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Comparative Analysis of Rehabilitation Approaches for Pencak Silat Injuries: Evidence from Thailand and Iran

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ABSTRACT

Purpose of the Study: This study aims to compare sports injury rehabilitation approaches in Thailand and Iran, particularly the effectiveness of Swedish massage, hot compress therapy, and stretching for reducing pain and improving range of motion among adolescent martial arts athletes with upper limb injuries.

Methodology: This study employed a comparative qualitative review design using sports rehabilitation literature from Thailand and Iran. Data were collected from journal articles, experimental rehabilitation studies, physiotherapy reports, and sports medicine publications. Comparative thematic analysis was applied to evaluate Swedish massage, hot compress, and stretching interventions for adolescent combat sport injury rehabilitation.

Main Findings: The findings showed that Swedish massage was more effective for pain reduction, while hot compress therapy provided superior range of motion recovery. Thailand demonstrated stronger standardized physiotherapy implementation and institutional rehabilitation systems, whereas Iran emphasized individualized athlete-centered recovery approaches. Early adolescent athletes in both countries showed faster rehabilitation responsiveness compared to late adolescents.

Novelty/Originality of this Study: This study provides a cross-country comparative perspective on martial arts injury rehabilitation by examining how therapeutic approaches and rehabilitation systems differ across Thailand and Iran. The novelty lies in integrating clinical rehabilitation perspectives with contextual differences in healthcare systems, athlete management, and treatment approaches to propose a more comprehensive framework for Pencak Silat injury rehabilitation.

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1. INTRODUCTION

Combat sports are among the athletic activities with the highest risk of musculoskeletal injuries due to intensive physical contact, rapid body movements, repetitive impact, and high biomechanical demands during both training and competition. Martial arts disciplines such as pencak silat, Muay Thai, taekwondo, and wrestling require athletes to perform explosive movements involving striking, kicking, blocking, throwing, and grappling techniques. These complex movement patterns demand optimal flexibility, muscular strength, balance, coordination, and neuromuscular control [1]-[3]. Consequently, athletes are highly vulnerable to various upper limb injuries, including muscle strains, ligament sprains, joint stiffness, tendon inflammation, and soft tissue trauma that may interfere with athletic performance and long-term physical function [4]-[6].

In adolescent athletes, the risk of injury becomes even more significant because the musculoskeletal system is still undergoing biological growth and maturation [7]-[9]. Adolescent combat sport athletes frequently experience fluctuations in flexibility, muscle strength, coordination, and tissue adaptability due to developmental processes [10]-[12]. These physiological conditions increase susceptibility to injury while simultaneously influencing rehabilitation responsiveness [13]-[15]. If injury management is not conducted appropriately, athletes may experience prolonged recovery, decreased competitive performance, recurrent injuries, and psychological stress associated with delayed return to sport participation. Therefore, effective rehabilitation strategies are critically important for restoring physical function, reducing pain, and accelerating recovery among young combat sport athletes.

Thailand has become internationally recognized for its advanced integration of sports science into combat sport rehabilitation programs [16]-[18]. The country possesses well-developed physiotherapy systems, university-based sports rehabilitation laboratories, and structured athlete monitoring programs supported by professional sports medicine personnel [19], [20], [21]. Rehabilitation practices in Thailand commonly emphasize evidence-based physiotherapy modalities, therapeutic massage, thermotherapy, progressive stretching, and systematic functional recovery protocols. The strong sporting culture surrounding Muay Thai and martial arts has encouraged continuous development of rehabilitation science and athlete recovery management throughout the country [22]-[24].

Meanwhile, Iran has developed a strong reputation in combat sports medicine through its achievements in wrestling, taekwondo, and martial arts training systems. Iranian rehabilitation approaches often combine modern sports medicine with traditional therapeutic methods and individualized rehabilitation planning [25]-[27]. Sports rehabilitation centers in Iran generally emphasize athlete-specific recovery programs, soft tissue mobilization, pain management, gradual functional restoration, and psychological readiness during rehabilitation. This individualized rehabilitation philosophy is particularly beneficial for adolescent athletes because therapeutic interventions can be adjusted according to injury severity, physical condition, and athlete responsiveness during the recovery process [28]-[30].

Although Thailand and Iran both demonstrate advanced rehabilitation systems in combat sports, substantial differences remain in rehabilitation philosophy, therapeutic priorities, and clinical implementation. Thailand generally prioritizes standardized physiotherapy procedures, structured rehabilitation monitoring, and systematic intervention protocols [31]-[33]. In contrast, Iran tends to emphasize individualized rehabilitation adaptation based on athlete condition, injury characteristics, and personal recovery responses. These differences indicate that each country possesses unique strengths and limitations in managing sports injuries among combat sport athletes.

Among the most commonly utilized non-pharmacological rehabilitation modalities in both countries are Swedish massage, hot compress therapy, and stretching interventions [34]-[36]. Swedish massage contributes to pain reduction by improving blood circulation, stimulating mechanoreceptors, decreasing muscular tension, and promoting neuromuscular relaxation [37], [38]. Hot compress therapy improves connective tissue extensibility, enhances vasodilation, and facilitates range of motion restoration through increased tissue flexibility [39]-[41]. Stretching interventions are also widely implemented to improve flexibility, reduce muscle stiffness, and restore functional movement following injury. These therapeutic approaches are frequently applied because they are relatively safe, practical, non-invasive, and effective in supporting rehabilitation outcomes among combat sport athletes.

However, despite the extensive use of these rehabilitation modalities, previous studies have predominantly focused on examining therapeutic effectiveness within a single country or a single rehabilitation context. Comparative discussions regarding how different countries implement and optimize rehabilitation modalities for adolescent combat sport athletes remain very limited. In particular, there is still insufficient literature comparing the rehabilitation systems of Thailand and Iran, especially regarding their approaches to Swedish massage, hot compress therapy, and stretching interventions in managing upper limb injuries among adolescent martial arts athletes.

This gap in the literature highlights the need for comparative rehabilitation analysis between countries with strong combat sport traditions and different rehabilitation philosophies. Such analysis is important because understanding the strengths and weaknesses of each rehabilitation system may contribute to the development of

more comprehensive, effective, and adaptable sports injury rehabilitation models. Furthermore, the increasing participation of adolescents in combat sports worldwide has created an urgent need for evidence-based rehabilitation strategies capable of supporting rapid recovery, minimizing injury recurrence, and maintaining long-term athlete health and performance.

The urgency of this study also arises from the growing demand for non-pharmacological rehabilitation methods that are safe, accessible, and suitable for adolescent athletes. Excessive dependence on pharmacological pain management may produce side effects and potentially interfere with natural tissue healing processes. Therefore, rehabilitation approaches based on physiotherapy, manual therapy, thermotherapy, and functional exercise have become increasingly important in modern sports medicine practice.

The novelty of this study lies in its comparative analysis of sports injury rehabilitation systems between Thailand and Iran focusing specifically on Swedish massage, hot compress therapy, and stretching interventions among adolescent combat sport athletes. Unlike previous studies that mainly investigate rehabilitation effectiveness in isolated contexts, this study integrates comparative perspectives involving rehabilitation philosophy, therapeutic implementation, pain management strategies, range of motion recovery, and adolescent rehabilitation responsiveness across two countries with strong martial arts traditions.

Therefore, this study aims to compare rehabilitation approaches, therapeutic implementation, and rehabilitation outcomes associated with Swedish massage, hot compress therapy, and stretching interventions between Thailand and Iran in the management of upper limb injuries among adolescent combat sport athletes. The findings are expected to contribute to the development of more comprehensive rehabilitation strategies by combining the systematic rehabilitation framework commonly applied in Thailand with the individualized rehabilitation approach frequently implemented in Iran.

2. RESEARCH METHOD

2.1 Type of Research

This study employed a comparative qualitative review design to analyze and compare sports injury rehabilitation approaches implemented in Thailand and Iran. The qualitative approach was selected because the data examined are inherently contextual, rehabilitation philosophies, therapeutic implementation strategies, and clinical decision-making processes cannot be fully captured through quantitative measurements alone [32], [33]. A comparative design was applied to systematically identify similarities, differences, strengths, and limitations across the rehabilitation systems of both countries. This design is appropriate for generating comprehensive, contextually grounded insights into how different national healthcare systems manage sports injuries among adolescent combat sport athletes.

2.2 Subject and Object of Research

The subject of this study consisted of scientific publications, rehabilitation studies, sports medicine reports, physiotherapy articles, and academic literature related to combat sport injury rehabilitation in Thailand and Iran. The object of research was non-pharmacological rehabilitation modalities, specifically Swedish massage, hot compress therapy, and stretching interventions, applied to adolescent martial arts athletes with upper limb injuries.

Literature selection was conducted purposively according to the following criteria: Inclusion criteria: (1) publications discussing Swedish massage, hot compress therapy, or stretching interventions; (2) research subjects consisting of martial arts or combat sport athletes; (3) rehabilitation context related to Thailand, Iran, or comparative Asian sports medicine systems; (4) publications indexed in Scopus, Web of Science, PubMed, or recognized academic databases; and (5) publication year 2019–2026.

Exclusion criteria: (1) studies focusing exclusively on pharmacological interventions as the primary rehabilitation method; (2) publications not addressing adolescent athletes or combat sports; and (3) literature without full-text accessibility.

2.3 Data Sources and Data Collection Techniques

Data were collected from secondary sources through a systematic literature review utilizing four major electronic databases: Scopus, Web of Science, PubMed, and Google Scholar. Search keywords included: "Swedish massage rehabilitation", "hot compress therapy sports injury", "stretching combat sports", "Pencak Silat injury", "adolescent athlete rehabilitation", "sports physiotherapy Thailand", and "sports medicine Iran". Additional data were obtained from physiotherapy reports, sports medicine conference proceedings, rehabilitation textbooks, and official sports medicine publications from Thailand and Iran.

Collected data were organized and categorized according to research variables and five predefined comparative analytical dimensions: (1) physiotherapy implementation and therapeutic protocols, (2) rehabilitation philosophy and athlete management approaches, (3) pain reduction strategies, (4) range of motion recovery techniques, and (5) adolescent rehabilitation responsiveness based on biological maturation stage.

2.4 Research Instruments

The primary research instrument was a structured Document Analysis Sheet developed by the research team based on the study objectives and predefined variables. The instrument was used to record, categorize, and compare key information extracted from each literature source. An additional Comparative Analysis Matrix was employed to systematically map the similarities and differences between Thailand's and Iran's rehabilitation approaches across all analytical dimensions.

Table 1. Research Instruments

Variable	Indicator	Data Collection Technique	Instrument	Remarks
Rehabilitation System Characteristics	Rehabilitation philosophy, program structure, institutional support	Document & Literature Analysis	Document Analysis Sheet	Thailand–Iran Comparison
Swedish Massage Effectiveness	Pain reduction, muscle relaxation, circulation improvement	Document & Literature Analysis	Data Extraction Sheet	Based on previous studies
Hot Compress Therapy Effectiveness	ROM recovery, tissue extensibility, flexibility restoration	Document & Literature Analysis	Data Extraction Sheet	Based on previous studies
Adolescent Rehabilitation Responsiveness	Recovery speed by developmental stage (early vs. late adolescent)	Document & Literature Analysis	Document Analysis Sheet	Biological maturation classification
Injury Management Strategy	Intervention protocols, individualized vs. standardized approaches	Document & Literature Analysis	Comparative Analysis Matrix	Thailand–Iran Comparison

The data presented in Table 1 illustrate the structured framework used in this study to systematically analyze rehabilitation approaches for Pencak Silat injuries in Thailand and Iran. The instruments were designed to capture key dimensions of rehabilitation, including system characteristics, therapy effectiveness, and injury management strategies, through a consistent document and literature analysis procedure. The Document Analysis Sheet served as the primary tool for extracting and organizing relevant information, while the Comparative Analysis Matrix facilitated a systematic cross-country comparison. Overall, the combination of these instruments ensured a comprehensive, transparent, and structured analysis of rehabilitation practices across both contexts.

2.5 Data Analysis Techniques

Collected data were analyzed using comparative thematic analysis conducted through three sequential stages [34], [35]. The first stage, data reduction, involved selecting, focusing, and simplifying relevant data from all literature sources according to the predefined research variables and analytical dimensions. The second stage, data display, consisted of organizing the reduced data into structured descriptive narratives, comparative tables, and analytical matrices to facilitate systematic interpretation. The third stage, conclusion drawing, involved synthesizing findings from both countries to produce comprehensive comparative insights regarding rehabilitation system strengths, limitations, and strategic recommendations.

Thematic analysis was applied across five analytical dimensions: (1) implementation of physiotherapy protocols and therapeutic modalities, (2) rehabilitation philosophy and athlete-centered management approaches, (3) pain reduction strategies and clinical outcomes, (4) range of motion recovery techniques and functional restoration, and (5) adolescent rehabilitation responsiveness based on developmental stage. Source triangulation was applied by cross-referencing findings across multiple literature sources to strengthen data credibility and analytical consistency.

2.6 Research Procedure

The research was conducted through eight systematic stages: (1) problem identification and research objective formulation based on existing gaps in comparative rehabilitation literature; (2) development of a conceptual framework centered on non-pharmacological rehabilitation modalities for adolescent combat sport

athletes; (3) systematic literature searching across Scopus, Web of Science, PubMed, and Google Scholar using predefined keywords; (4) literature screening and selection applying inclusion and exclusion criteria; (5) data extraction and coding using structured Document Analysis Sheets and Comparative Analysis Matrices; (6) comparative thematic analysis across the five analytical dimensions; (7) synthesis and interpretation of findings to generate comprehensive comparative insights; and (8) formulation of practical and theoretical recommendations for the development of more comprehensive rehabilitation models for Pencak Silat injury management.

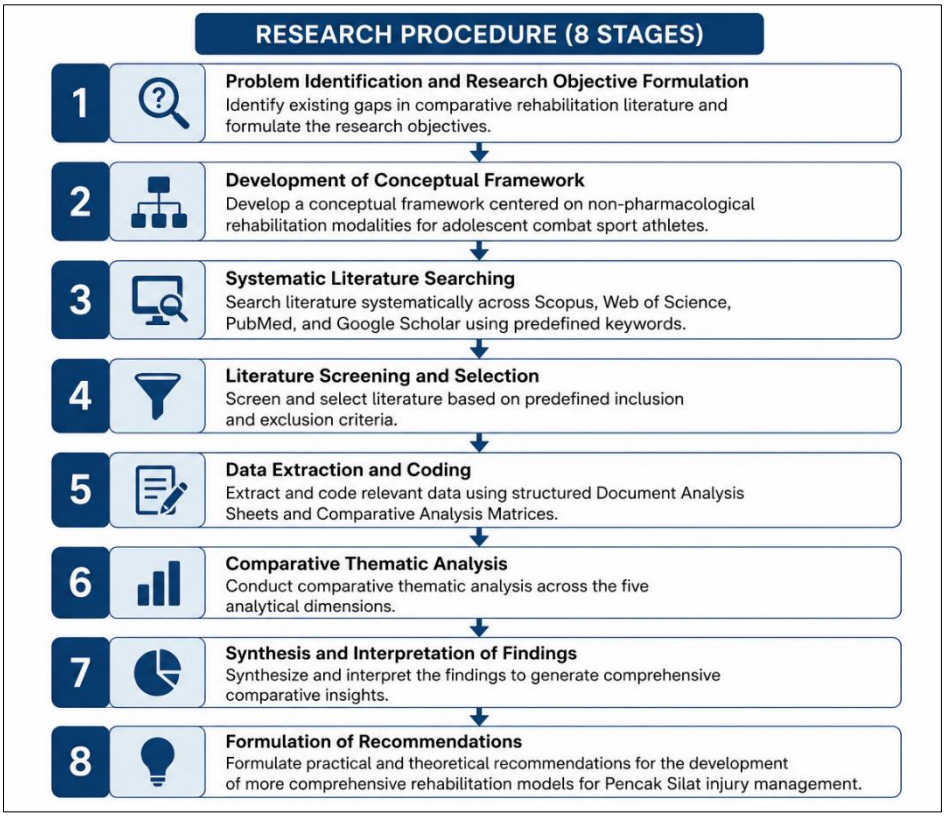

Figure 1. Research Prosedure

3. RESULTS AND DISCUSSION

3.1 Rehabilitation Characteristics in Thailand

The systematic analysis of rehabilitation literature from Thailand reveals a structured and institutionally integrated sports rehabilitation system, particularly in combat sports medicine. Thailand's long-standing involvement in Muay Thai and martial arts disciplines has supported the development of evidence-based physiotherapy education, sports science institutions, and rehabilitation technology [16]–[18]. University-based physiotherapy programs and sports medicine laboratories play a central role in producing standardized rehabilitation protocols designed to accelerate athlete recovery and support safe return-to-competition processes.

Document analysis consistently identified three primary non-pharmacological rehabilitation modalities applied in Thailand: Swedish massage, hot compress thermotherapy, and progressive stretching. Swedish massage implementation in Thailand follows structured therapeutic sequences comprising effleurage, petrissage, friction, tapotement, and vibration techniques [27], [28]. Each movement is applied systematically according to rehabilitation goals and injury characteristics. Effleurage is used during early treatment phases to improve superficial circulation; petrissage and friction reduce muscular tension and break down adhesions; tapotement and vibration stimulate neuromuscular activation and promote muscular relaxation.

Hot compress thermotherapy in Thailand is administered through controlled-temperature moist heat packs applied prior to active rehabilitation exercises to optimize tissue extensibility and reduce joint stiffness [29]–[31]. Thai rehabilitation centers combine heat application with active mobility training, allowing athletes to regain movement capacity more effectively. Structured rehabilitation monitoring using standardized assessment tools for pain intensity, flexibility, muscular strength, and functional movement enables objective evaluation of rehabilitation progression.

Preventive rehabilitation strategies constitute another distinguishing characteristic of the Thai system. Stretching programs and recovery exercises are routinely integrated into regular training sessions, supported by multidisciplinary collaboration among physiotherapists, coaches, and sports scientists. The integration of

biomechanical analysis, movement assessment, and sports science principles into rehabilitation planning contributes to evidence-based clinical decision-making, positioning Thailand as a regional leader in combat sport rehabilitation.

3.2 Rehabilitation Characteristics in Iran

Comparative analysis of rehabilitation literature from Iran reveals a system characterized by individualized, athlete-centered recovery approaches that integrate modern sports medicine with traditional therapeutic practices [19], [20]. Iranian rehabilitation models prioritize therapeutic flexibility according to athlete condition, injury severity, and psychological readiness, distinguishing them from the highly standardized protocols prevalent in Thailand.

Swedish massage application in Iran demonstrates strong individualization. Iranian therapists commonly adapt massage duration, intensity, pressure, and therapeutic focus according to athlete-specific biomechanical limitations and pain tolerance [27], [28]. This adaptive approach allows rehabilitation programs to become more personalized and responsive to individual recovery trajectories. During the initial rehabilitation phase, therapists prioritize pain reduction, minimization of muscle spasm, and tissue relaxation before progressing to more intensive functional exercises.

Hot compress thermotherapy in Iran is frequently integrated directly with active rehabilitation exercises, resistance training, and neuromuscular reconditioning, rather than serving purely as preparatory passive therapy [29]–[31]. Stretching interventions are implemented progressively according to athlete pain tolerance and tissue healing stage, with gradual progression from passive to active flexibility exercises to minimize reinjury risk.

A distinctive strength of the Iranian rehabilitation system lies in its holistic philosophy incorporating psychological support. Athlete motivation, emotional stability, and mental readiness are systematically evaluated throughout rehabilitation [21]–[23]. This psychological integration is particularly beneficial for adolescent combat sport athletes who may experience fear of reinjury, reduced self-confidence, or anxiety regarding return-to-competition readiness. Therapists encourage communication and emotional support during sessions to strengthen athlete engagement and rehabilitation adherence.

3.3 Comparative Analysis of Swedish Massage Effectiveness

Thematic analysis across both countries confirms that Swedish massage is recognized as one of the most effective non-pharmacological rehabilitation modalities for pain reduction and muscular recovery among combat sport athletes [27], [28]. However, substantial differences exist in implementation philosophy and clinical integration.

In Thailand, Swedish massage is implemented within standardized physiotherapy frameworks with predetermined treatment durations, therapeutic sequences, and clinical monitoring systems. This structured approach contributes to consistency in rehabilitation quality and facilitates objective outcome evaluation. Thai physiotherapists integrate massage into both post-injury rehabilitation and routine conditioning programs, reflecting a preventive rehabilitation philosophy aimed at reducing muscular fatigue and minimizing injury risk. In Iran, massage implementation is substantially more individualized therapists adapt intensity, duration, pressure, and therapeutic focus according to athlete-specific conditions, pain perception levels, and psychological comfort, creating a more adaptive and athlete-centered therapeutic environment.

Physiologically, Swedish massage reduces pain through mechanical stimulation of mechanoreceptors that inhibit pain transmission pathways, improved circulation accelerating metabolite removal, decreased muscular tension, and endogenous analgesic responses [27], [28]. Both countries report substantial pain reduction following repeated Swedish massage interventions, though Thailand's structured environment provides advantages in consistency and standardization, while Iran's individualized model may contribute more strongly to athlete satisfaction, comfort, and psychological recovery readiness.

These comparative findings suggest that integrating systematic rehabilitation structures with individualized therapeutic adaptation may optimize rehabilitation outcomes. The combination of standardized protocols ensuring clinical consistency with individualized adjustments addressing athlete-specific needs represents a potentially superior rehabilitation model for adolescent combat sport athletes.

3.4 Comparative Analysis of Hot Compress Therapy

Comparative thematic analysis confirms that hot compress therapy demonstrates considerable effectiveness in restoring range of motion and improving tissue flexibility in both Thailand and Iran [29]–[31]. However, the countries differ in application emphasis and integration with active rehabilitation components.

In Thailand, thermotherapy follows standardized protocols regarding heat intensity, treatment duration, and application procedures. Physiotherapists administer controlled-temperature moist heat packs before active rehabilitation exercises, subsequently encouraging controlled ROM exercises to exploit the window of enhanced tissue flexibility. This sequence, passive thermotherapy followed immediately by active mobility training contributes to more efficient restoration of movement capacity while minimizing exercise discomfort.

Iran integrates thermotherapy within broader rehabilitation sessions encompassing stretching, resistance training, and neuromuscular conditioning. Heat application is viewed as preparatory therapy facilitating subsequent functional rehabilitation activities. Iranian therapists additionally encourage gradual active movement restoration following heat application, ensuring that flexibility improvements are accompanied by functional muscular control and joint stability an approach contributing positively to long-term functional recovery and reinjury prevention.

Physiologically, hot compress therapy improves rehabilitation outcomes through increased blood circulation, vasodilation, enhanced collagen extensibility, and reduced muscle spindle sensitivity [29]–[31]. These mechanisms collectively facilitate greater ROM recovery. The comparative analysis indicates that Thailand's structured thermotherapy protocols excel in standardization and monitoring, while Iran's integrated approach better aligns passive thermal therapy with active functional rehabilitation. Combining these strengths standardized thermotherapy protocols with integrated active rehabilitation, may provide optimal ROM recovery outcomes for adolescent combat sport athletes.

3.5 Stretching Interventions and Adolescent Rehabilitation Responsiveness

Stretching interventions remain essential rehabilitation components in both Thailand and Iran, though thematic analysis indicates they produce more moderate outcomes compared to Swedish massage and thermotherapy when applied in isolation. Flexibility restoration, muscular relaxation, and movement re-education are primary stretching objectives during sports injury rehabilitation.

Thailand emphasizes preventive stretching programs integrated into routine conditioning and recovery sessions, supported by progressive protocols and structured movement evaluation. Iran prioritizes individualized stretching progression according to athlete pain tolerance and tissue healing status, with gradual intensity advancement from passive to active stretching to minimize reinjury risk. These contrasting approaches reflect the broader rehabilitation philosophies identified across both analytical dimensions: standardized systematic progression in Thailand versus adaptive individualized progression in Iran.

An important finding emerging from comparative literature analysis is the significant influence of adolescent developmental stage on rehabilitation responsiveness. Early adolescent athletes demonstrate faster recovery compared to late adolescents due to greater tissue hydration, higher cellular regenerative capacity, superior neuromuscular plasticity, and improved connective tissue adaptability [9]–[12]. These physiological characteristics enable more efficient circulation responses and faster restoration of movement capacity following rehabilitation interventions.

Late adolescent athletes require longer rehabilitation duration and more progressive intervention intensity due to reduced tissue adaptability and greater muscular stiffness. These developmental differences indicate that rehabilitation planning must account for biological maturation stage rather than chronological age alone. Both Thailand and Iran demonstrate awareness of this principle, though Iran's individualized rehabilitation model is inherently better positioned to adapt interventions to individual maturational status.

3.6 SWOT Comparative Analysis of Rehabilitation Systems

The SWOT comparative analysis, derived from systematic thematic coding of rehabilitation literature from both countries, demonstrates that Thailand and Iran possess distinct strategic characteristics in combat sport injury rehabilitation management.

Table 2. SWOT Comparative Analysis of Sports Injury Rehabilitation Systems in Thailand and Iran

Country	Strengths	Weaknesses	Opportunities	Threats
Thailand	Modern stadium-equivalent physiotherapy infrastructure; strong government support; professional club management; standardized rehabilitation monitoring systems	High operational costs; dependence on continuous innovation; challenges in maintaining commercialization balance	International sports tourism market; regional sports rehabilitation leadership; digital health integration	Increasing competition among Southeast Asian rehabilitation centers; regional economic fluctuations
Iran	Individualized athlete-centered rehabilitation; strong cultural identity in combat sports; holistic rehabilitation philosophy	Limited standardization; lower international rehabilitation exposure; infrastructure constraints compared to Thailand	Development of culturally integrated rehabilitation models; increasing global interest in traditional-modern	Limited financial investment; weak international rehabilitation promotion; insufficient

Country	Strengths	Weaknesses	Opportunities	Threats
	incorporating psychological support		combined approaches	systemic integration

The SWOT analysis confirms that successful sports injury rehabilitation requires a balanced integration of systematic clinical structure and individualized therapeutic adaptation. Thailand's competitive advantages lie in rehabilitation standardization, institutional support, evidence-based monitoring, and multidisciplinary collaboration, contributing to consistent and measurable rehabilitation outcomes. Iran's competitive advantages are rooted in individualized athlete-centered care, holistic rehabilitation philosophy incorporating psychological support, and adaptive therapeutic flexibility.

These findings suggest that a hybrid rehabilitation model, combining Thailand's systematic protocols with Iran's individualized adaptation, may represent the most effective approach for adolescent Pencak Silat injury rehabilitation. Such integration would address the dual requirements of clinical consistency and athlete-specific responsiveness, potentially reducing rehabilitation duration while improving both physical and psychological recovery outcomes.

4. CONCLUSION

This study demonstrates that sports injury rehabilitation approaches for adolescent Pencak Silat athletes in Thailand and Iran share common foundations in the application of non-pharmacological interventions, particularly Swedish massage, hot compress therapy, and stretching exercises, but differ substantially in rehabilitation philosophy, clinical implementation, and athlete management strategies. Thailand represents a more standardized and system-oriented rehabilitation model characterized by structured physiotherapy protocols, institutional support, objective monitoring systems, and integration of sports science principles. In contrast, Iran demonstrates a more individualized athlete-centered rehabilitation model that emphasizes therapeutic adaptation, psychological readiness, and personalized recovery planning.

The comparative analysis indicates that Swedish massage is highly beneficial for pain reduction and muscular relaxation, while hot compress therapy provides important contributions to range of motion restoration and tissue flexibility improvement. Stretching interventions remain essential for functional recovery, although their effectiveness depends strongly on progressive application, injury characteristics, and the athlete's developmental stage. The findings also highlight that adolescent rehabilitation responsiveness is influenced by biological maturation, requiring rehabilitation programs to consider individual growth and physiological conditions rather than chronological age alone.

This study suggests that an integrated rehabilitation framework combining Thailand's standardized clinical protocols with Iran's individualized athlete-centered approach may provide a more comprehensive strategy for managing combat sport injuries. Such a hybrid model has the potential to optimize pain management, accelerate functional recovery, minimize reinjury risk, and improve long-term athlete development outcomes. Future research should validate this comparative framework through empirical clinical trials and longitudinal investigations involving adolescent martial arts athletes across diverse sport systems.

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AUTHOR CONTRIBUTIONS

Conceptualization, A.N.W.; Methodology, A.N.W. and U.C.B.; Investigation, A.N.W., M.M.K., Z.M.N., and U.C.B.; Data Curation, A.N.W. and M.M.K.; Formal Analysis, A.N.W.; Literature Review and Synthesis, A.N.W., M.M.K., Z.M.N., and U.C.B.; Writing – Original Draft Preparation, A.N.W.; Writing – Review & Editing, A.N.W., M.M.K., Z.M.N., and U.C.B.; Visualization, M.M.K. and Z.M.N.; Project Administration, A.N.W.; Supervision, A.N.W.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

Not applicable.

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