

Multimodal vs Single Physiotherapy on Pain Intensity in Dysmenorrhea: Systematic Review and Narrative Synthesis

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Abstract

Background: Primary dysmenorrhea is a highly prevalent condition that significantly affects women's quality of life and daily functioning. Physiotherapy interventions are widely used; however, the comparative effectiveness of multimodal versus single-modality approaches remains unclear.

Objective: To evaluate the effectiveness of multimodal compared with single physiotherapy interventions in reducing pain intensity among women with primary dysmenorrhea.

Methods: A systematic review was conducted in accordance with PRISMA 2020 guidelines. Scopus and PubMed databases were searched for studies published between 2015 and 2025. Experimental and observational comparative studies evaluating multimodal versus single physiotherapy interventions were included. Due to substantial clinical and methodological heterogeneity, findings were synthesised narratively following the SWIM framework. Risk of bias was assessed using the Cochrane Risk of Bias 2 tool and ROBINS-I, while certainty of evidence was evaluated using the GRADE approach.

Results: Eight studies involving 528 participants were included. Two studies demonstrated statistically significant between-group differences favouring multimodal interventions (MD 2.08, 95% CI 0.61–3.54; $d = 0.842$; and MD -19.8 to -26.0 mm; SMD 1.3–1.8; $p < 0.001$). The remaining studies showed consistent directional improvements without statistical significance. Risk of bias ranged from low to serious, and overall certainty of evidence was rated as low.

Conclusion: Multimodal physiotherapy may provide greater pain reduction than single-modality interventions. However, the strength of evidence is limited by heterogeneity, risk of bias, and imprecision, indicating the need for high-quality randomized controlled trials.

Keywords

Dysmenorrhea; Pain Measurement; Physical Therapy Modalities; Exercise Therapy; Women

Introduction

Primary dysmenorrhea is defined as recurrent menstrual pain occurring in the absence of identifiable pelvic pathology, primarily driven by increased prostaglandin production and subsequent myometrial hyperactivity.^{1,2} This condition is highly prevalent among adolescents and young adult women, with global estimates ranging from 66% to 71%, making it one of the most common gynecological disorders during the reproductive years.³ Beyond pain symptoms, primary dysmenorrhea exerts a substantial negative impact on daily functioning, including reduced academic performance, impaired concentration, sleep disturbances, and decreased quality of life.^{4,5} Given its high prevalence and functional consequences, effective management strategies are essential not only for symptom control but also for maintaining overall well-being and productivity.

Pharmacological treatment, particularly nonsteroidal anti-inflammatory drugs (NSAIDs) and hormonal contraceptives, remains the first-line approach for managing primary dysmenorrhea.⁶ However, clinical response to these interventions is often variable, and long-term use may be limited by adverse effects such as gastrointestinal disturbances, cardiovascular risks, and hormonal-related complications.⁶ These limitations have led to increasing interest in non-pharmacological strategies, especially physiotherapy-based interventions, which are considered safer and potentially effective alternatives or adjuncts.⁷ Recent systematic reviews and meta-analyses have demonstrated that various physiotherapy modalities, including manual therapy, therapeutic exercise, transcutaneous electrical nerve stimulation (TENS), and kinesio taping, can reduce menstrual pain intensity and improve related symptoms.^{8–11} Nevertheless, the quality of evidence across these interventions remains heterogeneous, and no single modality has been consistently identified as superior.

Emerging evidence suggests that primary dysmenorrhea is not solely a peripheral condition driven by prostaglandin-mediated uterine contractions but also involves central pain processing mechanisms, including central sensitization, altered pain modulation, and psychosocial factors such as anxiety and pain catastrophizing.^{12,13} This multidimensional nature of pain supports the use of more comprehensive treatment approaches that address multiple underlying mechanisms simultaneously. In this context, multimodal physiotherapy, defined as the combination of two or more interventions with distinct and complementary mechanisms of action, has gained increasing attention in clinical practice.^{14,15} By integrating passive modalities, such as manual therapy or electrophysical agents, with active interventions, such as exercise or mind-body techniques, multimodal approaches aim to target both peripheral nociceptive input and central pain modulation pathways.

Several primary studies have reported that multimodal physiotherapy interventions may produce greater improvements in pain intensity, pressure pain threshold, and quality of life compared with single-modality approaches.¹⁴ However, these findings are not entirely consistent, and the magnitude of benefit appears to vary depending on the specific combination of interventions, treatment dosage, and study design. Furthermore, previous systematic reviews have primarily evaluated individual physiotherapy modalities or broadly categorized interventions without explicitly distinguishing multimodal approaches as a separate analytical category.^{9,11} As a result, the comparative effectiveness of multimodal versus single physiotherapy interventions remains insufficiently synthesised and lacks clear clinical guidance.

This gap in the literature highlights the need for a focused synthesis that specifically examines multimodal physiotherapy as a distinct intervention strategy. Therefore, the present systematic review aims to evaluate the effectiveness of multimodal compared with single physiotherapy interventions in reducing pain intensity among women with primary dysmenorrhea. Additionally, this review seeks to identify common patterns of multimodal intervention combinations and to explore their associated clinical outcomes, thereby providing a more comprehensive evidence base to inform clinical decision-making and future research.

Methods

This study employed a systematic review design to evaluate the effectiveness of multimodal physiotherapy interventions compared with single-modality approaches in reducing pain intensity among women with primary dysmenorrhea. The review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines to ensure methodological transparency, reproducibility, and completeness of reporting.¹⁶ The protocol was developed a priori and prospectively registered in the PROSPERO database (Registration ID: CRD420251246664).

The research question and eligibility criteria were defined using the Population, Intervention, Comparison, and Outcome (PICO) framework. The population of interest included women diagnosed with primary dysmenorrhea, defined as menstrual pain in the absence of identifiable pelvic pathology. The intervention consisted of multimodal physiotherapy approaches, operationally defined as the combination of two or more physiotherapy modalities with distinct and complementary mechanisms of action within a single treatment protocol. The comparator included single-modality physiotherapy interventions or usual care. The primary outcome was pain intensity, measured using validated instruments such as the Visual Analogue Scale (VAS) or Numeric Rating Scale (NRS), both of which are widely accepted tools with established validity and reliability in pain assessment.¹⁷

A comprehensive literature search was conducted in two electronic databases, Scopus and PubMed, on December 27, 2025. These databases were selected due to their extensive indexing of peer-reviewed biomedical and health sciences literature. The search strategy was developed to ensure both sensitivity and specificity by combining controlled vocabulary and free-text terms related to dysmenorrhea, multimodal interventions, and physiotherapy. Keywords included “dysmenorrhea,” “menstrual pain,” “multimodal,” “combined,” “physiotherapy,” “exercise,” “manual therapy,” and “TENS,” among others. Boolean operators (AND, OR) were applied to appropriately combine search terms. The search was limited to studies published in English between 2015 and 2025 to ensure the inclusion of contemporary evidence. The full search strategy for each database is provided in the Appendix.

Following the search process, all identified records were exported and screened for duplicates. Study selection was conducted independently by two reviewers in two stages: initial screening based on titles and abstracts, followed by full-text assessment. Discrepancies between reviewers were resolved through discussion, and when necessary, a third reviewer was consulted to achieve consensus. The inclusion criteria comprised experimental studies (including randomized controlled trials, controlled clinical trials, and quasi-experimental designs) and observational comparative studies (such as prospective cohort or controlled before–after studies) that directly compared multimodal and single physiotherapy interventions. Studies were excluded if they were review articles, qualitative studies, case reports, non-comparative designs, or not available in full text.

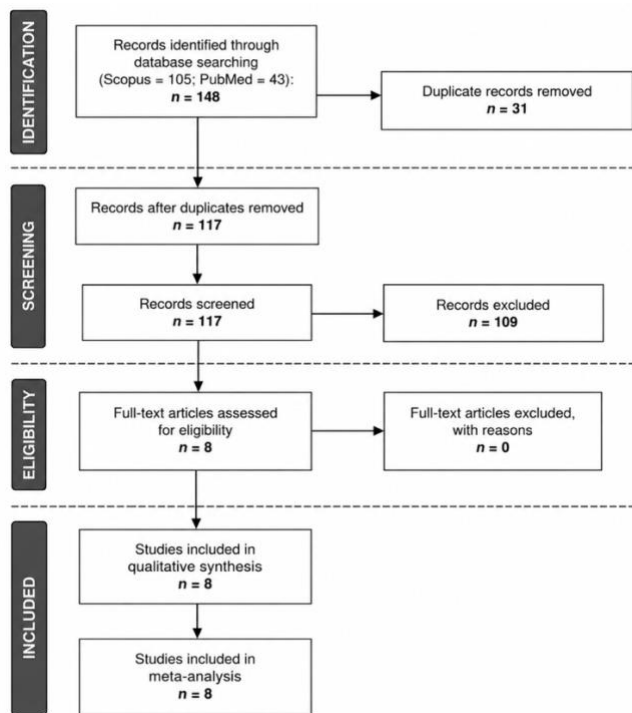


Figure 1. PRISMA flow diagram of study selection

Data extraction was performed using a standardized data extraction form developed specifically for this review. One reviewer extracted the data, and a second reviewer verified the accuracy and completeness of the extracted information. The extracted data included study characteristics (author, year, country, design), participant characteristics (sample size, age), intervention details (type, duration, frequency), outcome measures, and main findings, including pain intensity scores and between-group comparisons.

The methodological quality of the included studies was assessed using validated risk-of-bias tools. Randomized controlled trials were evaluated using the Cochrane Risk of Bias 2 (RoB 2) tool, which assesses domains including randomization process, deviations from intended interventions, missing outcome data, measurement of outcomes, and selective reporting. Observational studies were assessed using the Risk Of Bias In Non-randomized Studies of Interventions (ROBINS-I) tool, which evaluates potential

bias due to confounding, selection, classification, deviations from intended interventions, missing data, measurement, and reporting. These tools are widely recommended for systematic reviews evaluating intervention effectiveness.¹⁶

Due to substantial clinical and methodological heterogeneity across studies, including differences in intervention components, duration, outcome measurement time points, and comparator groups, a quantitative meta-analysis was not considered appropriate. Instead, data were synthesised narratively following the Synthesis Without Meta-analysis (SWiM) framework. Studies were grouped based on dominant multimodal physiotherapy patterns, such as combinations of manual therapy and exercise, exercise-based multimodal interventions, and combinations of electrophysical modalities. The direction and magnitude of treatment effects were examined, with particular emphasis on between-group differences favouring multimodal interventions.

Pain intensity outcomes were analysed descriptively using reported mean differences, confidence intervals, and effect sizes where available. Given that outcome measures were reported on comparable continuous scales (VAS or NRS), no data transformation was performed. Where statistical significance was not reported, interpretation was based on direction of effect and consistency across studies.

The certainty of evidence for the primary outcome was evaluated using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach, which considers risk of bias, inconsistency, indirectness, imprecision, and publication bias. Evidence was classified into four levels: high, moderate, low, or very low. This approach provides a structured and transparent framework for interpreting the overall strength of evidence in systematic reviews.

Results

The results of this systematic review are presented in a structured manner, beginning with study selection, followed by study characteristics, pain intensity outcomes, risk of bias assessment, and certainty of evidence. The presentation is aligned with the predefined research objectives, particularly the comparative effectiveness of multimodal versus single physiotherapy interventions. To enhance transparency in the study selection process, the PRISMA flow diagram is first described narratively and can be converted into a visual figure.

A total of 148 records were identified through database searching, comprising 105 from Scopus and 43 from PubMed. After the removal of 31 duplicate records, 117 articles remained for title and abstract screening. Of these, 109 were excluded due to ineligible study design, absence of direct comparison between multimodal and single interventions, or irrelevant population. Eight full-text articles were assessed and all met the inclusion criteria, resulting in eight studies included in the final synthesis.

Following study selection, the characteristics of the included studies are summarised to provide context regarding study design, population, and intervention variability. The included studies consisted of seven randomized controlled trials and one prospective observational study conducted across multiple countries, including Turkey, Spain, Italy, China, Egypt, Brazil, and Iran. Sample sizes ranged from 30 to 120 participants, with a total of 528 individuals. Participants were predominantly adolescents and young adult women aged between 15 and 45 years with clinically diagnosed primary dysmenorrhea.

The characteristics of the included studies are summarised in Table 1 to provide an overview of study design, participant demographics, intervention types, and outcome measures. This table highlights the heterogeneity across studies, particularly in intervention composition and duration, which is relevant for interpreting the overall findings.

Table 1. Characteristics of Included Studies

Author (Year)	Country	Study Design	Sample Size	Age (years)	Intervention (Multimodal vs Single)	Duration	Outcome Measure
Koçoğlu et al. (2025) ¹⁷	Turkey	RCT	62	18–30	MOPEXE + RE vs MOPEXE vs RE	8 weeks	VAS
Conesa-Albaladejo et al. (2025) ¹⁵	Spain	RCT	39	NR	BA + OMT vs BA	9 weeks	VAS
Deodato et al. (2023) ¹⁸	Italy	Observational	30	20–45	MT + PFE vs MT vs PFE	4 weeks	NRS
Fu et al. (2023) ¹⁹	China	RCT	69	18–25	Tuina + Ba Duan Jin vs Tuina	3 cycles	VAS
Yosri et al. (2022) ²⁰	Egypt	RCT	120	19–25	Yoga + squat vs Yoga	2 cycles	VAS
Machado et al. (2019) ²¹	Brazil	RCT	74	18–44	MWD + TENS vs single/placebo	Single session	NRS
Gaubeca-Gilarranz et al. (2018) ²²	Spain	RCT	56	18–25	DN + Stretching vs control	2 months	VAS
Fallah & Mirfeizi (2018) ²³	Iran	RCT	78	15–18	Stretching + Massage vs single	8 weeks	VAS

The interventions evaluated across studies demonstrated substantial heterogeneity in both composition and dosage. Multimodal physiotherapy approaches commonly involved combinations of manual therapy and exercise, exercise-based multimodal programmes, or combinations of electrophysical modalities such as microwave diathermy and transcutaneous electrical nerve stimulation. Intervention duration varied from a single treatment session to programmes spanning multiple menstrual cycles, reflecting differences in therapeutic intensity and potential dose–response effects. Pain intensity was consistently reported as the primary outcome, most commonly measured using the Visual Analogue Scale (VAS) or Numeric Rating Scale (NRS). To facilitate comparison of treatment effects across studies without redundancy, key pain intensity outcomes are summarised in Table 2. The table presents the direction of effects, between-group differences, and statistical significance, while the accompanying narrative focuses on overall patterns rather than repeating numerical details.

Table 2. Summary of Pain Intensity Outcomes

Author (Year)	Multimodal Effect	Single Effect	Between-Group Difference	Effect Size	Significance
Koçoğlu et al. (2025) ¹⁷	↓ significant	↓ significant	Not reported	Not reported	p < 0.001
Conesa-Albaladejo et al. (2025) ¹⁵	↓ greater	↓ moderate	MD 2.08 (0.61–3.54)	d = 0.842	p = 0.007
Deodato et al. (2023) ¹⁸	↓	↓	Not significant	pn ² = 0.511 (time)	p > 0.05
Fu et al. (2023) ¹⁹	↓ greater	↓	Not significant	Not reported	p > 0.05
Yosri et al. (2022) ²⁰	↓ largest	↓	Not reported	d up to 5.89	p < 0.05
Machado et al. (2019) ²¹	↓ greater	↓	-1.1	Not reported	p = 0.07
Gaubeca-Gilarranz et al. (2018) ²²	↓ significant	↓	-19.8 to -26.0 mm	SMD 1.3–1.8	p < 0.001
Fallah & Mirfeizi (2018) ²³	↓	↓	Not significant	Not reported	NS

Overall, multimodal physiotherapy interventions demonstrated a consistent trend toward greater reductions in pain intensity compared with single-modality interventions. However, statistically significant between-group differences were reported in only two of the eight included studies. In the randomized clinical trial by Conesa-Albaladejo et al., the combination of body awareness and osteopathic manual therapy resulted in a significantly greater reduction in pain compared with body awareness alone (MD 2.08, 95% CI 0.61–3.54; $p = 0.007$; $d = 0.842$). Similarly, Gaubeca-Gilarranz et al. reported significantly greater pain reduction in the multimodal group (dry needling combined with stretching) compared with control conditions, with between-group differences ranging from -19.8 to -26.0 mm and large effect sizes (SMD 1.3–1.8; $p < 0.001$).

The remaining six studies showed reductions in pain intensity across both multimodal and single-modality groups, with the direction of effect generally favouring multimodal interventions. However, these differences did not reach statistical significance in between-group comparisons. For example, in the study by Fu et al., the addition of Ba Duan Jin to Tuina therapy resulted in greater reductions in VAS scores across three menstrual cycles compared with Tuina alone, although the between-group difference was not statistically significant. Similarly, Fallah and Mirfeizi reported comparable reductions in pain intensity across combined and single intervention groups without significant between-group differences.

In studies involving exercise-based multimodal interventions, such as those combining yoga with squat exercises or motor imagery-based pelvic floor exercises with relaxation techniques, progressive reductions in pain intensity were observed across intervention periods. Although between-group statistical significance was not consistently reported, the magnitude of within-group improvements tended to be greater in multimodal groups, suggesting a potential additive effect.

Risk of bias assessment was conducted to evaluate the methodological quality of the included studies, and the results are summarised narratively to complement the corresponding figures. Among the eight included studies, two randomized controlled trials were rated as having low risk of bias, five were assessed as having some concerns, and one observational study was judged to have a serious risk of bias. The primary sources of bias included limitations in allocation concealment, lack of participant and therapist blinding inherent to physiotherapy interventions, and potential confounding in the observational study. Despite these limitations, outcome measurement bias was generally low in studies that employed blinded assessors or standardized self-report instruments. To provide an overall assessment of the strength of evidence, the certainty of evidence for pain intensity was evaluated using the GRADE approach, and the summary is presented in Table 3.

Table 3. Certainty of Evidence (GRADE)

Outcome	Studies (n)	Design	Risk of Bias	Inconsistency	Imprecision	Certainty
Pain intensity (VAS/NRS)	8 (528)	7 RCTs, 1 observational	Serious	Serious	Serious	⊕⊕○○ Low

The overall certainty of evidence was rated as low. This rating was primarily due to serious concerns regarding risk of bias, inconsistency in between-group effects across studies, and imprecision resulting from small sample sizes and incomplete reporting of confidence intervals. Although publication bias could not be formally assessed due to the limited number of studies, it cannot be excluded.

Taken together, these findings indicate that while multimodal physiotherapy interventions show a consistent tendency toward greater pain reduction compared with single-modality approaches, the evidence is not sufficiently robust to establish definitive superiority. The variability in intervention design, dosage, and study quality contributes to heterogeneity in reported outcomes and limits the strength of conclusions that can be drawn.

Discussion

The present systematic review aimed to evaluate the comparative effectiveness of multimodal versus single-modality physiotherapy interventions in reducing pain intensity among women with primary dysmenorrhea. Overall, the findings indicate a consistent tendency for multimodal approaches to produce greater reductions in pain intensity compared with single interventions. However, statistically significant between-group differences were observed in only a minority of included studies, and the overall certainty of evidence was rated as low. These findings highlight a clinically relevant trend while simultaneously underscoring important methodological limitations that constrain the strength of inference.

From a mechanistic perspective, the observed superiority of multimodal physiotherapy can be understood within the framework of contemporary pain science. Primary dysmenorrhea is increasingly recognised as a multidimensional condition involving not only peripheral prostaglandin-mediated uterine contractions but also central pain processing mechanisms, including central sensitization, altered conditioned pain modulation, and enhanced temporal summation.²⁴ These central mechanisms may explain the persistence and amplification of pain beyond the menstrual phase and suggest that interventions targeting a single physiological pathway may be insufficient to achieve optimal clinical outcomes.²⁵ In this context, multimodal physiotherapy offers a biologically plausible advantage by simultaneously addressing peripheral nociceptive input, neuromuscular dysfunction, and central pain modulation processes.

The findings of this review are consistent with prior literature demonstrating the effectiveness of individual physiotherapy modalities in reducing dysmenorrhea-related pain. Previous systematic reviews have reported that exercise-based interventions, manual therapy, and electrophysical modalities such as transcutaneous electrical nerve stimulation (TENS) significantly reduce pain intensity compared with control conditions.^{26–28} However, these studies have largely evaluated modalities in isolation and have not explicitly examined the potential additive or synergistic effects of combining interventions. The present review extends this body of evidence by suggesting that combining modalities with complementary mechanisms may enhance overall treatment effectiveness, even though the magnitude of benefit varies across studies.²⁹

Despite this general trend, the lack of consistent statistical significance in between-group comparisons warrants careful interpretation. Only two of the eight included studies demonstrated statistically significant superiority of multimodal interventions, while the remaining studies reported directionally consistent but non-significant findings. This inconsistency may be explained by several methodological factors, including small sample sizes, variability in intervention protocols, and differences in outcome measurement timing. In particular, insufficient statistical power may have limited the ability of several studies to detect between-group differences, even when clinically meaningful improvements were present. This interpretation is supported by the relatively large within-group effect sizes reported in several trials, suggesting that both multimodal and single interventions are effective, but the incremental benefit of combining modalities may be modest and context-dependent.³⁰

Another critical factor influencing the observed variability is the heterogeneity in intervention dosage and duration. Evidence from exercise-based interventions indicates that programmes of at least eight weeks are associated with more consistent and sustained pain reduction compared with shorter interventions.^{27,31} In the present review, intervention durations ranged from a single treatment session to multi-cycle programmes spanning several weeks, which may have contributed to differences in treatment

response. Short-duration interventions may be insufficient to induce meaningful changes in neuromuscular adaptation or central pain modulation, thereby attenuating observable between-group differences. Conversely, longer and more intensive multimodal programmes may provide cumulative benefits through repeated stimulation of multiple therapeutic pathways.³²

The pattern of multimodal combinations identified in this review further supports the importance of mechanistic complementarity. The most commonly reported combinations involved manual therapy paired with active exercise, or combinations of different exercise modalities.³³ Manual therapy may reduce peripheral sensitization and improve local tissue mobility, while exercise interventions contribute to neuromuscular regulation, improved blood flow, and activation of descending inhibitory pathways. This synergistic interaction aligns with the broader concept of multimodal analgesia, which has been extensively validated in other pain conditions and emphasises the integration of interventions targeting distinct mechanisms to achieve superior outcomes.³⁴

Importantly, the role of psychosocial factors should not be overlooked in interpreting these findings. Emerging evidence indicates that psychological variables such as pain catastrophizing, anxiety, and maladaptive beliefs significantly influence pain perception and treatment response in primary dysmenorrhea.¹³ Multimodal physiotherapy approaches that incorporate elements such as body awareness, relaxation, or mind–body exercise may indirectly address these psychosocial dimensions, thereby contributing to improved outcomes. However, the extent to which these factors mediate treatment effects remains insufficiently explored in the included studies and represents an important area for future research.³⁵

The methodological quality of the included studies also plays a critical role in interpreting the findings. Although two randomized controlled trials were rated as low risk of bias, the majority were classified as having some concerns, primarily due to limitations in allocation concealment and the inherent difficulty of blinding participants and therapists in physiotherapy interventions. The inclusion of one observational study with a serious risk of bias further limits the strength of causal inference. These methodological constraints are reflected in the overall GRADE rating of low certainty, indicating that the true effect may differ substantially from the observed estimates.

From a clinical perspective, the findings suggest that multimodal physiotherapy may be considered a preferable approach in the management of primary dysmenorrhea, particularly when interventions are selected to target complementary mechanisms. However, given the current limitations in the evidence base, clinical decision-making should remain individualised, taking into account patient preferences, resource availability, and treatment feasibility. Exercise-based multimodal programmes may offer a practical and accessible option, especially in settings with limited access to specialised physiotherapy services.

Several limitations of this review should be acknowledged. First, the inclusion of studies with heterogeneous designs, interventions, and outcome measures limited the feasibility of meta-analysis and necessitated a narrative synthesis approach. Second, variability in intervention dosage and follow-up duration complicates direct comparison across studies and may influence the observed treatment effects. Third, the reliance on self-reported pain measures introduces potential reporting bias, particularly in unblinded studies. Finally, publication bias cannot be excluded, as studies with negative findings may be underrepresented in the literature.

Future research should prioritise well-designed randomized controlled trials with adequate sample sizes, standardised intervention protocols, and longer follow-up periods to better evaluate the effectiveness of multimodal physiotherapy. In addition, incorporating components such as pain neuroscience education may further enhance treatment outcomes by addressing central sensitization and maladaptive pain beliefs, as suggested by emerging evidence.³⁶

Conclusion

This systematic review demonstrates that multimodal physiotherapy interventions tend to provide greater reductions in pain intensity compared with single-modality approaches in women with primary dysmenorrhea. However, statistically significant between-group differences were observed in only a limited number of studies, and the overall certainty of evidence was low due to methodological heterogeneity, risk of bias, and imprecision.

From a clinical perspective, multimodal approaches that combine interventions with complementary mechanisms, particularly manual therapy and exercise-based strategies, may offer a more comprehensive framework for pain management. These approaches have the potential to address both peripheral and central components of pain, although their superiority over single interventions cannot yet be established with high confidence.

Future research should focus on well-designed randomized controlled trials with larger sample sizes, standardized intervention protocols, and longer follow-up durations. In addition, incorporating multidimensional outcomes and emerging components such as pain neuroscience education may provide a more robust understanding of treatment effectiveness and mechanisms.

Author Contribution

Sabrina Aulia: Conceptualization, Methodology, Literature search, Data curation, Formal analysis, Writing original draft, Visualization. Faizah Abdullah Djawas: Supervision, Methodology, Validation, Writing review and editing, Final approval of manuscript.

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Conflict of Interest Statement

The authors declare no conflict of interest.

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Ethics Statement

This study was conducted in accordance with a prospectively registered protocol in the PROSPERO database (Registration ID: CRD420251246664).

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