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ORIGINAL RESEARCH

Western Medical Acupuncture Perception and Use for Pain Management Among Athletes: A Systematic Review

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Purpose: This systematic review aims to assess the use and perception of "Western" medical acupuncture—based on conventional biomedical mechanisms and evidence-based medicine for diagnosis and needle placement—for pain management among athletes and their healthcare providers.

Methods: A systematic review is reported based on the PRISMA guidelines. PubMed, Web of Science, SPORTDiscus, Allied and Complementary Medicine databases, and Google Scholar were searched (search: from database inception to July 2023). Two authors independently conducted multi-stage screening, data extraction, and quality assessment. The outcomes of interest were prevalence of acupuncture prescriptions by healthcare professionals, prevalence of acupuncture use by athletes, and perceptions related to acupuncture effectiveness among healthcare professionals and athletes. Only studies wherein "Western" medical acupuncture was used for pain management were included.

Results: Our review included 11 observational studies and clinical trials. The prevalence of "Western" medical acupuncture prescription varied from 15.4% (UK) to 58.4% (US) among sports medicine healthcare professionals. Prevalence of acupuncture use among athletes ranged from 2.2% among college athletes in Palestine to 61% among professional football players in the Netherlands. Acupuncture was used for managing delayed-onset of soreness and pain due to various types of musculoskeletal injuries. Both athletes and their healthcare providers reported positive perceptions of acupuncture.

Conclusion: Our systematic review identifies a notable research gap in evaluating the practice and perception of "Western" medical acupuncture among healthcare professionals and athletes. Our findings suggest that "Western" medical acupuncture is not only prescribed by sport medicine professionals and used by athletes for diverse musculoskeletal pains but is also generally perceived positively for its effectiveness. Given the positive clinical experience of health professionals, athletes' favorable perception, and acupuncture's well-established safety profile, acupuncture should be given serious consideration—as a complementary approach—in the overall management of pain.

Registration: Open Science Framework (https://osf.io/qb9gc).

Keywords: western medical acupuncture, perception, pain, athletes

Introduction

Delayed-onset muscle soreness (DOMS) and acute and overuse musculoskeletal injuries are common issues among athletes. Managing musculoskeletal pain is crucial for athletes' well-being, performance, and careers.[1] Acupuncture is a frequently employed method in pain management and comes in various forms, including "Western" medical and traditional Chinese, Korean, and Japanese acupuncture.

"Western" medical acupuncture refers to the insertion of needles into specific points guided by principles of anatomy, physiology, pathology, and evidence-based medicine,[2,3] which triggers the release of chemicals in the body such as endorphins, the pain killer hormone.[4] Conventional healthcare professionals practicing "Western" medical acupuncture adhere to evidence-based medicine for diagnosing and treating health conditions, distinct from traditional Asian

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acupuncture concepts like Qi circulation[5] and the Yin/Yang.[2] Although these types of acupuncture methods share many trigger points,[6] "Western" medical and traditional Asian acupuncture are distinct in terms of theoretical foundations and clinical applications.[7] Therefore, distinguishing between them is recommended when synthesizing and reporting data.[8] It is important to recognize that evidence-based acupuncture extends beyond Western regions.[9] Hence, referring to "Western" acupuncture as evidence-based acupuncture and avoiding a geographical label is more accurate and suitable.

Acupuncture's pain reduction effectiveness has been debated in the research literature;[1,10–15] however, no systematic reviews have synthesized healthcare professionals' and athletes' use and their perceptions of "Western" medical acupuncture. Given the high incidence of DOMS[3] and musculoskeletal injuries[16] among athletes and the resulting detrimental effects on their wellbeing and performance, the primary objective of this systematic review is to map the evidence and synthesize the available prevalence data on the use of "Western" medical acupuncture by practitioners and athletes as well as the perceptions of healthcare professionals and athletes regarding the efficacy of acupuncture for pain management. The systematic review aims to pinpoint research gaps and provide a comprehensive synthesis of the existing evidence concerning the perception and utilization of evidence-based acupuncture, often referred to as "Western" medical acupuncture, within the conventional medical community and among athletes.

Methods

The protocol of this research was developed a priori and prospectively registered on Open Science Framework (https://osf.io/qb9gc). The systematic review was developed based on the Cochrane Collaboration Handbook[17] and is reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) extension for acupuncture[8] (Table S1).

The two populations of interest in this study were athletes of all ages (adults and children), who practiced any sport, as well as their healthcare providers. The intervention of interest was evidence-based acupuncture, often called "Western" medical acupuncture, including manual acupuncture (MA), electroacupuncture (EA), or dry needling (DN). These methods should be employed by conventional healthcare practitioners, relying on biomedical mechanisms and evidence-based medicine for diagnosis and needle placement, rather than traditional Asian concepts like Qi circulation[5] and the Yin/Yang.[2]

The outcomes of interest were as follows: (1) prevalence of acupuncture prescriptions by healthcare professionals, (2) prevalence of acupuncture use by the athletes, and (3) perceptions related to acupuncture effectiveness among healthcare professionals and athletes.

PubMed, Web of Science, SPORTDiscus, and the Allied and Complementary Medicine (AMED) databases were searched for primary studies published up to December 2023. A Google Scholar search for gray and non-gray literature was done in February 2022. No language restriction was applied in the search. The search strategy and search terms were refined with the guidance of an experienced librarian. The search terms included controlled vocabulary terms, free-text terms related to the following three key components: intervention (acupuncture), outcome (pain), and population (athletes). This broad search strategy aimed to identify all reports on acupuncture for pain among athletes, encompassing usage and perception. Details on the search strategy are reported in Table S2. The search was supplemented by screening of reference lists of relevant reviews and included articles.

Two authors conducted multi-stage screening independently on Rayyan software (Rayyan Systems Inc, Cambridge, MA, USA).[18] Inclusion criteria comprised studies where pain was diagnosed by a conventional healthcare provider using evidence-based medicine. All levels of pain, including historical or current pain, were considered. Furthermore, acupuncture points were chosen based on anatomy and physiology principles. Studies involving acupuncture practice aligned with traditional Asian principles or associating pain with imbalances in the body's "Qi" energy flow, as well as diagnosing pain through assessment of underlying disharmony patterns, were excluded. Additionally, studies reporting perception of non-athletes and non-conventional healthcare providers were excluded from this review. Any discrepancies in study selection were resolved through team discussion until a 100% agreement was reached.

Data extraction was independently done by two authors in a predesigned extraction sheet developed on Microsoft Excel and included i) study characteristics (eg, study design, sampling method, data collection time, sample size); ii) setting; iii) population description including age and sex; iv) details of the intervention; and v) outcome (eg, prevalence

of prescription, prevalence of athletes' use, perception). Additionally, all independently extracted data were checked for accuracy. Any discrepancies in the extracted data were resolved by discussion among team members.

The risk of bias (ROB) and the quality of the included randomized controlled trials (RCTs) were appraised by one author and checked by another using the Cochrane Collaboration Risk of bias tool.[19] For observational studies, methodological quality was assessed with the NHLBI Study Quality Assessment tool for Observational Cohort and Cross-sectional studies[20] (Table S3). Any discrepancies in quality assessment were resolved by discussion among team members.

Data synthesis was performed narratively due to the absence of sufficient data and the significant heterogeneity among the studies, preventing a feasible meta-analysis.

Results

Three clinical trials,[21–23] one cohort study,[24] two longitudinal studies,[25,26] and five cross-sectional studies[27–31] described healthcare professional prescribing practice, the use of "Western" medical acupuncture among athletes, and their perceptions (Figure 1 and Table 1). The three clinical trials[21–23] assessing athletes' perception of acupuncture had high risk of selection, performance, and detection bias and low risk of attrition and reporting bias (Table S4). Quality

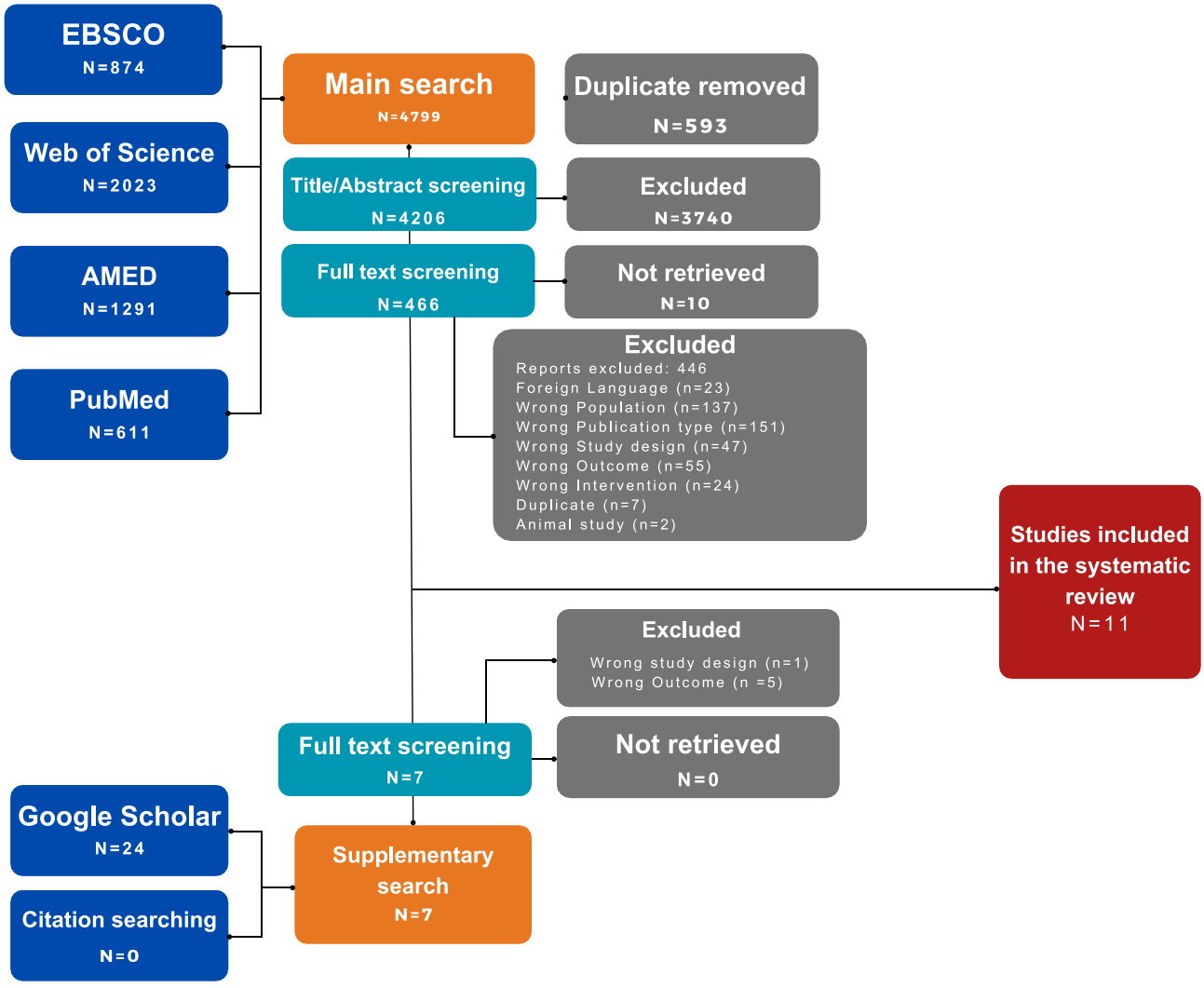

Figure 1 Study selection flow diagram.

Notes: Out of the 10 unretrieved reports, 9 were without available abstracts, preventing us from determining their publication type. The tenth unretrieved report was published in 1980. Exclusion due to languages (Italian, Romanian, Chinese, Japanese, and German): These are the languages not spoken by the authors (proficient in English, French, Spanish, Arabic, and Urdu). Nineteen language-excluded reports were published between 1974 and 1999.

Table 1 Included Cross-Sectional Studies Reporting Acupuncture Perception Among Athletes

Reference	Population Description	Pain	Type of Intervention	Previous Exposure to Acupuncture	Perceptions of Athletes on Acupuncture
McCray, 2019[31]	National Collegiate Athletic Association Division I athletes attending a university at South Western United States, USA. Sample size: 26 Mean age: 19; Age range 18–24 M: 19 (27.5%) F: 50 (72.5%)	Any	DN	Yes	• 14 (53%) agreed that their DN experience has been comfortable 4 (15%) disagreed. • 12 (46%) reported DN as effective for muscle pain management. 1 (3%) disagreed. • 11 (42%) would use DN again for recovery. None (0%) disagreed. • 11 (42%) would recommend DN to others for training recovery, competition, and for muscle pain. 1 (3%) disagreed.
McCray, 2019[31]	National Collegiate Athletic Association Division I athletes attending a university at South Western United States, USA Sample size: 51 Mean age: 19 Age range 18–24 M: 19 (27.5%) F: 50 (72.5%)	Any	DN	No	• 6 (12%) of participants agreed that they were worried about pain, bruising or soreness. 18 (35%) disagreed • 14 (27%) of participants were unsure if treatment would work for muscular pain or recovery. 10 (20%) agreed that dry needling would help. • 12 (23%) reported that they would rather use other recovery treatments. 8 (16%) disagreed. • 1 (2%) participant reported they had been advised not to use DN by a medical professional. 22 (43%) disagreed. • 1 (2%) reported cultural beliefs are counter to dry needling. 19 (37%) disagreed.
Harding, 2009[30]	Runners participating in the 2007 Flora London Marathon, UK Sample size: 99 M: 66 (67%) F: 33 (33%)	Any	MA	9%	• 85% of participants shared acupuncture was very beneficial for treating injuries. • Participants perceived acupuncture as one of the most expensive treatments (proportion not reported).

assessment of the observational studies showed that two studies justified their sample sizes[26,29] and had a participation rate >50%[28,30] (Table S5). However, all studies clearly stated their research questions, clearly defined study populations, and recruited their study population from the same population. All studies disclosed no conflict of interest, except that the two studies had no disclosures.[28,30]

Acupuncture Perception and Use Among Athletes

Two surveys[30,31] assessed athletes' perception of acupuncture use (Table 1). Overall, athletes perceived acupuncture as beneficial for treating injuries,[30] muscular pain, and recovery.[31] Of those who had used acupuncture in the past, 42% reported that they would use it again and would recommend it to others for muscle pain. The overall perception of acupuncture was that the treatment process was comfortable. However, 12% of those who had never experienced acupuncture worried about the treatment causing pain, bruising, and soreness.[31] Some survey respondents perceived acupuncture as being one of the most expensive complementary and alternative medicine treatments.[30]

Five intervention studies[21–23,25,26] assessed athletes' acupuncture perception after receiving acupuncture treatment for DOMS and musculoskeletal pain (Table 2). Before the treatments, participants reported their concern that acupuncture might

Table 2 Included Intervention Studies Reporting Acupuncture Perception Among Athletes

Reference	Intervention group	Pain	Intervention	Perceptions of Athletes on Acupuncture Use After Intervention
Cushman, 2021[21]	Runners at the finish line of the 2018 Salt Lake City Marathon and Half-Marathon, USA Sample size: 28 Mean age (SD): 42.1 (11.8) M: 14 (50.0%) F: 14 (50.0%)	DOMS	DN 1 day Single session post-race	Compared to prerace, runners receiving DN reported better-than-expected soreness at each of the postrace time points (from day 1 to day 7, ORs ranged from 2.21 to 4.02, p-values< 0.05). Compared to the control group receiving sham needling, runners who received DN reported similar subjective feeling (OR=1.94, p-value=0.089)
Luetmer, 2019[26]	Athletes at 2 local high school football teams, USA Sample size: 27 Mean age: 16; Age range: 13–18 M: 22 (100%)	DOMS	MA At least 1 of the 5 sessions One session each day	Over the course of 5 days, 145 responses were analyzed. Out of these, 130 participants (89%) rated their experience as "very good" or "excellent" Participants also expressed their willingness to recommend acupuncture to teammates or other athletes and indicated they would consider acupuncture in the future. **Rating of the overall experience with acupuncture**: No participants rated experience as "poor" or "fair". 16 participants (59%) rated the overall experience as "excellent". 10 participants (37%) rated the overall experience as "good". 1 participant (4%) did not provide a rating for their experience. **Survey's comments section**: Participants provided positive feedback, and no negative comments were received. Participants shared that the experience was interesting and fun Participants shared that the study had changed their perspective on acupuncture Some participants requested information on other future acupuncture therapy treatment
Garlanger, 2017[25]	Athletes of a local Nordic Ski Team, USA Sample size: 15 Age range: 14–17 M: 3 (20%) F: 12 (80%)	DOMS	MA At least 1 of the 5 sessions One session each day	By the last treatment day, all subjects reported that they would recommend acupuncture to a teammate or other athlete. All subjects stated that they would consider acupuncture in the future after each treatment day except for 1 subject, who on day 4 responded "No" due to local discomfort that day. However, this participant subsequently changed their response to "Yes" on the final treatment day. **Rating of the overall experience with acupuncture**: 8 participants (62%) shared that their overall experience was "excellent" No participant reported an overall poor experience 1 participant reported discomfort on treatment day 4, and changed that rating to "fair" on the final treatment day Over the course of 5 days, 76.7% of the 60 responses rated the experience within the "very good" and "excellent" categories.
Luo, 2017[23]	First-tier athletes Sample size: 21 Age range: 16–21 M: 12 (57%) F: 9 (43%)	Myofascial pain syndrome	MA 4 weeks Once every other day	Acupuncture stretching manipulation supported by functional training received significantly higher degree of satisfaction rating from participants compared to acupuncture alone or functional training alone.
Callison, 2002[22]	Athletes involved in running sports Sample size: 12 Range: 18–45 M/F (NR)	Medial tibial stress syndrome	MA Two treatments, one each week	100% participants reported reduction in pain level 72.5% of the athletes reported an increased effectiveness of the treatment from the first follow-up to the second follow-up. 90% of the athletes reported a reduction in pain levels during non-sporting activity. 91.7% of the athletes reported less hindrance from pain after sport activities.

Abbreviations: DN, dry needling; MA, manual acupuncture.

be painful.[26] However, after the treatments, no athletes rated the experience as poor.[25,26] Better-than-expected pain relief was perceived by runners who received dry needling.[21] However, similar subjective feeling was perceived in the control group receiving sham needling. High levels of satisfaction were reported regarding the effectiveness of acupuncture.[22,23] Participants shared that they would recommend acupuncture to a teammate or other athletes.

Four observational studies[24,29–31] reported prevalence of acupuncture use among athletes (Table 3). The prevalence of acupuncture use among athletes ranged from 2.2% college athletes in Palestine[29] to 61% among professional football players in the Netherlands.[24] Acupuncture was reported to be used for musculoskeletal injuries.

Acupuncture Prescribing Practices and Perception Among Healthcare Professionals

Among physician members of the American Medical Association of Sports Medicine, 58.4% have prescribed acupuncture[27] (Table 4). Reported conditions for prescribing acupuncture were as follows: ligament sprain/tear (5.8%), muscle strain/tear (20.2%), tendinopathy (15.8%), low back pain (37.7%), and other conditions (20.2%) such as concussion.[27] Another study (published in 1999)[28] reported that 15.4% of healthcare professionals in UK Premier League football clubs had prescribed "Western" medical acupuncture as a treatment modality for musculoskeletal disorders.

When asked about their opinion on the effectiveness of acupuncture, two-thirds of the physicians of the American Medical Association of Sports Medicine thought that it was effective for the conditions treated, while one-third were unsure.[27] None of them thought that it was ineffective.[27]

Table 3 Included Studies Reporting Prevalence of Acupuncture Use Among Athletes

Reference	Study Description	Population Description	Instrument Administered	Type of Acupuncture	Pain	N	Prevalence (%)
Gouttebarge, 2018[24]	Netherlands Prospective cohort study 2012–2013	28 professional football players Mean age (SD): 24y (4) Age range: 17–31y M: 28 (100)	Injury report form	DN	Non-acute groin injury	28	61
Gouttebarge, 2018[24]	Netherlands Prospective cohort study 2012–2013	28 professional football players Mean age (SD): 24y (4) Range: 17–31y M: 28 (100)	Injury report form	MA	Non-acute groin injury	28	7
Harding, 2009[30]	UK Retrospective non-experimental survey 2007	99 runners M: 66 (67%) F: 33 (33%)	Self-Reported questionnaire	MA	Running related injuries	99	9
Qasrawi, 2021[29]	Palestine Cross-sectional study 2020	227 college athletes Mean age (SD): 20.4y (1.67); M: 133 (59) F: 94 (41)	Self-Reported questionnaire	MA	Musculoskeletal pain	227	2.2
McCray, 2019[31]	USA CS, "Quantitative non-experimental design" 2018	77 athletes (basketball, volleyball, soccer, tennis, lacrosse, baseball, softball, cross-country) Mean age: 19y; Age range: 18–24y M: 19 (27%) F: 50 (71%)	Self-Reported questionnaire	DN	Muscular pain following training and competition	77	33.8

Abbreviations: N, sample size of practitioners; DN, dry needling; MA, manual acupuncture.

Table 4 Included Studies Reporting Prevalence of Acupuncture Use Among Healthcare Professionals and Their Reasons and Perceptions

Reference	Study Details	Practitioner Background	Instrument Administered	Definition of Pain/ Injury	N	Prevalence of Acupuncture Use Among HCP and Reasons	Perceptions of HCP Prescribing Acupuncture
Kent, 2020[27]	USA Cross-sectional study Date of data collection: NR	Physician members of the American Medical Association of Sports Medicine	Self-Reported questionnaire	Sports medicine pathologies including ligamentous, tendinous and muscle injuries, low back pain, and concussion	257	58.4% (150/257, response rate: 11%) Reasons providers prescribed acupuncture: Ligament sprain/tear: 5.8% Muscle strain/tear: 20.2% Tendinopathy: 15.8% Low back pain: 37.7% Other: 20.2%	**Acupuncture is effective (% of respondents)**: Ligament sprain/tear: 64.7% (11/17) Muscle strain/tear: 59.3% (35/59) Tendinopathy: 66.7% (30/45) Low back pain: 66.4% (73/110)
Stacey, 1999[28]	UK Cross-sectional study Date of data collection: NR	Premier league football club doctor and physiotherapists and external acupuncturist	Self-Reported questionnaire	Musculoskeletal disorders	13	15.4% (2/13, response rate not reported)	NR

Abbreviations: N, sample size of practitioners; NR, Not reported.

Discussion

The systematic review identified a research gap concerning the evaluation of evidence-based acupuncture practice and its perception among healthcare professionals and athletes. Only two studies examined "Western" medical acupuncture prescription by healthcare providers for pain management. Furthermore, the review identified four studies exploring athletes' usage of acupuncture for pain management, one study focused on healthcare professionals' perception, and six studies investigated the athletes' perception. This lack of primary studies highlights the need for further investigation and comprehensive research in the field of acupuncture use and perception particularly in the context of pain management among athletes.

Available evidence presented in this review suggests that athletes and healthcare practitioners favorably perceive "Western" medical acupuncture for the treatment of various types of musculoskeletal pain. The use of acupuncture varied, low among athletes in Palestine but high among professional football players in the Netherlands. Most athletes believed acupuncture to be beneficial for various types of pain and would recommend it to their peers. While some athletes had apprehension prior to acupuncture treatments—because of potential pain, bruising, and soreness—this uneasiness disappeared after experiencing the acupuncture treatment. They also perceived acupuncture as one of the most expensive complementary and alternative medical treatments, which could be attributed to inadequate insurance coverage and reimbursement.

Alleviating musculoskeletal pain is essential for athletes' well-being, performance, careers, and income.[1] Therefore, healthcare professionals often include acupuncture in the overall management of pain among athletes. Strong evidence supports the use of acupuncture in pain management.[32–34] In general, athletes are at a higher risk for acute and overuse musculoskeletal injuries when compared to non-athletes.[35–37] The current use of acupuncture to manage pain among athletes, within the practice of evidence-based medicine is likely justified by the evidence, positive feedback from athletes and by its well-established safety profile.[15]

This systematic review has some limitations. Acknowledging the complexity and diversity of acupuncture techniques, it is important to emphasize the differentiation between "Western" medical acupuncture—grounded in biomedical mechanisms and evidence-based medicine for diagnosis and needle placement—and other approaches that rely on traditional Asian medicine concepts.[7] This differentiation holds importance in systematically assessing the prevalence of acupuncture usage and

perception, aligning with PRISMA guidelines for Acupuncture.[8] The data were self-reported and are likely subject to reporting bias. Further, study participants were most likely interested in acupuncture and therefore more likely to prescribe or use acupuncture. Another common limitation in systematic reviews is selection bias, which can occur when all available evidence cannot be identified through literature searches. One strength of this review was the involvement of an experienced librarian who actively contributed to developing a search strategy encompassing multiple databases with comprehensive search terms. However, the synthesis was potentially constrained by the available evidence on athletes' and healthcare professionals' perception and use of acupunctured. The review's data synthesized was limited by the scarcity of studies evaluating the outcomes of interest and the heterogeneity between studies, preventing the feasibility of a meta-analysis. Consequently, the evidence mapping highlights the paucity of primary studies, underscoring the necessity for expanded investigation on acupuncture use and perception concerning pain management among athletes.

Conclusion

Overall, our research indicates that "Western" medical acupuncture is prescribed by healthcare professionals and used by athletes for various types of musculoskeletal pain. Evidence concerning its effectiveness is quite strong, with health practitioners and athletes reporting positive perception of acupuncture use. Of course, there is a need for additional randomized controlled trials to better understand the role of acupuncture among athletes. However, considering health professionals' positive clinical experience, athletes' favorable perception, and the well-established effectiveness and safety profile of acupuncture, it should seriously considered as a complementary modality in the overall management of pain.

Data Sharing Statement

The original contributions presented in the study are included in the article and in an online supplement. Further inquiries can be directed to the corresponding author.

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Author Contributions

K.C. and R.M. made a significant contribution to the conception and study design. All the authors made a significant contribution to the execution and acquisition of data. K.C. and R.M. made a significant contribution to the analysis and interpretation. K.C. has written the first draft of the manuscript. All the authors have critically reviewed the article, agreed on the journal to which the article will be submitted, on all versions of the article before submission, during revision, the final version accepted for publication, and any significant changes introduced at the proofing stage. All the authors also agree to take responsibility and be accountable for the contents of the article.

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Disclosure

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References

1. Lee JW, Lee JH, Kim SY. Use of acupuncture for the treatment of sports-related injuries in athletes: a systematic review of case reports. *Int J Environ Res Public Health*. 2020;17:21.
2. White A. Western medical acupuncture: a definition. *Acupunct Med*. 2009;27(1):33–35. doi:10.1136/aim.2008.000372
3. Rubens C. Chapter 21 - Western medical acupuncture. In: Short E, editor. *A Prescription for Healthy Living*. Academic Press; 2021:235–239.

4. Baldry P. Management of myofascial trigger point pain. *Acupunct Med*. 2002;20(1):2–10. doi:10.1136/aim.20.1.2
5. Yao W, Yang H, Ding G. Mechanisms of Qi-blood circulation and Qi deficiency syndrome in view of blood and interstitial fluid circulation. *J Tradit Chin Med*. 2013;33(4):538–544. doi:10.1016/S0254-6272(13)60162-4
6. Lee S, Lee IS, Chae Y. Similarities between Ashi acupoints and myofascial trigger points: exploring the relationship between body surface treatment points. *Front Neurosci*. 2022;16:947884. doi:10.3389/fnins.2022.947884
7. Yoon DE, Lee IS, Chae Y. Comparison of the acupuncture manipulation properties of traditional East Asian medicine and Western medical acupuncture. *Integr Med Res*. 2022;11(4):100893. doi:10.1016/j.imr.2022.100893
8. Wang X, Chen Y, Liu Y, et al. Reporting items for systematic reviews and meta-analyses of acupuncture: the PRISMA for acupuncture checklist. *BMC Complementary and Alternative Medicine*. 2019;19(1):208. doi:10.1186/s12906-019-2624-3
9. Ernst E, White A. *Acupuncture: A Scientific Appraisal*. UK: Oxford: Butterworth-Heinemann; 1999.
10. Chang WD, Chang NJ, Lin HY, Wu JH. Effects of acupuncture on delayed-onset muscle soreness: a systematic review and meta-analysis. *Evid Based Complement Alternat Med*. 2020;2020:5864057. doi:10.1155/2020/5864057
11. Ko GWY, Clarkson C. The effectiveness of acupuncture for pain reduction in delayed-onset muscle soreness: a systematic review. *Acupunct Med*. 2020;38(2):63–74. doi:10.1177/0964528419887978
12. Trinh K, Zhou F, Belski N, Deng J, Wong CY. The effect of acupuncture on hand and wrist pain intensity, functional status, and quality of life in adults: a systematic review. *Med Acupunct*. 2022;34(1):34–48. doi:10.1089/acu.2021.0046
13. Yuan QL, Wang P, Liu L, et al. Acupuncture for musculoskeletal pain: a meta-analysis and meta-regression of sham-controlled randomized clinical trials. *Sci Rep*. 2016;6(1):30675. doi:10.1038/srep30675
14. Zhang Y, Wang C. Acupuncture and chronic musculoskeletal pain. *Curr Rheumatol Rep*. 2020;22(11):80. doi:10.1007/s11926-020-00954-z
15. Allen J, Mak SS, Begashaw M, et al. Use of acupuncture for adult health conditions, 2013 to 2021: a systematic review. *JAMA Network Open*. 2022;5(11):e2243665. doi:10.1001/jamanetworkopen.2022.43665
16. Gimigliano F, Resmini G, Moretti A, et al. Epidemiology of musculoskeletal injuries in adult athletes: a scoping review. *Medicina*. 2021;57 (10):1118. doi:10.3390/medicina57101118
17. Higgins TJ, Chandler J, Cumpston M, Li T, Page MJ, Welch VA. Cochrane Handbook for Systematic Reviews of Interventions version 6.3 Cochrane; 2022. Available from: www.training.cochrane.org/handbook. Accessed October, 2021.
18. Mourad Ouzzani HH, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan — a web and mobile app for systematic reviews. *Syst Rev*. 2016;5 (1):210. doi:10.1186/s13643-016-0384-4
19. Higgins JP, Altman DG, Gøtzsche PC, et al. The Cochrane collaboration's tool for assessing risk of bias in randomised trials. *BMJ*. 2011;343: d5928. doi:10.1136/bmj.d5928
20. National Heart Lung and Blood Institute. Study quality assessment tools. NHLBI, NIH; 2022.
21. Cushman DM, Cummings K, Skinner L, et al. Postrace dry needling does not reduce subsequent soreness and cramping-a randomized controlled trial. *Clin J Sport Med*. 2021;31(3):225–231. doi:10.1097/JSM.0000000000000794
22. Callison M. Clinical study. Acupuncture and tibial stress syndrome (shin splints). *J Chin Med*. 2002;70:24–27.
23. Luo P, Lin H. Curative efficacy of myofascial pain syndrome (MPS) treated by comprehensive treatment focusing on acupuncture stretching. *Int J Clin Acupu*. 2017;26(2):85–90.
24. Gouttebarge V, Veenstra E, Goedegebuure S, Frings-Dresen M, Kuijer PP. Professional football players at risk for non-acute groin injuries during the first half of the season: a prospective cohort study in The Netherlands. *J Back Musculoskel Rehabil*. 2018;31(1):15–21. doi:10.3233/BMR-150427
25. Garlanger KL, Fredericks WH, Do A, Bauer BA, Laskowski ER. The feasibility and effects of acupuncture in an adolescent Nordic ski population. *Pm r*. 2017;9(8):795–803. doi:10.1016/j.pmrj.2016.11.010
26. Luetmer MT, Do A, Canzanello NC, Bauer BA, Laskowski ER, Feasibility T. and effects of acupuncture on muscle soreness and sense of well-being in an adolescent football population. *Am J Phys Med Rehabil*. 2019;98(11):1–7. doi:10.1097/PHM.0000000000001226
27. Kent JB, Tanabe KO, Muthusubramanian A, Statuta SM, MacKnight JM. Complementary and alternative medicine prescribing practices among sports medicine providers. *Alter Ther Health Med*. 2020;26(5):28–32.
28. Stacey R. Acupuncture and alternative therapies in premiership football clubs. *Acupuncture Med*. 1999;17(1):62–63. doi:10.1136/aim.17.1.62
29. Qasrawi H, Assi S, Ghanim N, Zyoud SH, Al-Jabi SW, Descriptive A. Study of pain relief practices among student-athletes in Palestine: focus on non-steroidal anti-inflammatory drugs, and complementary medicine and alternative medicine use. *J Commun Health*. 2021;46(4):684–692. doi:10.1007/s10900-020-00935-4
30. Harding S, Swait G, Johnson IP, Cunliffe C. Utilisation of CAM by runners in the UK: a retrospective survey among non-elite marathon runners. *Clin Chiropract*. 2009;12(2):61–66. doi:10.1016/j.clch.2009.08.004
31. McCray S Understanding the perceptions of dry needling in NCAA division I athletes; 2019.
32. Linde K, Allais G, Brinkhaus B, et al. Acupuncture for the prevention of tension-type headache. *Cochrane Database Syst Rev*. 2016;4(4): Cd007587. doi:10.1002/14651858.CD007587.pub2
33. Berman BM, Langevin HM, Witt CM, Dubner R. Acupuncture for chronic low back pain. *N Engl J Med*. 2010;363(5):454–461. doi:10.1056/NEJMct0806114
34. He Y, Guo X, May BH, et al. Clinical evidence for association of acupuncture and acupressure with improved cancer pain: a systematic review and meta-analysis. *JAMA Oncol*. 2020;6(2):271–278. doi:10.1001/jamaoncol.2019.5233
35. Jayanthi N, Kleithermes S, Dugas L, Pasulka J, Iqbal S, LaBella C. Risk of injuries associated with sport specialization and intense training patterns in young athletes: a longitudinal clinical case-control study. *Orthop J Sports Med*. 2020;8(6):2325967120922764. doi:10.1177/2325967120922764
36. Aicale R, Tarantino D, Maffulli N. Overuse injuries in sport: a comprehensive overview. *J Orthopaedic Surg Res*. 2018;13(1):309. doi:10.1186/s13018-018-1017-5
37. Lundberg Zachrisson A, Ivarsson A, Desai P, Karlsson J, Grau S. Risk factors for overuse injuries in a cohort of elite Swedish track and field athletes. *BMC Sport Sci Med Rehabil*. 2021;13(1):73. doi:10.1186/s13102-021-00297-x