of structured programs were studied in futsal also and a 11 plus FIFA based 5-week intervention improved power strength, speed of sprinting and lowered the perceived effort level of elite female athletes (Patti et al., 2022). In general these findings point to the feasibility of codified, sport-specific warm-up sequences in generating a large extent of benefits that relate mainly to performance and safety and also serving as a standard through which individualized sequencing problems can be assessed at a later phase. So they are a good starting point for the individual work of the athletes and coach.

In recent years, methodological and technological developments have significantly increased the detail with which the effects of warming-up can be discerned. In professional basketball players, jump characteristics have shown changes due to warm-up and readiness that depend on the position of the players and their roles in the team, such as the starters and non-starters. This research is based on the data of force-time derived from force plates (Cabarkapa et al., 2023a, 2023b). The combined effects of foam-rolling and stretching after acute and chronic sessions have been made clear by systematic reviews and meta-analyses (Konrad et al., 2021a, 2021b) while more detailed research has compared vibration foam rolls to static stretching or standard foam rolling in a study of changes in the mechanical properties of the hamstrings, knee extensors (Reiner et al., 2022; Kasahara et al., 2022), and the effect of combining static stretching and vibration foam rolling as a warm-up (Nakamura et al., 2023). Diversified studies have focused on the mechanical properties of triceps brachii after bench-press exercise (Trybulski et al., 2022), cluster-set and rest-redistribution set structures as ways to design training session instead of basing them on the loss in velocity method (Jukic et al., 2022), whether the positive effects of foam-rolling are the same as those of the general dynamic warm-up, (Warneke et al., 2023), a broader view, at a more general level, revisiting the stretch-induced force deficit by means of multilevel meta-analysis (Warneke & Lohmann, 2024). Variation in static stretching duration has been shown to have not only short-term but also long-lasting effect on muscle strength and shear elasticity (Sato et al., 2020), and vibration rolling has been found to have a beneficial influence on ankle mobility and strength whether it is dynamic or not (Lyu et al., 2020). Combining dynamic and static stretching, foam rolling or vibration rolling as a warm-up was found to be extremely effective in table tennis players (Hsu et al., 2021), and the acute effects of vibration foam rolling and local vibration during warm-up in tennis players have also been demonstrated (Wang et al., 2022).

Although we are gaining evidence about the warm-up effect, researchers have found there is a significant gap regarding the arrangement of warm-up components compared to one another. In amateur soccer, research compared small-sided games with regular warm-up routines and showed that the sequence and way you pick

activities can have a different impact on physical fitness immediately thereafter. A dynamic warm-up with a weighted vest has been proven to enhance change-of-direction skills in young soccer players significantly better than a standard protocol. (Turki et al., 2020). Researchers also compared static and dynamic stretching warm-ups and handball players repeated-sprint performance was found to be affected differently. (Zmijewski et al., 2020) On the other hand, the comparison of dynamic and foam-rolling warming strategies in elite tennis players produced different physical-performance profiles (Lopez-Samanes et al., 2021). The effectiveness of halftime re-warm-ups that help maintain physical readiness during halftime was also supported by a systematic review (González-Devesa et al., 2021) which revealed that halftime re-warm-up significantly influences second-half performance. Another piece of evidence was provided by the study where Ramirez-Campillo and colleagues pointed out that a difference in physical condition adaptation was made when one group placed the plyometric drill training before soccer training whereas the other after. (Ramirez-Campillo et al., 2020). In other words, these research works demonstrate that changing the order in which components of warm-up are done has different effects. Therefore, there is a clear necessity for the development of the unified concept of the optimal ordering of the warm-up elements across different sports and populations but there isn't agreement yet on how to do this.

A second, but less studied gap pertains to the psychological, chronobiological, and environmental modulators that can combine with an otherwise standardized warm-up sequence. It has been established that one can use music to overcome the detrimental mental and physical performances following partial sleep deprivation. This positive cognitive and mental effect of music depends, to a large extent, on the time when a person is exposed to the music (Khemila et al., 2021). On the other hand, music listened to while doing a repeated-sprint protocol, by themselves, have been seen to improve performance and psychophysiological responses in healthy adults (Jebabli et al., 2023). Moreover, researchers found that, by interacting with music-related interventions, menstrual-cycle phase could also have influenced the short-term exercise performance of female handball players (Ghazel et al., 2022). It is well known now that a person's time of day has a systematic effect on one's performance at maximal physical exercise, just like in Mirizio et al., 2020). Going from this physical time aspect to basic biology and research, long-term myonuclear permanence and the regulation after strength training at the transcriptional level has begun to throw some light on the way in which training history is a contextual variable, a very much ignored one, that might dictate the immediate reaction of a person to warm-up and conditioning stimuli (Cumming et al., 2024). Despite the fact that chronobiological and psychological factors are known to influence outcomes to an extent similar to that of the immediate physiological aspects of a warm-up, they are rarely used in sequencing warm-up research.

These knowledge gaps are extremely important because warm-up prescription may influence such a large population. A well-organized core-focused warm-up can promote physical activity, mobility, and balance among schoolchildren (Chang et al., 2020), wider physical activity programs have led to greater physical fitness levels in schoolchildren (Thomas et al., 2020), and a brief, physical activity session can alter preschool children's executive function in a way that depends on the level of physical activity usually done by them (Zhang et al., 2020). As for the high performance athletes' side, one study demonstrated that jump roping can help endurance runners get faster by increasing the speed of the lower limb movement (García-Pinillos et al., 2020), an apparatus for measuring reactive agility has been developed and confirmed in evaluating readiness level of youth football players (Hoffman, 2020), and researchers showed that blood flow restricted running will result in changes in sprint ability and strength (Chen et al., 2021). Post-activation performance enhancement (PAPE) strategies have also been tested on groups that range from coffee drinking female volleyball players (Filip-Stachnik et al., 2022), vertical jump in traditional sets vs. cluster sets (Iacono et al., 2020), to female rowers (Harat et al., 2020) among other sports people such as: swimming at the moment of the swim start (Đurović et al., 2022), tennis players that compare dynamic stretching with heavy-load protocols (Moreno-Pérez et al., 2021), gymnasts (Yu et al., 2024) and boxers who compare the effect of ballistic conditioning vs. heavy-resistance conditioning activities (Yi et al., 2022) Given that this group is so varied in terms of sports, age and level of competitiveness, clearly a single, general warm-up programme will not work best in the majority of sports contexts; so the call for a coordinated analysis capable of pinpointing sequences of movements which may be common across the major sport population categories or alternatively be substantially different is very justified.

RQ1: Which combination of warm-up components (general, dynamic, sports-related, and activation/potential) in which order would make you give your best performance physically?

RQ2: How does the type of stretching (static or dynamic) along with the method of myofascial release (foam rolling, vibration rolling) interact with the position in the warm-up sequence that determines their effects on range of motion, force production, and athletic performance? This question addresses the combined acute and prolonged effects of stretching and self-myofascial release techniques and provides evidence whether and when these modalities should be placed before or after other parts of the warm-up.

RQ3: In different ways, how much do psychological, bioclock and environmental factors (music for exercise motivation, time of day, sleep status, phase of menstrual cycle, previous workout experience) affect the effectiveness of a warm-up and how can the influence of these factors be best integrated in practical warm-up prescriptions? Solving these three issues, the paper presents a new and integrated view which links the physiological sequence guidelines with the psychological and environmental aspects which together determine the success of translating into a theoretical optimal warm-up plan in practice a synthesis which, up to now, has not been done as part of one systematic overview of the literature.

Taken together, prior work has established that individual warm-up components are effective in isolation, but no existing systematic review has examined how general, dynamic, sport-specific, and activation/potential components should be ordered relative to one another, nor how psychological, chronobiological, and environmental moderators interact with that ordering; this is the specific gap the present review addresses. Accordingly, the operational objective of this review is to synthesize peer-reviewed evidence published between 2020 and 2026 in order to (1) compare the effects of different warm-up component sequences on measures of athletic performance and injury-prevention outcomes; (2) evaluate how stretching modality and myofascial-release technique and their position in the sequence affect range of motion, force production, and performance; and (3) determine how psychological, chronobiological, and environmental factors moderate warm-up effectiveness, across youth-to-elite sporting populations.

Method

Research Design and Framework

We decided on a systematic literature review (SLR) for this review. Since questions under investigation necessitated a synthesis of a mixed and rapidly expanding base of experimental and quasi-experimental warm-up studies, we found that SLR was most appropriate method. Furthermore, our choice of SLR is consistent with methodological rationale underlying systematic reviews in management and applied science literature (Tranfield et al., 2003) and that of health-related reviews in meta-analysis (Liberati et al., 2009). This report adheres to the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses 2020 statement (Page et al., 2021), which, among other things, divides the review procedure into phases: identification, screening, eligibility, and inclusion of studies. It also defines the reporting obligations at each stage of the review process.

Search Strategy

Scopus Boolean search string TITLE-ABS-KEY : ("warm-up" OR "warm up" OR "warmup" OR "warm-up sequence") AND ("exercise preparation" OR "pre-exercise" OR "competition preparation") AND ("sports performance" OR "physical performance" OR "athletic performance") There was no need to include truncation and adjacency operators because the OR-grouped synonym sets, as described, were comprehensive enough. The TITLE-ABS-KEY field code meant that documents' titles, abstracts and keywords would only be searched against. No further restriction was placed in the database e.g., limiting by subject areas so that the researcher can manually check the eligibility criteria, given in Section 3.4, for all of the records returned.

Database and Information Sources

Scopus has been the single bibliographic database used, which has justified by its extensive coverage of the sport and exercise science area of the literature and its provision of structured information, which can easily be imported and is thus ideal for systematic literature review projects. The search has been conducted on 8 September 2026. Other supplementary databases were not considered which is being referred to as an obvious limitation section 5.5. We relied only on Scopus for all bibliographic work since sport and exercise science field covers a lot of research works, and moreover, the data available from Scopus can be in structured formats, therefore, easy to import in systematic reviewing processes. We conducted the literature search by the way of Scopus on 8th Sept, 2026; no effort was made toward other supplementary databases so as to complement the database, and the fact that is a significant limitation is being highlighted in section 5.5.

Eligibility Criteria

Table 1. Inclusion and Exclusion Criteria

Criterion	Inclusion	Exclusion
Language	English only	Non-English
Document type	Article, Review	Conference paper, Book chapter, Editorial, Retracted
Publication period	2020–2026	Before 2020

Criterion	Inclusion	Exclusion
Subject area	Sports science, exercise physiology, strength and conditioning	Unrelated disciplines (e.g., computer science, engineering)
Accessibility	Full bibliographic and abstract data available in the Scopus export	Abstract only / incomplete metadata
Relevance	Directly addresses warm-up, stretching, potentiation, or exercise/competition preparation	Tangential or coincidental keyword match with no substantive relevance

Study Selection Process

Screening was carried out through three steps. Initially, all of the 569 Scopus records (exported) were screened at the title and author-keyword level to eliminate those that were topically unrelated to warm-up or exercise preparation (e.g., studies in computer vision, telecommunications, or unrelated engineering domains that matched search terms coincidentally). Next, the remaining records were reviewed against the eligibility criteria in Table 1, retaining only articles and reviews with a functional DOI the identifier of the digital object, and a strong substantive connection to the subject areas of this review: warm-ups, stretches, or performance-potentiation research. Eventually, the final selection was made based on the ranking by citation counts within each of the four subthemes (post-activation potentiation/performance enhancement; stretching and myofascial techniques; structured sport-specific programs; psychological and chronobiological modifiers), with the aim of carrying forward top 50 records of each thematic cluster representing most highly cited and the most representative ones in a topic for the final synthesis in order to make sure equal representation of all four themes. Title/keyword screening, eligibility assessment, and FICO quality appraisal were each conducted by a single reviewer rather than the dual, independent screening with inter-rater agreement statistics (e.g., Cohen's kappa) recommended for systematic reviews; this single-reviewer process is acknowledged as a methodological limitation in Section 5.5 and should be taken into account when interpreting the review's replicability.

Quality Assessment - FICO Framework

The chosen studies were critically analysed using the Focus, Information, Context, and Outcome (FICO) framework. Focus was evaluated on the basis of how clearly the article addressed warm-up-related exposures (e.g., a particular type of stretching, potentiated protocol, or structured program). Information was judged based on the level of detail about the methods and results of the report. Context was measured by how specific the article was about the target population, sport and competitive level. Outcome focused on the employment of measures that were both valid and related to sporting ability. A study had to be considered at least as sufficient, in terms of FICO rating of the domains, to be eligible for review if the details given in the Scopus-derived title, abstract, and reference record were taken as a source. Each domain was rated on a three-point ordinal scale (insufficient, sufficient, strong); a study was retained only if it was rated sufficient or strong on all four FICO domains, and any study rated insufficient on one or more domains was excluded from the final synthesis.

Data Extraction Procedure

Details of each included study and where the data could not be obtained from a scopus export were recorded as follows: authors, year of publication, name of the journal where the study was published, country of the corresponding author (if possible to determine), study group and sport, the type of warm-up or intervention being studied, comparator condition, and the direction of the result as reported. In the case where a certain piece of information could not be found in the exported dataset (e.g., the exact number of participants or the exact duration of the protocol), the phrase "data not available in source file" was noted rather than the information being guessed or filled in.

Network and Bibliometric Analysis Methodology

A descriptive keyword and thematic clustering exercise was performed manually in 50 study records in order to classify them into four recurring themes which are post-activation potentiation/performance enhancement, stretching and myofascial release, structured sport-specific warm-up programs, and psychological/chronobiological/environmental modifiers. These themes are also the organizing basis of the thematic synthesis in Section 5.3. A formal network or co-citation analysis using specialized bibliometric tools (e.g. VOSviewer, Bibliometrix) was not carried out and is noted here as a way forward for future research.

Data Analysis and Synthesis

Thematic synthesis followed the general approach put forward by Thomas and Harden (2008), where study results are first coded descriptively by type of warm-up and direction of outcome, and then grouped into overarching analytical themes corresponding to the three research questions. The themes were continuously refined by matching possible groupings against the titles and outcomes of the 50 studies to make sure each theme was coherent on its own.

Reporting and Documentation

This review provides the methodology and result of the search based on the PRISMA 2020 checklist (Page et al., 2021, BMJ, 372, n71, <https://doi.org/10.1136/bmj.n71>).

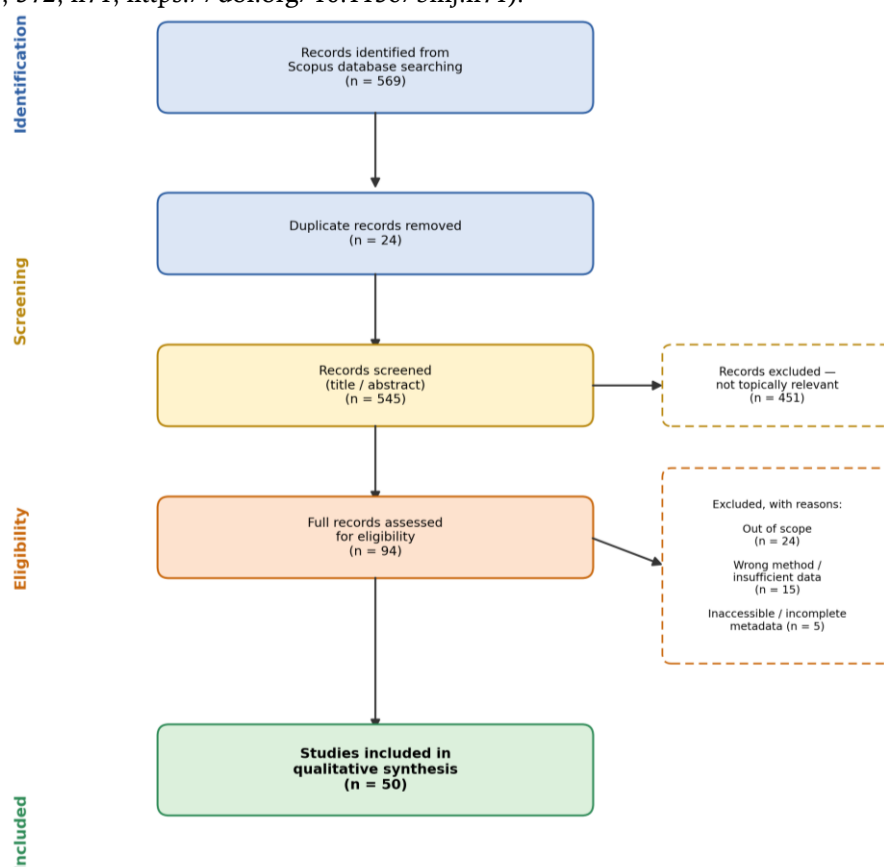


Figure 1. PRISMA 2020 flow diagram summarizing identification, screening, eligibility, and inclusion of studies (n = 50 included).

Results and Discussions

Study Selection Results

Of the 569 records from Scopus that were dated up to and including 8 September 2026, there were duplicates found as being duplicates and thus 24 of them were deleted which left 545 papers. The titles and the keywords from the authors are used to eliminate 451 records since they did not pertain to the three themes of warm-up, stretching, and exercise/competition-performance (many of which turned out to be unrelated computer sciences and engineering fields due to accidental keyword matches). From the 94 records that were still considered after the screening for the top-level topic, 24 were considered outside the scope of the warm-up sequencing topic of the review, 15 had been identified to be methodologically insufficient or to have a non-comparative research design that would have been inappropriate, and 5 were discarded on the basis of bibliographic information that was either incomplete or inaccessible. The results were the remaining 50 studies that were included in the synthesis, appraisal of the studies, and listed at the end of this review together with the references.

Descriptive Characteristics

Table 2. Summary of Included Studies (n = 10 of 50 included studies)

Title	Author(s)	Year	Method	Key Findings
Lunge exercises with blood-flow restriction induces post-activation potentiation and improves vertical jump performance	Doma et al.	2020	Randomized crossover, resistance-trained males	Blood-flow-restricted lunges elicited PAP and improved subsequent vertical jump height.
Sequencing Effects of Plyometric Training Applied Before or After Regular Soccer Training on Measures of Physical Fitness in Young Players	Ramirez-Campillo et al.	2020	Randomized controlled trial, youth soccer players	Order of plyometric training relative to soccer training differentially affected fitness adaptations.

Effects of the FIFA 11+ and a modified warmup programme on injury prevention and performance improvement among youth male football players	Asgari et al.	2022	Randomized controlled trial, youth male footballers	FIFA 11+ and a modified version both improved performance and injury-related outcomes.
Warm-up optimization in amateur male soccer players: A comparison of small-sided games and traditional warm-up routines on physical fitness qualities	Thapa et al.	2023	Crossover comparison, amateur soccer players	Small-sided games produced comparable or superior fitness responses versus traditional warm-up.
Acute effects of dynamic versus foam rolling warm-up strategies on physical performance in elite tennis players	Lopez-Samanes et al.	2021	Randomized crossover, elite tennis players	Dynamic and foam-rolling warm-ups produced differential effects on performance measures.
Dynamic warm-up with a weighted vest: Improvement of repeated change-of-direction performance in young male soccer players	Turki et al.	2020	Randomized crossover, young soccer players	Weighted-vest dynamic warm-up improved repeated change-of-direction performance.
Acute Effects of a Static vs. a Dynamic Stretching Warm-up on Repeated-Sprint Performance in Female Handball Players	Zmijewski et al.	2020	Randomized crossover, female handball players	Dynamic stretching warm-up produced more favorable repeated-sprint performance than static stretching.
The effectiveness of a practical half-time re-warm-up strategy on performance and the physical response to soccer-specific activity	Fashioni et al.	2020	Randomized controlled, soccer players	A practical re-warm-up strategy attenuated half-time performance decrements.
The effects of post-activation performance enhancement and different warm-up protocols on swim start performance	Đurović et al.	2022	Randomized crossover, competitive swimmers	PAPE-based warm-up protocols improved swim-start performance relative to standard warm-up.
Examining the Influence of Warm-Up Static and Dynamic Stretching, as well as Post-Activation Potentiation Effects, on the Acute Enhancement of Gymnastic Performance: A Systematic Review with Meta-Analysis	Yu et al.	2024	Systematic review with meta-analysis, gymnasts	Combined stretching and PAP-based warm-up components acutely enhanced gymnastic performance.

Different types of studies from around ten included papers are presented in Tabel 2 as an example of the variety of people, sports, and warm-up methods that were covered in this review, The whole 50 papers that were referred to in this review are also metioned in the sections, “Results and Discussion” baseides the entire list can be found in the “References”. Table 2 intentionally presents an illustrative subset of 10 of the 50 included studies, selected to span all four thematic clusters, rather than the full extraction table, for reasons of space; the complete data-extraction table covering all 50 studies (author, year, method, sample, and key findings) is available from the corresponding author on reasonable request.

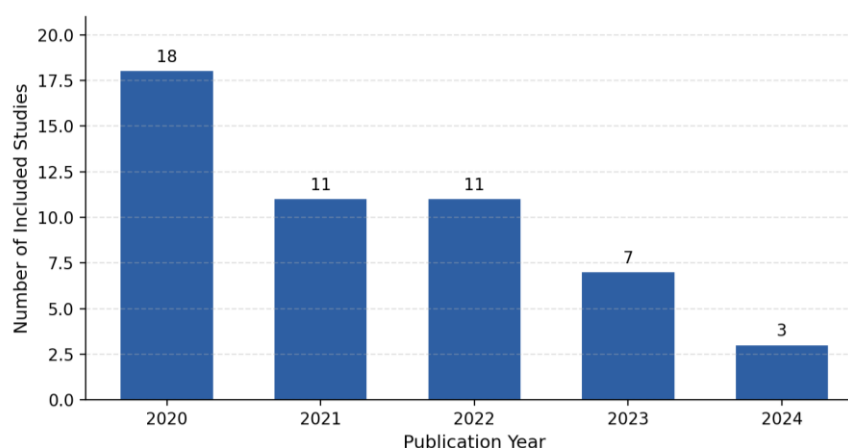


Figure 2. Publication trend of the 50 included studies by year, calculated directly from the Scopus export (2020–2024).

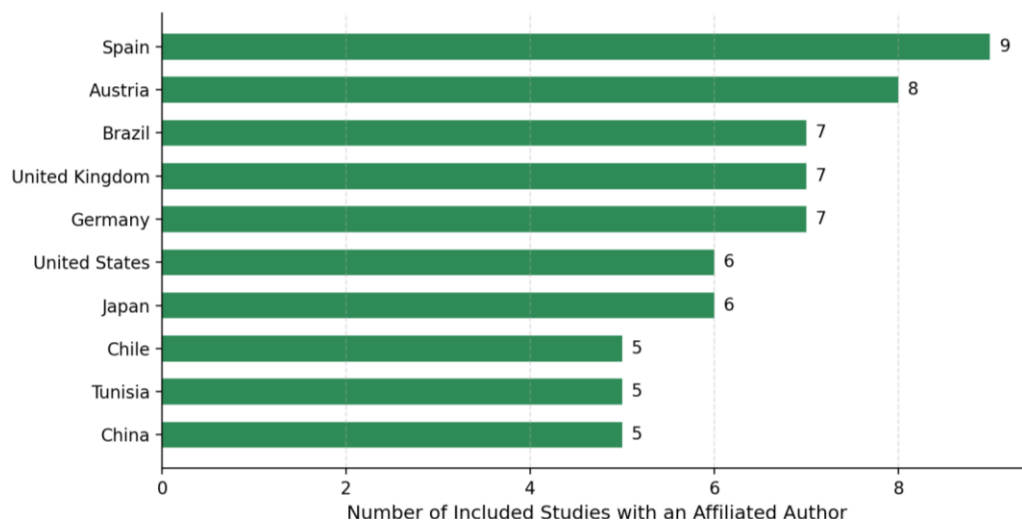


Figure 3. Top 10 contributing countries among the 50 included studies, based on author affiliation countries extracted from the Scopus export.

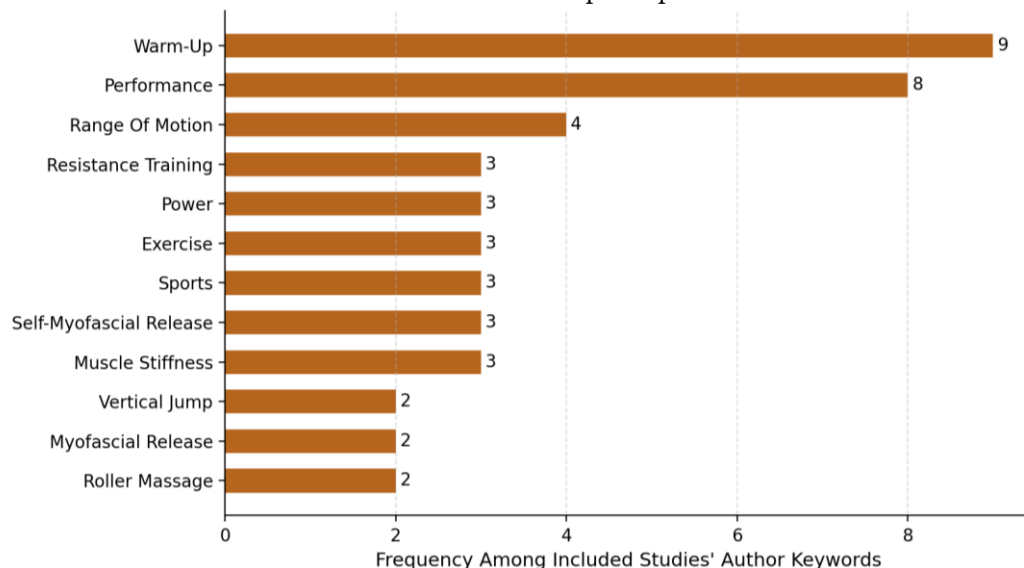


Figure 4. Most frequent author keywords among the 50 included studies, based on the Author Keywords field of the Scopus export.

Thematic Synthesis

Findings for RQ1: Optimal Sequencing of General, Dynamic, Sport-Specific, and Activation Components

In the studies reviewed, the primary sequencing strategy that emerged was the placement of activation/potentialization components either at the end or just after the warm-up to immediately precede the exercise for which they have been prescribed. Blood Flow Restricted Lunges (Doma et al. 2020), high-intensity flywheel loading (Maroto-Izquierdo et al. 2020), and heavy-load, velocity-based bench-press-throw protocols (Tsoukos et al. 2021) all resulted in potentiation effect time-dependent, and therefore these types of work have to be the last sequence item in the warm-up session and not to be mixed together with the early warm-up elements. Similarly to this approach, cluster-set and rest-redistribution structures serve as practical means for potentiating loads without inducing fatigue ahead of the competition (Jukic et al. 2022), whereas different approaches of postactivation potentiation protocols between traditional- and cluster-set show that the last activation recovery interval plays a major role in determining the vertical jump level after the exercise (Iacono et al. 2020).

The idea behind the organization of such pre-planned sports programs as FIFA 11+ is the general-to-specific movement sequencing where sport-specific activities are the last in the sequence. Such logic suggests that one starts with a light running session and then progressively performs strength, plyometric, and balance exercises before the sport activity itself. Short-term use of this type of training has improved agility and jump performance for young players (Trajković et al., 2020), while the modified form of such training was also found to be beneficial in the aspect of both performance and the prevention of injury among adolescent boy footballers

(Asgari et al., 2022). Similar positive results have been found in elite female futsal players undergoing a five-week intervention (Patti et al., 2022). The research which compares small-sided games as one the alternative means for the traditional warm-up sessions shows that if an activity with sport-specific movements is ecologically valid and introduced at the tail end of the sequence it can match or provide even greater physical benefits than conventional drills (Thapa et al., 2023). Dynamic warm-ups that have been added with external load via a weighted vest have also been proven to further enhance repeated change-of-direction performance beyond that of the standard protocol (Turki et al., 2020).

Population-specific evidence is supporting the idea that an optimal sequence will not be the same for all situations. Through a breakdown of force-time metrics performed by NBA players, it has been found out that factors such as playing position and starting status are linked to completely different countermovement jump profiles (Cabarkapa et al., 2023a, 2023b). Hence, it can be inferred that the number of movements, the intensity, and the content of the activation phase may require individual adjustments even within one team's warm-up routine. This is corroborated by a number of sports and population-specific calibration studies such as using reactive agility devices assessments in youth soccer (Hoffman, 2020), jump ropes-based conditioning in the endurance runners (García-Pinillos et al., 2020), and the development of bloodflowrestriction running protocols (Chen et al., 2021). These suggest that rather than having a one-size-fits-all structure of warm-up one should instead be developing a sport- and population-specific warm-up structure.

Findings for RQ2: Stretching Modality, Myofascial Technique, and Sequence Position

The papers available present a relatively detailed picture of stretching modality and what combination is most efficient. Static stretching for a prolonged period, e.g., 20 seconds or longer, results in a temporary decrease in muscle strength and shear elastic modulus, and the authors Sato et al. (2020) describe it as a negative change. A meta-analysis which re-evaluated the classic issue of stretch-related force loss by means of multi-level methods has confirmed that this effect, although small, is consistent throughout all studies (Warneke & Lohmann, 2024). This is likely, since static stretching is not a pre-activity activity but rather an activity which one does in advance. By contrast, dynamic stretching is mainly correlated with more favorable repeated-sprint and change-of-direction results when situated towards the end of the sequence. Zmijewski et al. (2020) and Turki et al. (2020) have described this.

Myofascial release methods through foam rolling and vibration foam rolling seem to work well when used in sequence with stretching, rather than replacing one or the other. According to a thorough review along with combining different methods, studies show that stretching combined with foam rolling increases joint range of motion and physical performance consistently, whereas stretching or foam rolling alone does not, both immediately (Konrad et al., 2021b) and during an extended practice time period (Konrad et al., 2021a). Vibration foam rolling and static stretching were directly compared on the changes of hamstring mechanical properties (Reiner et al., 2022) and vibration foam rolling versus standard foam rolling was analyzed based on the effects on knee-extensor properties (Kasahara et al., 2022), the evidence suggested that vibration-based techniques offered more acute advantage than standard foam rolling, a trend that was supported when a combination of stretching with vibration foam rolling (Nakamura et al., 2023) and vibration foam rolling with local vibration in the tennis-specific warm-up exercise was introduced (Wang et al., 2022). Joint use of different methods producing the same kinds of benefits are documented for dynamic + static stretching combination stretching methods of a table tennis training program (Hsu, Yung-Chun et al., 2021), vibration rolling with and without dynamic muscle contraction for ankle mobilization (Lyu et al., 2020) and also for a single proprioceptive neuromuscular facilitation stretch paired with post-stretch activation on plantar flexor mechanical properties (Reiner et al., 2021).

Debates are still going on about what causes the ergogenic effect of foam rolling, whether it is because of the myofascial technique or if it is just a reflection of a general dynamic warm-up effect. Warneke et al. (2023) in a carefully designed comparative experiment that aimed to separate these mechanisms concluded that foam-rolling-specific effects could not really be separated from the general warm-up-induced potentiation. This uncertainty affects sequencia planning recommendations directly as it shows that the benefit added by including the dedicated myofascial release step would be heavily dependent on the presence of other warm-up components in the sequence. Elite tennis sport evidence serves again as illustration, showing that dynamic-stretching-based and foam-rolling-based warm-up methods lead to different performance outcome in same athlete groups (López-Samanes et al., 2021). Also, in case of comparing post-activation performance enhancements due to dynamic stretching with those of heavy-load protocols one observed that modalities-dependent benefits were pretty much the same (Moreno- Pérez et al., 2021). A gymnastic-specific meta-analytical research shows that combining warm-up-stretching with the post-activation potentiation elements results in a greater and immediate performance enhancement than stretching alone (Yu et al., 2024). Moreover, a combined-modality performance enhancement was also seen in a change of mechanical characteristics of a particular muscle group (triceps

brachii) due to acute bench-press exercises (Trybulski et al., 2022) as well as in case of a post-activation performance enhancement with the caffeine augmentation for female volleyball players (Filip-Stachnik et al., 2022).

Findings for RQ3: Psychological, Chronobiological, and Environmental Moderators

In some cases, however, there is a smaller yet rather consistent set of research findings that support the notion that the effectiveness of a warm-up program that is physiologically identical is not an automatic thing but is influenced by psychological and environmental factors too. The authors of the work found that when they provided motivational music to participants during the warm up, they were able to reduce the negative effects of the short-term cognitive and max performance that occur when one is partially sleep deprived. They also observed that the size of this protective effect differed by time of day (Khemila et al., 2021). On the other hand, when they played music during a repeated-sprint protocol, it was found that the performance and the psychophysiological responses improved without interference from the other variables in the experiment. This was for healthy individuals who are physically active (Jebabli et al., 2023). Another example is the interaction of menstrual-cycle phase with music-based interventions, which resulted in shaping short-term exercise performance in a group of female handball players with different menstrual cycles. The findings suggest that hormonal status is also a contextual factor that is relevant to determining the variability in warm-up outcomes (Ghazel et al., 2022).

Temporal effects are not only applicable to music-based interventions but can also influence the maximal performance of short-duration exercise activities depending on the different time of the day (Mirizio et al., 2020). These fluctuations of performance across the day can lead to the situation where a warm-up routine that was tested successfully at a certain hour of the day may fail to give the same results when a competition is scheduled on another hour of the day. In terms of underlying biology, data on prolonged retention of muscle nuclei and regulation of gene expression by strength training (Cumming et al., 2024) suggest that the athlete's overall training history may be regarded as a sort of physiological "muscle memory," which could affect the degree of warmth-up that is required to elicit potentiation an important factor which has so far played very little or no part in warm-up sequencing research.

These moderating aspects were also shown in the non-elite and the developmental populations that are part of this review. Structured Core-conditioning warm-ups enhanced the movement capability and the balance and the physical fitness of school children (Chang et al., 2020). Also, broader physical activity interventions enhanced the physical fitness of schoolchildren (Thomas et al., 2020). Moreover, acute physical activity executive function differentially in preschoolers depending on their habitual level activity (Zhang et al., 2020)- which together show that psychosocial and developmental factors play a role in determining the effect of warm-up, even when outside of professional sport. Practical half-time re-warm-up strategies (Fashioni et al., 2020) as well as meta-analysis-based evidence on re-warm-up strategies beyond the competitive setting (González-Devesa et al., 2021) further demonstrate that environmental factors like extended passive rest during half-time intervals typical in competitive settings can negate the advantages of the well-planned warm-up unless a dedicated re-warm-up plan is employed, thereby pointing out the importance of the sequence not being viewed independently but rather as a factor that is to be taken into consideration with the circumstance that a warm-up is taking place.

Interpretation of findings

Talking to athletes about warming up, one way or another, the synthesis reveals that there is one best approach. One best way to warm up the body is to start with general low-intensity physical activities such as walking or easy-paced jogging while incorporating some body-mobility exercises. Later, one should move towards dynamic stretching which is different from static stretching since it uses controlled movements and can be incorporated with sport-specific components. As long as the sport allows it, a session of myofascial release will follow the other steps. The warm-up sequence is finally topped by sport-specific drills and a targeted activation or potentiation which should ideally happen just before the competition or test begins.

Theoretical implications

These results further the post-activation potentiation and performance enhancement theories by providing new evidence that their acute and time-sensitive properties are most effectively utilized when the potentiating stimuli are delivered at the end, on the one hand. On the other hand, the research also shows that the stretch-induced force deficits that have been observed for static stretching (Warneke & Lohmann, 2024) constitute some boundary conditions as to when static-stretching content should be safely incorporated in the sequence such that the subsequent potentiation is not blunted.

Practical implications

These findings will be particularly useful for coaches and sport practitioners to prescribe individualized warm-up programs that may vary based on the playing position or role (Cabarkapa et al., 2023a, 2023b); sport-specific

movement pattern demands (Palucci Vieira et al., 2021); and different situational elements such as half-time break (Fashioni et al., 2020; González-Devesa et al., 2021), in addition to the mindful use of psychological preparedness methods such as motivational music mainly if conditions of limited sleep or adverse competition timetable is present (Khemila et al., 2021; Jebabli et al., 2023).

Comparison with prior reviews

Different from the above-reviewed previous systematic, critical reviews, most of the attention has been given only to warm-up effects in one specific sport, e.g., soccer kicking performance (Palucci Vieira et al., 2021), or only to a single modality, e.g., foam rolling and stretching (Konrad et al., 2021a, 2021b); on the contrary, this paper brings together evidence from various sports, exercises, and psychological mediators, providing a much more detailed warm-up sequence framework than a combination of these elements done up to now. This synthesis is positioned against, and extends, a broader set of single-modality and single-population studies than those two reviews alone, including sequencing and dosage evidence on post-activation potentiation and flywheel loading (Doma et al., 2020; Maroto-Izquierdo et al., 2020; Tsoukos et al., 2021; Iacono et al., 2020; Jukic et al., 2022), stretching and myofascial-release comparisons (Sato et al., 2020; Reiner et al., 2021, 2022; Kasahara et al., 2022; Nakamura et al., 2023; Lyu et al., 2020; Hsu et al., 2021; Wang et al., 2022; Warneke et al., 2023), structured sport-specific programs (Trajković et al., 2020; Asgari et al., 2022; Patti et al., 2022; Thapa et al., 2023; Turki et al., 2020; Zmijewski et al., 2020; Lopez-Samanes et al., 2021; González-Devesa et al., 2021; Fashioni et al., 2020; Ramirez-Campillo et al., 2020), and psychological/chronobiological moderators (Khemila et al., 2021; Jebabli et al., 2023; Ghazel et al., 2022; Mirizio et al., 2020; Cumming et al., 2024), so that, across these more than 25 primary studies, the present review's contribution is the cross-cutting synthesis rather than any single comparison.

Contradictions in the literature

Warneke et al. (2023) have indicated that the question of whether foam-rolling mechanisms are indeed specific and distinguishable from general dynamic warm-up mechanisms has not yet been settled. Besides that, results from studies of the stretch modality are often inconsistent in relation to the direction of the effect as stretching duration, sport activity, and outcome measures vary (Sato et al., 2020; Zmijewski et al., 2020). In this case, sequences of exercise should not be conceived of as immutable laws, but rather as tendencies that are likely or highly probable.

Research gaps

Three main gaps need a close look: (1) There is a lack of research directly comparing the effects of entire warm-up routines (instead of individual components) in a single study design; (2) Researchers haven't paid much attention to how the sequence of warm-up activities is affected by mental and biological factors, although it is known that these factors influence the results (Khemila et al., 2021; Mirizio et al., 2020); (3) There is little known about whether an athlete's longtime training experience and state of neuromuscular adjustment (Cumming et al., 2024) would result in the necessity of customized sequencing of warm-up instead of standard prescriptions only.

Limitations of this review

This article acknowledges at least three major limitations. First, synthesis work was based only on using one bibliography database (Scopus) without considering supplementary sources like PubMed and SPORTDiscus, thus excluding studies relevant to the paper. Second, quality assessment of the included works through the FICO framework was mainly based on the abstracts and bibliometric information provided in Scopus instead of the full texts of the works because of the limited scope of the source. Third, this systematic review is a summary of research findings in several different types of sports, involving varied populations, and measuring various different outcome indicators, such that it may not be feasible to make a comprehensive recommendation for everyone in the sports setting. Fourth, screening, eligibility assessment, and FICO appraisal were performed by a single reviewer rather than two or more independent reviewers, so no inter-rater reliability statistic could be reported; this limits the replicability of the study-selection process. Fifth, the eligibility criteria restricted inclusion to English-language records published in 2020-2026, which likely excludes relevant foundational, pre-2020, and non-English-language literature and constrains the geographic and disciplinary diversity of the evidence base.

Future research agenda

Absolutely nothing changes in terms of recommendations if your warm-up is the standard one that most people use, with stretching in the beginning, then the cardio stuff, then the muscle work for the specific activity. However, if you want to go one step further and really understand how a whole sequence is effective compared to other sequences then you can do that by randomized trials which look at entire warm-up sequences only or, in other words, the whole sequence of activities that you do in the warm-up, compared rather than just the isolated components in the warm-up. Moreover, the researchers may also include psychological-readiness and chronobiological measures as covariates in warm-up sequencing experiments. Last but not the least, they could

make some individualized warm-up algorithm that could be able to cater to the demands of players by taking into account their specific position during the game, a training history and the kind of competitive situation. In developing such an algorithm they would be using the already developing approaches by professional sports teams called force-time-metric (references: Cabarkapa et al., 2023a, 2023b).

If we are to be directly and fully in harmony with the research questions, one of the best ways to describe RQ1 is to present through a sequence that goes from general to sport specific to activation, with the potentiation components coming last; as for RQ2, the combination and placement of dynamic stretching and myofascial Release after static stretching and prior to the sport-specific and activation phases make the most sense from a benefits' standpoint; and finally, RQ3 verifies that it is psychological, Chronobiological. Environmental moderators that have the potential to change meaningfully the result of a warm-up sequence which would have been identical in all aspects, and should therefore be explicitly taken into account by the person designing a practical warm-up prescription.

Conclusions

This systematic review of the literature pooled over 50 studies to see what was best practice in warm-up activity sequencing immediately before exercise and sport. The principal novel contribution of this review is the integration, within a single synthesis, of physiological sequencing evidence with the psychological, chronobiological, and environmental moderators of warm-up effectiveness -- an integration not undertaken by prior single-sport or single-modality reviews (e.g., Palucci Vieira et al., 2021; Konrad et al., 2021a, 2021b). Based on this work of synthesis of findings, the main takeaway seems to be that a good warm-up usually proceeds generally through three levels starting with general aerobic and mobility exercises, followed by dynamic stretching and myofascial release done appropriately in combination. This is usually followed by sport-specific drills and concluding with a targeted neuromuscular activation or post-activation potentiation component delivered close to the onset of performance. In the case of static stretching, however, where it was included, it was found to be best introduced earlier so that the possible force deficits caused by temporary stretching would not have too much carry over into the performance. This review also confirms the impact of psychological, chronobiological, and environmental factors, like motivational music, time of day, sleep states, etc., and menstrual-cycle phase on performance effectiveness that were moderated by different factors meaning, these factors should not be seen as just side notes in warm-up design. As a practical matter, these findings help to coach and strength conditioning practitioners as well as sport scientists to build personalized, periodized warm-up protocols that are sensitive to playing position, competitive context, and athlete readiness that will not be relying on generic, one-size-fits-all routines. As the review is limited to one bibliographic database, only quality appraisal from the abstract and a variety of populations and outcome measures are mentioned in its limitations. Screening and quality appraisal were also conducted by a single reviewer, which further constrains the certainty of these conclusions. Research to directly compare different total warm-up sequences, to factor in psychological-readiness variables, and to come up with individualized sequencing tools needs to carry the translation of these principles into specific, prescriptive advice suitable to various population.

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References

- Asgari, M., Alizadeh, M. H., Shahrbanian, S., Nolte, K., & Jaitner, T. (2022). Effects of the FIFA 11+ and a modified warmup programme on injury prevention and performance improvement among youth male football players. *PLoS ONE*, 17(10 October), Article e0275545. <https://doi.org/10.1371/journal.pone.0275545>
- Cabarkapa, D., Cabarkapa, D. V., Aleksic, J., Philipp, N. M., Scott, A. A., Johnson, Q. R., & Fry, A. C. (2023a). Differences in countermovement vertical jump force-time metrics between starting and non-starting professional male basketball players. *Frontiers in Sports and Active Living*, 5, Article 1327379. <https://doi.org/10.3389/fspor.2023.1327379>

- Cabarkapa, D., Philipp, N. M., Cabarkapa, D. V., & Fry, A. C. (2023b). Position-specific differences in countermovement vertical jump force-time metrics in professional male basketball players. *Frontiers in Sports and Active Living*, 5, Article 1218234. <https://doi.org/10.3389/fspor.2023.1218234>
- Chang, N. -J., Tsai, I. -H., Lee, C. -L., & Liang, C. -H. (2020). Effect of a six-week core conditioning as a warm-up exercise in physical education classes on physical fitness, movement capability, and balance in school-aged children. *International Journal of Environmental Research and Public Health*, 17(15), 1-11. <https://doi.org/10.3390/ijerph17155517>
- Chen, Y. -T., Hsieh, Y. -Y., Ho, J. -Y., & Lin, J. -C. (2021). Effects of Running Exercise Combined With Blood Flow Restriction on Strength and Sprint Performance. *Journal of Strength and Conditioning Research*, 35(11), 3090-3096. <https://doi.org/10.1519/JSC.0000000000003313>
- Cumming, K. T., Reitzner, S. M., Hanslien, M., Skilnand, K., Seynnes, O. R., Horwath, O., Psilander, N., Sundberg, C. J., & Raastad, T. (2024). Muscle memory in humans: evidence for myonuclear permanence and long-term transcriptional regulation after strength training. *Journal of Physiology*, 602(17), 4171-4193. <https://doi.org/10.1113/JP285675>
- Doma, K., Leicht, A. S., Boulosa, D., & Woods, C. T. (2020). Lunge exercises with blood-flow restriction induces post-activation potentiation and improves vertical jump performance. *European Journal of Applied Physiology*, 120(3), 687-695. <https://doi.org/10.1007/s00421-020-04308-6>
- Fashioni, E., Langley, B., & Page, R. M. (2020). The effectiveness of a practical half-time re-warm-up strategy on performance and the physical response to soccer-specific activity. *Journal of Sports Sciences*, 38(2), 140-149. <https://doi.org/10.1080/02640414.2019.1686941>
- Filip-Stachnik, A., Spieszny, M., Stanisz, L., & Krzysztofik, M. (2022). Does caffeine ingestion affect the lower-body post-activation performance enhancement in female volleyball players?. *BMC Sports Science, Medicine and Rehabilitation*, 14(1), Article 93. <https://doi.org/10.1186/s13102-022-00488-0>
- García-Pinillos, F., Lago-Fuentes, C., Latorre-Román, P. A., Pantoja-Vallejo, A., & Ramirez-Campillo, R. (2020). Jump-rope training: Improved 3-km time-trial performance in endurance runners via enhanced lower-limb reactivity and foot-arch stiffness. *International Journal of Sports Physiology and Performance*, 15(7), 927-933. <https://doi.org/10.1123/ijsp.2019-0529>
- Ghazel, N., Souissi, A., Chtourou, H., Aloui, G., & Souissi, N. (2022). The effect of music on short-term exercise performance during the different menstrual cycle phases in female handball players. *Research in Sports Medicine*, 30(1), 50-60. <https://doi.org/10.1080/15438627.2020.1860045>
- González-Devesa, D., Vaquera, A., Suárez-Iglesias, D., & Ayán-Pérez, C. (2021). The efficacy of re-warm-up practices during half-time: A systematic review. *Medicina (Lithuania)*, 57(9), Article 976. <https://doi.org/10.3390/medicina57090976>
- Harat, I., Clark, N. W., Boffey, D., Herring, C. H., Goldstein, E. R., Redd, M. J., Wells, A. J., Stout, J. R., & Fukuda, D. H. (2020). Dynamic post-activation potentiation protocol improves rowing performance in experienced female rowers. *Journal of Sports Sciences*, 38(14), 1615-1623. <https://doi.org/10.1080/02640414.2020.1754110>
- Hoffman, J. R. (2020). Evaluation of a Reactive Agility Assessment Device in Youth Football Players. *Journal of Strength and Conditioning Research*, 34(12), 3311-3315. <https://doi.org/10.1519/JSC.0000000000003867>
- Hsu, F. -Y., Tsai, K. -L., Lee, C. -L., Chang, W. -D., & Chang, N. -J. (2021). Effects of dynamic stretching combined with static stretching, foam rolling, or vibration rolling as a warm-up exercise on athletic performance in elite table tennis players. *Journal of Sport Rehabilitation*, 30(2), 198-205. <https://doi.org/10.1123/JSR.2019-0442>
- Iacono, A. D., Beato, M., & Halperin, I. (2020). The effects of cluster-set and traditional-set postactivation potentiation protocols on vertical jump performance. *International Journal of Sports Physiology and Performance*, 15(4), 464-469. <https://doi.org/10.1123/ijsp.2019-0186>
- Jebabli, N., Ben Aabderrahman, A., Boulosa, D., Chtourou, H., Ouerghi, N., Rhibi, F., Govindasamy, K., Saeidi, A., Clark, C. C. T., Granacher, U., & Zouhal, H. (2023). Listening to music during a repeated sprint test improves performance and psychophysiological responses in healthy and physically active male adults. *BMC Sports Science, Medicine and Rehabilitation*, 15(1), Article 21. <https://doi.org/10.1186/s13102-023-00619-1>
- Jukic, I., Helms, E. R., McGuigan, M. R., & García-Ramos, A. (2022). Using cluster and rest redistribution set structures as alternatives to resistance training prescription method based on velocity loss thresholds. *PeerJ*, 10, Article e13195. <https://doi.org/10.7717/peerj.13195>
- Kapnia, A., Dallas, C. N., Gerodimos, V., & Flouris, A. D. (2023). Impact of Warm-Up on Muscle Temperature and Athletic Performance. *Research Quarterly for Exercise and Sport*, 94(2), 460-465. <https://doi.org/10.1080/02701367.2021.2007212>
- Kasahara, K., Konrad, A., Yoshida, R., Murakami, Y., Koizumi, R., Sato, S., Ye, X., Thomas, E., & Nakamura, M. (2022). Comparison of the Prolonged Effects of Foam Rolling and Vibration Foam

- Rolling Interventions on Passive Properties of Knee Extensors. *Journal of Sports Science and Medicine*, 21(4), 580-585. <https://doi.org/10.52082/jssm.2022.580>
- Khemila, S., Abedelmalek, S., Romdhani, M., Souissi, A., Chtourou, H., & Souissi, N. (2021). Listening to motivational music during warming-up attenuates the negative effects of partial sleep deprivation on cognitive and short-term maximal performance: Effect of time of day. *Chronobiology International*, 38(7), 1052-1063. <https://doi.org/10.1080/07420528.2021.1904971>
- Konrad, A., Nakamura, M., Bernsteiner, D., & Tilp, M. (2021a). The accumulated effects of foam rolling combined with stretching on range of motion and physical performance: a systematic review and meta-analysis. *Journal of Sports Science and Medicine*, 20(3), 535-545. <https://doi.org/10.52082/jssm.2021.535>
- Konrad, A., Tilp, M., & Nakamura, M. (2021b). A Comparison of the Effects of Foam Rolling and Stretching on Physical Performance. A Systematic Review and Meta-Analysis. *Frontiers in Physiology*, 12, Article 720531. <https://doi.org/10.3389/fphys.2021.720531>
- Lopez-Samanes, A., Del Coso, J., Hernández-Davó, J. L., Moreno-Pérez, D., Romero-Rodriguez, D., Madruga-Parera, M., Muñoz, A., & Moreno-Pérez, V. (2021). Acute effects of dynamic versus foam rolling warm-up strategies on physical performance in elite tennis players. *Biology of Sport*, 38(4), 595-601. <https://doi.org/10.5114/biolSport.2021.101604>
- Lyu, B. -J., Lee, C. -L., Chang, W. -D., & Chang, N. -J. (2020). Effects of vibration rolling with and without dynamic muscle contraction on ankle range of motion, proprioception, muscle strength and agility in young adults: A crossover study. *International Journal of Environmental Research and Public Health*, 17(1), Article 354. <https://doi.org/10.3390/ijerph17010354>
- Maroto-Izquierdo, S., Bautista, I. J., & Rivera, F. M. (2020). Post-activation performance enhancement (PAPE) after a single bout of high-intensity flywheel resistance training. *Biology of Sport*, 37(4), 343-350. <https://doi.org/10.5114/BIOLSPORT.2020.96318>
- Mirizio, G. G., Nunes, R. S. M., Vargas, D. A., Foster, C., & Vieira, E. (2020). Time-of-Day Effects on Short-Duration Maximal Exercise Performance. *Scientific Reports*, 10(1), Article 9485. <https://doi.org/10.1038/s41598-020-66342-w>
- Moreno-Pérez, V., Hernández-Davó, J. L., Nakamura, F., López-Samanes, Á., Jiménez-Reyes, P., Fernández-Fernández, J., & Behm, D. G. (2021). Post-activation performance enhancement of dynamic stretching and heavy load warm-up strategies in elite tennis players. *Journal of back and musculoskeletal rehabilitation*, 34(3), 413-423. <https://doi.org/10.3233/BMR-191710>
- Nakamura, M., Konrad, A., Kasahara, K., Yoshida, R., Murakami, Y., Sato, S., Aizawa, K., Koizumi, R., & Wilke, J. (2023). The Combined Effect of Static Stretching and Foam Rolling With or Without Vibration on the Range of Motion, Muscle Performance, and Tissue Hardness of the Knee Extensor. *Journal of Strength and Conditioning Research*, 37(2), 322-327. <https://doi.org/10.1519/JSC.0000000000004263>
- Palucci Vieira, L. H., Santinelli, F. B., Carling, C., Kellis, E., Santiago, P. R. P., & Barbieri, F. A. (2021). Acute Effects of Warm-Up, Exercise and Recovery-Related Strategies on Assessments of Soccer Kicking Performance: A Critical and Systematic Review. *Sports Medicine*, 51(4), 661-705. <https://doi.org/10.1007/s40279-020-01391-9>
- Patti, A., Giustino, V., Cataldi, S., Stoppa, V., Ferrando, F., Marvulli, R., Farì, G., Neş, Ş. F., Bianco, A., Muscella, A., Greco, G., & Fischetti, F. (2022). Effects of 5-Week of FIFA 11+ Warm-Up Program on Explosive Strength, Speed, and Perception of Physical Exertion in Elite Female Futsal Athletes. *Sports*, 10(7), Article 100. <https://doi.org/10.3390/sports10070100>
- Ramirez-Campillo, R., Alvarez, C., Gentil, P., Loturco, I., Sanchez-Sanchez, J., Izquierdo, M., Moran, J., Nakamura, F. Y., Chaabene, H., & Granacher, U. (2020). Sequencing Effects of Plyometric Training Applied Before or After Regular Soccer Training on Measures of Physical Fitness in Young Players. *Journal of Strength and Conditioning Research*, 34(7), 1959-1966. <https://doi.org/10.1519/JSC.0000000000002525>
- Reiner, M., Tilp, M., Guilhem, G., Morales-Artacho, A., Nakamura, M., & Konrad, A. (2021). Effects of a Single Proprioceptive Neuromuscular Facilitation Stretching Exercise With and Without Post-stretching Activation on the Muscle Function and Mechanical Properties of the Plantar Flexor Muscles. *Frontiers in Physiology*, 12, Article 732654. <https://doi.org/10.3389/fphys.2021.732654>
- Reiner, M. M., Tilp, M., Guilhem, G., Morales-Artacho, A., & Konrad, A. (2022). Comparison of A Single Vibration Foam Rolling and Static Stretching Exercise on the Muscle Function and Mechanical Properties of the Hamstring Muscles. *Journal of Sports Science and Medicine*, 21(2), 287-297. <https://doi.org/10.52082/jssm.2022.287>
- Sato, S., Kiyono, R., Takahashi, N., Yoshida, T., Takeuchi, K., & Nakamura, M. (2020). The acute and prolonged effects of 20-s static stretching on muscle strength and shear elastic modulus. *PLoS ONE*, 15(2), Article e0228583. <https://doi.org/10.1371/journal.pone.0228583>

- Thapa, R. K., Clemente, F. M., Moran, J., Garcia-Pinillos, F., Scanlan, A. T., & Ramirez-Campillo, R. (2023). Warm-up optimization in amateur male soccer players: A comparison of small-sided games and traditional warm-up routines on physical fitness qualities. *Biology of Sport*, 40(1), 321-329. <https://doi.org/10.5114/biolSport.2023.114286>
- Thomas, E., Bianco, A., Tabacchi, G., da Silva, C. M., Loureiro, N., Basile, M., Giaccone, M., Sturm, D. J., Şahin, F. N., Güler, Ö., Gómez-López, M., Sánchez, G. F. L., Pajaujiene, S., Zuoziene, I. J., Rada, A., Alesi, M., & Palma, A. (2020). Effects of a physical activity intervention on physical fitness of schoolchildren: The enriched sport activity program. *International Journal of Environmental Research and Public Health*, 17(5), Article 1723. <https://doi.org/10.3390/ijerph17051723>
- Trajković, N., Gušić, M., Molnar, S., Mačak, D., Madić, D. M., & Bogataj, Š. (2020). Short-term FIFA 11+ improves agility and jump performance in young soccer players. *International Journal of Environmental Research and Public Health*, 17(6), Article 2017. <https://doi.org/10.3390/ijerph17062017>
- Trybulski, R., Wojdała, G., Alexe, D. I., Komarek, Z., Aschenbrenner, P., Wilk, M., Zajac, A., & Krzysztofik, M. (2022). Acute Effects of Different Intensities during Bench Press Exercise on the Mechanical Properties of Triceps Brachii Long Head. *Applied Sciences (Switzerland)*, 12(6), Article 3197. <https://doi.org/10.3390/app12063197>
- Tsoukos, A., Brown, L. E., Terzis, G., Veligekas, P., & Bogdanis, G. C. (2021). Potentiation of Bench Press Throw Performance Using a Heavy Load and Velocity-Based Repetition Control. *Journal of strength and conditioning research*, 35, S72-S79. <https://doi.org/10.1519/JSC.0000000000003633>
- Turki, O., Dhahbi, W., Gueid, S., Hmaied, S., Souaifi, M., & Khalifa, R. (2020). Dynamic warm-up with a weighted vest: Improvement of repeated change-of-direction performance in young male soccer players. *International Journal of Sports Physiology and Performance*, 15(2), 196-203. <https://doi.org/10.1123/ijssp.2018-0800>
- Wang, F., Zhang, Z., Li, C., Zhu, D., Hu, Y., Fu, H., Zhai, H., & Wang, Y. (2022). Acute effects of vibration foam rolling and local vibration during warm-up on athletic performance in tennis players. *PLoS ONE*, 17(5 May), Article e0268515. <https://doi.org/10.1371/journal.pone.0268515>
- Warneke, K., Aragão-Santos, J. C., Alizadeh, S., Bahrami, M., Anvar, S. H., Konrad, A., & Behm, D. G. (2023). Are Acute Effects of Foam-Rolling Attributed to Dynamic Warm Up Effects? A Comparative Study. *Journal of Sports Science and Medicine*, 22(2), 180-188. <https://doi.org/10.52082/jssm.2023.180>
- Warneke, K., & Lohmann, L. H. (2024). Revisiting the stretch-induced force deficit: A systematic review with multilevel meta-analysis of acute effects. *Journal of Sport and Health Science*, 13(6), 805-819. <https://doi.org/10.1016/j.jshs.2024.05.002>
- Wells, J. E. T., & Langdown, B. L. (2020). Sports science for golf: A survey of high-skilled golfers' "perceptions" and "practices". *Journal of Sports Sciences*, 38(8), 918-927. <https://doi.org/10.1080/02640414.2020.1737350>
- Yi, W., Chen, C., Zhou, Z., Cui, W., & Wang, D. (2022). Acute effects of ballistic versus heavy-resistance exercises on countermovement jump and rear-hand straight punch performance in amateur boxers. *BMC Sports Science, Medicine and Rehabilitation*, 14(1), Article 161. <https://doi.org/10.1186/s13102-022-00557-4>
- Yu, W., Feng, D., Zhong, Y., Luo, X., Xu, Q., & Yu, J. (2024). Examining the Influence of Warm-Up Static and Dynamic Stretching, as well as Post-Activation Potentiation Effects, on the Acute Enhancement of Gymnastic Performance: A Systematic Review with Meta-Analysis. *Journal of Sports Science and Medicine*, 23(1), 156-176. <https://doi.org/10.52082/jssm.2024.156>
- Zhang, B., Liu, Y., Zhao, M., Meng, X., Deng, Y., Zheng, X., Wang, X., Xiong, S., & Han, Y. (2020). Differential effects of acute physical activity on executive function in preschoolers with high and low habitual physical activity levels. *Mental Health and Physical Activity*, 18, Article 100326. <https://doi.org/10.1016/j.mhpa.2020.100326>
- Zmijewski, P., Lipinska, P., Czajkowska, A., Mróz, A., Kapuściński, P., & Mazurek, K. (2020). Acute Effects of a Static vs. a Dynamic Stretching Warm-up on Repeated-Sprint Performance in Female Handball Players. *Journal of Human Kinetics*, 72(1), 161-172. <https://doi.org/10.2478/hukin-2019-0043>
- Đurović, M., Stojanović, N., Stojiljković, N., Karaula, D., & Okičić, T. (2022). The effects of post-activation performance enhancement and different warm-up protocols on swim start performance. *Scientific Reports*, 12(1), Article 9038. <https://doi.org/10.1038/s41598-022-13003-9>
- Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., Ioannidis, J. P. A., Clarke, M., Devereaux, P. J., Kleijnen, J., & Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. *PLoS Medicine*, 6(7), e1000100. <https://doi.org/10.1371/journal.pmed.1000100>
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A.,

-
- Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., ... Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372, n71. <https://doi.org/10.1136/bmj.n71>
- Thomas, J., & Harden, A. (2008). Methods for the thematic synthesis of qualitative research in systematic reviews. *BMC Medical Research Methodology*, 8, Article 45. <https://doi.org/10.1186/1471-2288-8-45>
- Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British Journal of Management*, 14(3), 207-222. <https://doi.org/10.1111/1467-8551.00375>