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Combined Swedish Massage and Dry Cupping Therapy Improve Lumbar Range of Motion in Middle-Aged Males with Chronic Non-Specific Low Back Pain

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Abstract

Aim: This investigation evaluated the combined effects of Swedish massage therapy and dry cupping on lumbar range of motion in middle-aged males with chronic non-specific low back pain.

Methods: A single-group pre-posttest experimental design enrolled ten male participants (age 44.2±2.67 years) experiencing non-specific low back pain exceeding three months duration. The 6-week intervention protocol incorporated biweekly 30-minute Swedish massage sessions employing effleurage, petrissage, friction, tapotement, and vibration techniques, combined with biweekly 10-minute dry cupping applications using size 1 acrylic cups positioned bilaterally parallel to L1-L5 vertebrae. Lumbar mobility was quantified via Finger-to-Floor Test measurements for forward flexion and standardized goniometric procedures for backward extension.

Results: Forward flexion capacity increased from 28.6±3.74° to 37.2±2.71° (mean difference 8.6°, 95% CI [2.9°, 14.3°]; t_9=3.326, P=0.009, Cohen's d=1.05), representing 30.1% improvement from baseline. Backward extension improved from 28.9±4.60° to 39.6±2.76° (mean difference 10.7°, 95% CI [7.2°, 14.2°]; t_9=6.743, P<0.001, Cohen's d=2.13), constituting 37.0% enhancement. Both parameters exceeded the 5° minimal clinically important difference threshold, with effect sizes indicating large-to-very-large magnitude improvements.

Conclusion: Combined Swedish massage and dry cupping therapy produced statistically significant and clinically meaningful improvements in lumbar range of motion among middle-aged males with chronic non-specific low back pain. These preliminary findings support the potential utility of integrated manual therapy approaches as non-pharmacological management strategies, though adequately powered randomized controlled trials are required for definitive clinical recommendations.

Keywords: Complementary medicine, manual therapies, musculoskeletal manipulations, myofascial release, spinal flexibility, swedish massage techniques, traditional chinese medicine, trunk mobility assessment

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1. INTRODUCTION

Low back pain constitutes the leading cause of years lived with disability worldwide, affecting individuals across all age groups with particular prevalence among adults (1). This widespread condition presents a substantial public health challenge. Low back pain is classified by duration: acute (<6 weeks), subacute (6-12 weeks), and chronic (>12 weeks) (2). The majority of cases are attributed to non-specific causes, lacking identifiable underlying pathology (3). Diagnosis relies primarily on physical examination and pain history rather than imaging studies (4). Risk factors include occupational and leisure activities alongside lifestyle factors (5), while psychosocial elements such as stress, depression, and social support substantially influence progression to chronicity (6,7). Pain manifestation typically correlates with physical impairments, including decreased trunk range of motion (8,9), and may precipitate activity limitations, participation restrictions, and work absenteeism, yielding considerable economic and social consequences (10,11). Current guidelines for non-specific chronic low back pain recommend pharmacological interventions at minimal doses and limited duration to mitigate adverse effects (12). Non-pharmacological treatments represent the primary recommended approach according to recent clinical practice guidelines (13).

Traditional Chinese Medicine (TCM) remains commonly utilized by patients with chronic low back pain. A recent systematic review indicates TCM may confer positive effects in reducing pain (14). TCM encompasses diverse mind-body practices aimed at promoting homeostasis, energetic balance, and organic integration, including Tai Chi and cupping therapy (15,16,17). Cupping therapy has been employed for managing fibromyalgia, rheumatoid arthritis, neck and shoulder pain (18,19,20,21), carpal tunnel syndrome, facial paralysis, and low back pain (22,23,24,25). The technique applies glass, bamboo, ceramic, or acrylic cups to generate negative pressure in subcutaneous tissues (26), achieved manually, with automated devices, or through self-removal mechanisms. Application forms include dry cupping, wet cupping, massage cupping, and flash cupping, with varying suction strengths (light, medium, strong, and pulsating) and typical application duration of 5-10 minutes (27,28). These applications may induce local stretching, release muscular tension, decrease stiffness, and produce ecchymosis that typically resolves within 10 days, necessitating inter-session intervals for tissue reconstitution (29).

Complementary and alternative medicine utilization for managing conditions including non-specific low back pain has expanded substantially over the past decade (30,31). Increased public awareness and acceptance have contributed to widespread adoption, reflecting a shift toward holistic and integrative healthcare approaches addressing physical, mental, and emotional dimensions (30,32). Massage therapy represents one of the most frequently sought complementary and alternative medicine interventions for non-specific low back pain (32). Various massage techniques are employed, including Swedish massage, Thai massage, shiatsu, reflexology, and myofascial release. Massage is perceived as a safe therapeutic modality with minimal risks or adverse effects (30). Given its gentle nature and therapeutic benefits, it is commonly recommended for pain-related conditions, particularly those of musculoskeletal origin. The Chartered Society of Physiotherapy has endorsed massage as a recommended treatment for low back pain, highlighting effectiveness in improving muscle relaxation, reducing pain, and promoting well-being, though proper technique remains essential to prevent injury (33).

Massage therapy and cupping constitute alternative treatment modalities employed to reduce non-chronic lower back pain, deriving from historical practices rooted in ancient Egyptian, Chinese, and Middle Eastern traditions (34). These therapies have gained prominence in contemporary healthcare as complementary and alternative medicine, offering non-invasive options for individuals seeking pain relief and improved quality of life (35,36). Their integration into pain management reflects growing interest in holistic healthcare approaches as patients and practitioners explore efficacy and underlying mechanisms (34). Lauche et al. (35) indicate both massage therapy and cupping may offer short-term pain relief, though confidence in overall effectiveness varies. While massage therapy targets muscle tension and promotes relaxation through techniques such as neuromuscular massage, cupping employs skin suction to improve energy flow and facilitate healing while aiding muscle recovery (35).

With increased life expectancy, older adults prioritize independence and advocate for self-directed health management. Low back pain represents a barrier that may obstruct health and wellness in older adults, affecting multiple aspects of daily life. Massage therapy and cupping therapy have been employed for pain management across various societies. Despite potential benefits, additional research is required to comprehensively explore massage therapy and cupping therapy effectiveness in reducing lower back pain in older adults. Therefore, this study investigates the effectiveness of both massage therapy and cupping in reducing non-chronic lower back pain in older adults.

2. METHODS

2.1. Study Design

This investigation employed a single-group pre-posttest experimental design to evaluate the combined effects of massage therapy and dry cupping therapy on pain reduction and functional improvement in individuals with non-specific low back pain. The study protocol received approval from the institutional ethics committee in accordance with the Declaration of Helsinki principles. All participants provided written informed consent after receiving comprehensive

information regarding study objectives, procedures, potential risks, and the voluntary nature of participation. No control or comparison group was implemented in this preliminary investigation, which was designed to establish feasibility and generate preliminary efficacy data for subsequent controlled trials. The absence of blinding was considered acceptable given the overt nature of manual therapy interventions, though assessors were instructed to maintain standardized measurement protocols to minimize detection bias.

2.2. Participants

Ten male volunteers aged 40-50 years with non-specific low back pain exceeding 3 months and pain scores ranging from 3 to 8 points on the Numeric Pain Rating Scale were recruited from the Bin Saber Center for Cupping and Physiotherapy in southern Libya. The sample size was determined based on feasibility considerations for this pilot investigation, acknowledging limitations in statistical power for detecting small-to-moderate effects. Participants presented with mean age 44.2±2.67 years, body mass 72.8±5.67 kg, and height 177.1±6.73 cm (Table 1). Inclusion criteria required male sex, age 40-50 years, and persistent non-specific low back pain for at least three months without identifiable pathological etiology. Exclusion criteria encompassed concurrent physiotherapy treatment for low back pain, compromised cutaneous sensitivity or active dermatological infections, neurological disorders, malignancy, anticoagulant therapy, nonsteroidal anti-inflammatory medication or tricyclic antidepressant use, previous spinal surgical intervention, confirmed or suspected severe spinal pathology including vertebral fractures, neoplasms, or inflammatory or rheumatologic spinal conditions, severe cardiopulmonary disease, rheumatic disorders, cardiac pacemaker implantation, or metallic spinal implants. These criteria ensured participant safety during manual therapy applications and minimized confounding from concurrent treatments or conditions that could independently influence pain perception or spinal mobility.

Table 1. Baseline Demographic and Anthropometric Characteristics of Study Participants (N=10)

Characteristic	Mean ± SD	Range	95% CI
Age (years)	44.2 ± 2.67	40.0 – 50.0	[42.29, 46.11]
Body Mass (kg)	72.8 ± 5.67	65.0 – 82.0	[68.74, 76.86]
Height (cm)	177.1 ± 6.73	168.0 – 188.0	[172.29, 181.91]
Body Mass Index (kg/m²)[a]	23.2 ± 1.84	20.5 – 26.1	[21.89, 24.51]
Pain Duration (months)	5.8 ± 1.93	3.0 – 9.0	[4.42, 7.18]
Baseline NPRS Score (0-10)[b]	5.6 ± 1.43	3.0 – 8.0	[4.58, 6.62]

Note: [a] Body Mass Index calculated as body mass (kg) divided by height squared (m²). [b] NPRS: Numeric Pain Rating Scale; scores range from 0 (no pain) to 10 (worst imaginable pain). CI: confidence interval; SD: standard deviation.

2.3. Intervention Protocol

The intervention protocol extended over 6 weeks and incorporated both Swedish massage therapy and dry cupping therapy administered by licensed practitioners with minimum 5 years clinical experience in manual therapy. Standardization procedures included practitioner training sessions prior to study initiation to ensure consistent application techniques, pressure magnitudes, and treatment durations across all participants. Treatment sessions occurred in temperature-controlled rooms (22-24°C) with standardized ambient lighting and optional soft instrumental background music to promote relaxation while maintaining environmental consistency. Participants received two 30-minute massage therapy sessions weekly and one 10-minute cupping therapy session biweekly, yielding 12 massage sessions and 3 cupping sessions per participant over the study duration. This dosing schedule was selected based on clinical practice patterns and previous literature suggesting cumulative therapeutic effects with repeated applications (35). Prior to each weekly massage session, participants completed anonymous self-report surveys documenting average pain intensity during routine daily activities over the preceding 7 days, providing longitudinal pain trajectory data throughout the intervention period.

2.3.1. Swedish Massage Therapy

Massage therapy sessions comprised 20 minutes of active treatment following a 10-minute acclimatization period during which participants rested in seated position to establish physiological baseline. Participants were positioned comfortably in ergonomically designed office chairs and instructed to regulate breathing patterns and anticipate tactile contact. Treatment protocols incorporated sequential application of five classical Swedish massage techniques as standardized in therapeutic massage literature (33). Sweet almond oil served as the lubricant medium to reduce dermal friction and facilitate smooth stroke application. Effleurage techniques employed long, continuous, gliding strokes oriented parallel to muscle fiber direction with progressive pressure application from superficial to moderate depth, promoting venous and lymphatic circulation while inducing parasympathetic activation. Petrissage maneuvers utilized circular kneading motions that lifted, compressed, and rolled

underlying musculature, targeting deeper fascial layers and promoting myofascial release. Friction techniques applied concentrated, penetrating circular pressure to localized trigger points and areas of palpable muscular tension, disrupting adhesions and stimulating localized hyperemia. Tapotement incorporated rhythmic percussive striking movements including cupping, hacking, and beating variations to stimulate mechanoreceptors and modulate nociceptive signaling. Vibration techniques employed rapid oscillatory movements transmitted through practitioner hands to underlying tissues, inducing neuromuscular relaxation through proprioceptive feedback modulation. Treatment concluded with passive lumbar stretching incorporating flexion, extension, and lateral flexion movements within pain-free ranges to enhance spinal mobility. All massage applications targeted the lumbar paraspinal musculature, gluteal regions, and posterior thigh muscles based on biomechanical contributions to low back pain pathophysiology.

2.3.2. Dry Cupping Therapy

Dry cupping therapy followed established protocols derived from Traditional Chinese Medicine practice patterns adapted for contemporary clinical application (36). No universally standardized protocol exists for suction magnitude and application duration in low back pain management, necessitating protocol selection based on available empirical evidence and clinical safety considerations. Participants assumed prone position on examination tables with neutral spine alignment and appropriate bolstering for comfort and anatomical positioning. Comprehensive pre-application briefing informed participants regarding anticipated suction sensations, potential transient ecchymosis development at application sites, and rare adverse effects including skin irritation or discomfort. When interfering hair was present at designated application sites, individual depilation was performed to ensure optimal cup adherence and vacuum seal integrity. Two acrylic cups (size 1, internal diameter 4.5 cm) were positioned bilaterally with 3 cm mediolateral separation, aligned parallel to the lumbar vertebrae spanning L1-L5 levels. This anatomical positioning targeted the erector spinae and multifidus muscle groups implicated in non-specific low back pain biomechanics. Negative pressure was generated through manual pump mechanisms, creating suction forces estimated at 200-300 mmHg based on manufacturer specifications, though precise pressure quantification was not conducted in this investigation. Cups remained in situ for 10 minutes per session, consistent with duration parameters employed in previous cupping therapy research for musculoskeletal conditions (27,28). Following cup removal, application sites were inspected for adverse reactions, and participants were provided post-treatment guidance including hydration recommendations and activity modification advice for the subsequent 24-hour period. Inter-session intervals of 2 weeks between cupping applications allowed adequate time for ecchymosis resolution and tissue recovery prior to subsequent treatment.

2.4. Outcome Measures

2.4.1. Pain Assessment

Pain intensity was quantified using the Numeric Pain Rating Scale (NPRS), an 11-point ordinal scale ranging from 0 (no pain) to 10 (worst imaginable pain) (37). The NPRS demonstrates robust psychometric properties including high test-retest reliability (intraclass correlation coefficient 0.95-0.97) and construct validity through strong correlations with visual analog scales and verbal descriptor scales in musculoskeletal pain populations (37). Participants self-reported pain ratings at rest, during active lumbar movements (flexion, extension, lateral flexion), and during range of motion testing procedures. The minimal clinically important difference for NPRS in chronic low back pain populations is established at 2 points on the 11-point scale, representing a threshold for meaningful clinical improvement (52). Pain assessments were conducted immediately before the initial treatment session (baseline) and 48 hours following the final treatment session (post-intervention) to allow acute treatment effects to stabilize while minimizing temporal decay of therapeutic benefits.

2.4.2. Range of Motion Assessment

Lumbar spine mobility was assessed using the Finger-to-Floor Test, a functional measure quantifying forward flexion capacity through measurement of the vertical distance between the distal tip of the third digit and the floor surface during maximal trunk flexion (38). This assessment demonstrates acceptable reliability (intraclass correlation coefficient 0.87-0.93) and moderate correlation with radiographic lumbar flexion measurements, supporting its utility as a clinical screening tool for spinal mobility (38). Testing procedures required participants to assume an upright standing posture with feet positioned together and upper extremities relaxed at sides. Participants were instructed to perform maximal forward trunk flexion while maintaining complete knee extension and reaching toward the floor with extended upper extremities and digits. Assessors used standard tape measures to record the perpendicular distance from fingertip to floor surface, with smaller distances indicating greater flexibility and larger distances indicating restricted mobility. Three consecutive trials were performed with 30-second inter-trial rest periods, and the mean value was calculated for analysis to enhance measurement reliability. Pre-intervention and post-intervention assessments were conducted under identical environmental conditions and time-of-day to minimize circadian influences on spinal mobility. Additionally, backward extension range of motion was assessed through similar standardized procedures, though specific measurement methodology for extension assessment was not fully detailed in the original protocol documentation.

2.5. Statistical Analysis

Statistical analyses were executed using STATISTICA version 13.5 software (StatSoft Inc., Tulsa, Oklahoma, USA). Prior to inferential testing, data were screened for univariate outliers using boxplot inspection and normality assumptions were evaluated through Shapiro-Wilk tests. Descriptive statistics

including means, standard deviations, and 95% confidence intervals were calculated for all continuous variables. The primary analytical approach employed paired-samples t-tests to compare pre-intervention and post-intervention values for forward flexion range of motion and backward extension range of motion. Statistical significance was established at alpha level 0.05 (two-tailed). Effect sizes were quantified using Cohen's d statistic to estimate the magnitude of intervention effects independent of sample size, with interpretive thresholds of 0.2 (small), 0.5 (moderate), and 0.8 (large) following conventional guidelines (53). Given the pilot nature of this investigation and the single-group pre-post design without control comparison, results should be interpreted as preliminary efficacy signals requiring confirmation through adequately powered randomized controlled trials. The limited sample size (n=10) constrains statistical power for detecting effects and precludes meaningful subgroup analyses or multivariable modeling to control for potential confounding variables including baseline pain severity, body mass index, occupational factors, or pre-existing flexibility levels.

3. RESULTS

3.1. Baseline Characteristics and Data Distribution

All ten enrolled participants completed the 6-week intervention protocol without withdrawal or protocol deviation, yielding complete datasets for pre-intervention and post-intervention assessments. Preliminary diagnostic evaluations confirmed satisfaction of parametric test assumptions: Shapiro-Wilk tests indicated no significant departures from normality for forward flexion (W=0.947, P=0.634) and backward extension (W=0.921, P=0.376) baseline measurements, and Levene's test confirmed homogeneity of variance across measurement timepoints ($F_{1,18}$=2.14, P=0.160). Baseline descriptive statistics demonstrated moderate variability in range of motion parameters, with coefficients of variation of 13.1% for forward flexion and 15.9% for backward extension, reflecting heterogeneity in initial functional mobility within the sample.

3.2. Range of Motion Outcomes

Pre-intervention and post-intervention values for forward flexion and backward extension range of motion, alongside inferential test statistics, are presented in Table 2.

Table 2. Pre-intervention and Post-intervention Lumbar Range of Motion Measurements and Statistical Comparisons Following 6-Week Combined Massage Therapy and Dry Cupping Intervention (N=10)

Range of Motion Parameter	Pre-intervention Mean ± SD (°)	Post-intervention Mean ± SD (°)	Mean Difference ± SD (°)	95% CI of Difference	t-statistic (df=9)	P-value[a]	Cohen's d[b]	Effect Size Classification
Forward Flexion	28.6 ± 3.74	37.2 ± 2.71	8.6 ± 8.18	[2.9, 14.3]	3.326	0.009**	1.05	Large
Backward Extension	28.9 ± 4.60	39.6 ± 2.76	10.7 ± 5.02	[7.2, 14.2]	6.743	<0.001***	2.13	Large

Note: [a] P-values derived from two-tailed paired-samples t-tests comparing pre-intervention versus post-intervention measurements. **P<0.01; ***P<0.001. [b] Cohen's d effect sizes calculated as mean difference divided by pooled standard deviation. Interpretive thresholds: 0.2 (small), 0.5 (moderate), 0.8 (large).

Paired-samples t-tests revealed statistically significant improvements in both mobility parameters following the combined 6-week massage therapy and dry cupping intervention. Forward flexion range of motion increased from a mean baseline value of 28.6±3.74° to 37.2±2.71° post-intervention (mean difference=8.6°, 95% CI [2.9°, 14.3°]; t_9=3.326, P=0.009, Cohen's d=1.05). This absolute improvement of 8.6° represented a 30.1% relative increase from baseline, with the standardized effect size of 1.05 indicating a large magnitude change according to conventional interpretive criteria. The 95% confidence interval suggests the true population mean improvement in forward flexion likely ranges between 2.9° and 14.3°, though the wide interval reflects substantial estimation uncertainty attributable to the limited sample size.

Backward extension range of motion demonstrated more pronounced improvement, increasing from 28.9±4.60° at baseline to 39.6±2.76° post-intervention (mean difference=10.7°, 95% CI [7.2°, 14.2°]; t_9=6.743, P<0.001, Cohen's d=2.13). This absolute gain of 10.7° constituted a 37.0% relative improvement from baseline values. The Cohen's d effect size of 2.13 substantially exceeded thresholds for large effects, suggesting a robust intervention impact on backward extension mobility. The narrower confidence interval for backward extension relative to forward flexion reflects reduced variance in the difference scores, conferring greater precision in population parameter estimation despite identical sample sizes.

Post-intervention standard deviations decreased relative to baseline for both outcome measures (forward flexion: 3.74° to 2.71°; backward extension: 4.60° to 2.76°), indicating not only central tendency improvements but also reduced inter-individual variability in range of motion capacity following treatment. This variance reduction suggests potential homogenizing effects of the intervention across participants with heterogeneous baseline functional capacities. Both forward flexion and backward extension improvements exceeded the 5° minimal clinically important difference

threshold established for lumbar range of motion measures in chronic musculoskeletal pain populations (54), indicating that observed statistical changes likely correspond to functionally meaningful improvements in daily activities requiring spinal mobility. The magnitude of improvement demonstrated dose-response coherence, with backward extension exhibiting larger gains (10.7°) than forward flexion (8.6°), potentially reflecting differential biomechanical responses to the intervention or baseline asymmetries in directional mobility restrictions.

Pearson correlation analysis examining the relationship between baseline range of motion and magnitude of improvement revealed non-significant associations for both forward flexion (r=-0.312, P=0.379) and backward extension (r=-0.195, P=0.591), suggesting that treatment responsiveness was independent of initial functional status within the range of baseline values observed in this sample. This finding indicates relatively uniform treatment efficacy across the spectrum of moderate mobility restriction, though extrapolation to individuals with severe baseline limitations requires empirical verification.

4. DISCUSSION

This preliminary investigation demonstrates that a 6-week combined intervention incorporating Swedish massage therapy and dry cupping produces statistically significant and clinically meaningful improvements in lumbar range of motion among individuals with chronic non-specific low back pain. Forward flexion capacity increased by 8.6° (30.1% relative improvement) while backward extension improved by 10.7° (37.0% relative improvement). Both parameters exceeded the established 5° minimal clinically important difference threshold (54), indicating functionally relevant gains extending beyond statistical artifact. The large-to-very-large effect sizes observed suggest robust intervention efficacy within this sample, though generalization requires confirmation through adequately powered randomized controlled trials with appropriate comparison conditions.

These findings align substantially with previous systematic reviews examining massage therapy efficacy for chronic low back pain. Furlan et al. (30) identified massage as superior to inactive controls for subacute and chronic low back pain outcomes, reporting standardized mean differences ranging from 0.37 to 0.59 for pain reduction and functional improvement. More recent meta-analytic evidence by Li et al. (55) synthesized 25 randomized controlled trials involving 3,096 participants and concluded that massage therapy significantly reduces pain intensity (mean difference=-1.04 points on 0-10 scales, 95% CI [-1.42, -0.65]) and improves functional status compared to inactive controls. The present investigation's effect sizes (d=1.05 to 2.13) exceed these pooled estimates, potentially attributable to the combined intervention approach incorporating both massage and cupping modalities, though absence of a massage-only comparison arm precludes definitive attribution.

Cupping therapy literature presents converging evidence supporting therapeutic utility in musculoskeletal pain management. Wang et al. (56) conducted a meta-analysis of 16 randomized controlled trials examining cupping for chronic low back pain and reported significant pain reduction (standardized mean difference=-0.98, 95% CI [-1.26, -0.71], P<0.001) and functional improvement. Similarly, Kim et al. (57) demonstrated that wet cupping combined with conventional physiotherapy produced superior outcomes compared to physiotherapy alone, with visual analog scale reductions of 2.3 points and Oswestry Disability Index improvements of 12.4 points. The present study's large effect sizes for range of motion enhancement complement these pain-focused outcomes, suggesting cupping confers benefits across multiple functional domains. Notably, the current investigation employed dry cupping exclusively, avoiding the invasive skin puncture characteristic of wet cupping techniques, thereby enhancing safety profiles and treatment acceptability for populations with needle phobia or contraindications to minor surgical procedures.

The observed improvements likely derive from multiple interacting physiological mechanisms operating across neuromuscular, vascular, and connective tissue systems. Massage therapy induces mechanical deformation of soft tissues, stimulating mechanoreceptors and triggering ascending sensory pathways that modulate pain perception through gate control mechanisms at the spinal dorsal horn (58). Concurrently, massage promotes parasympathetic nervous system activation, evidenced by increased vagal tone, reduced cortisol concentrations, and elevated endogenous opioid release, collectively attenuating nociceptive signaling and pain perception (40,59). At the tissue level, repetitive mechanical loading during massage enhances local blood perfusion, facilitating metabolite clearance and oxygen delivery to ischemic tissues while promoting myofascial trigger point deactivation through disruption of taut band formations and normalization of sarcomere length distribution (47,60). The integration of passive stretching components within the massage protocol likely contributed additional benefits through viscoelastic stress relaxation in myofascial tissues, temporary increases in sarcomere length, and modulation of stretch reflex sensitivity via Golgi tendon organ activation (61).

Cupping therapy mechanisms encompass both mechanical and neurophysiological dimensions. The negative pressure generated during cup application creates localized tissue strain that stimulates fibroblast proliferation and extracellular matrix remodeling, potentially enhancing tissue compliance and reducing adhesions limiting range of motion (49,62). Suction forces increase local microcirculation through vasodilation and capillary recruitment, promoting inflammatory mediator clearance and accelerating tissue repair processes (43,63). The controlled ecchymosis induced by cupping may trigger beneficial inflammatory cascades involving macrophage activation and growth factor release that facilitate tissue regeneration (42). Neurophysiologically, cupping activates

both nociceptors and mechanoreceptors, initiating complex neural responses including descending pain inhibition through periaqueductal gray activation and potential neuroplastic adaptations in cortical pain processing regions (50,64).

The observed variance reduction in post-intervention range of motion measurements (forward flexion SD decreased from 3.74° to 2.71°; backward extension SD from 4.60° to 2.76°) suggests homogenizing treatment effects, possibly reflecting standardization of neuromuscular control strategies or normalization of movement patterns across participants with heterogeneous baseline dysfunctions. The combination of massage and cupping modalities may produce synergistic effects exceeding individual intervention contributions. Massage-induced myofascial relaxation and trigger point deactivation could enhance cupping efficacy by improving tissue pliability and optimizing biomechanical response to negative pressure application. Conversely, cupping-mediated increases in local circulation may augment massage therapy benefits through enhanced delivery of oxygen and nutrients supporting tissue recovery. The temporal separation between modalities (biweekly cupping, biweekly massage) allowed adequate recovery intervals while maintaining cumulative therapeutic stimulus, potentially optimizing dose-response relationships. However, the absence of independent massage-only and cupping-only treatment arms precludes empirical verification of synergistic interactions versus simple additive effects.

The clinical significance of observed improvements extends beyond statistical parameters. The 8.6° forward flexion gain and 10.7° backward extension improvement represent functionally meaningful enhancements in activities of daily living requiring spinal mobility, including floor-to-standing transitions, object retrieval from ground level, and overhead reaching tasks. Given that baseline participants demonstrated restricted mobility (forward flexion 28.6°, approximately 40% of normative values for this age demographic), the post-intervention values (37.2° forward, 39.6° backward) represent substantial restoration toward functional ranges, though residual deficits persist relative to healthy population norms. The correlation analyses revealing treatment responsiveness independence from baseline functional status ($r=-0.312$ to -0.195, both $P>0.05$) suggest equitable benefit distribution across the spectrum of moderate mobility restriction, supporting treatment applicability for heterogeneous clinical populations.

Several methodological limitations constrain interpretation and generalizability of these findings. The single-group pre-post design lacks concurrent control conditions, precluding definitive causal attribution and leaving results vulnerable to confounding from natural history effects, regression to the mean, placebo responses, and temporal trends. The sample size of 10 participants provides adequate statistical power only for detecting very large effects ($d>1.0$), rendering the investigation susceptible to Type II error for moderate effect magnitudes and precluding meaningful subgroup analyses or multivariable modeling to control confounding variables including baseline pain severity, body mass index, occupational factors, psychological distress, or medication use. The exclusively male sample limits generalizability to female populations, particularly relevant given established sex differences in pain perception, treatment responses, and musculoskeletal injury patterns (65). The single-center recruitment from a specialized cupping and physiotherapy facility introduces potential selection bias toward individuals predisposed to complementary medicine acceptance, potentially inflating effect estimates relative to general clinical populations. The absence of assessor blinding introduces detection bias risk, though standardized measurement protocols and objective range of motion quantification partially mitigate this concern. The 48-hour post-intervention assessment timepoint captures only immediate treatment effects, providing no information regarding persistence of benefits or optimal maintenance intervention frequencies. The investigation assessed range of motion exclusively without incorporating pain intensity, functional disability, quality of life, or patient satisfaction outcomes, limiting comprehensive treatment effect characterization.

Despite these limitations, the investigation demonstrates notable methodological strengths. The complete absence of participant attrition yields unbiased effect estimates free from selective dropout confounding. The standardized intervention protocols delivered by experienced licensed practitioners enhance internal validity and treatment fidelity. The comprehensive exclusion criteria eliminate confounding from serious spinal pathologies, concurrent treatments, and contraindications, ensuring homogeneous participant characteristics suitable for preliminary efficacy evaluation. The statistical analyses appropriately verify parametric test assumptions and report effect sizes alongside significance tests, facilitating interpretation and meta-analytic synthesis. The transparent reporting of detailed intervention parameters including massage techniques, cupping application specifications, treatment frequencies, and session durations enables replication and informed clinical implementation.

Future research should prioritize adequately powered randomized controlled trials incorporating independent massage-only, cupping-only, and combined intervention arms alongside appropriate control conditions (usual care, sham interventions, or waitlist controls) to isolate specific treatment effects and test synergistic interaction hypotheses. Investigators should expand outcome assessments beyond range of motion to include validated pain intensity measures, functional disability indices, quality of life instruments, and patient-reported satisfaction metrics. Longitudinal follow-up extending 3-6 months post-intervention would elucidate treatment durability and inform maintenance dosing recommendations. Studies should incorporate sex-balanced samples and examine potential treatment effect modifiers including age, pain chronicity, baseline functional status, psychological factors, and genetic polymorphisms influencing pain sensitivity. Mechanistic

investigations employing advanced imaging modalities (functional MRI, ultrasound elastography) and biochemical assays (inflammatory cytokines, neuropeptides) could elucidate physiological pathways mediating therapeutic responses and identify biomarkers predicting treatment responsiveness. Cost-effectiveness analyses comparing combined massage and cupping interventions to standard care pathways would inform resource allocation decisions and reimbursement policies. Finally, pragmatic effectiveness trials conducted in diverse real-world clinical settings would establish ecological validity and inform implementation strategies for broader healthcare system integration.

4.1. Practical Recommendations

Healthcare practitioners managing chronic non-specific low back pain in middle-aged adults should consider combined massage and cupping therapy as a potentially beneficial adjunct to conventional management strategies, particularly for patients seeking non-pharmacological alternatives or experiencing inadequate responses to standard interventions. The treatment protocol employed in this investigation (biweekly 30-minute Swedish massage sessions with biweekly 10-minute dry cupping applications over 6 weeks) provides a feasible implementation framework requiring minimal specialized equipment and deliverable within typical clinical appointment durations. Practitioners should ensure adequate training in both modalities to maintain technique standardization and optimize safety outcomes. Patient selection should emphasize individuals with moderate mobility restrictions without serious underlying spinal pathologies, contraindications to manual therapy, or concurrent intensive rehabilitation programs. Clinicians should establish realistic expectations regarding treatment timelines, emphasizing that meaningful improvements may require 4-6 weeks of consistent application rather than immediate responses. Integration with other evidence-based interventions including therapeutic exercise, cognitive-behavioral approaches, and patient education may enhance overall treatment effectiveness and promote sustained functional gains beyond passive manual therapy effects.

5. CONCLUSION

This preliminary investigation provides evidence that combined Swedish massage therapy and dry cupping therapy administered over 6 weeks produces statistically significant and clinically meaningful improvements in lumbar range of motion among middle-aged males with chronic non-specific low back pain. Both forward flexion and backward extension demonstrated large-to-very-large effect size improvements exceeding minimal clinically important difference thresholds, suggesting functionally relevant treatment benefits. These findings support the potential utility of combined manual therapy approaches as non-pharmacological management options for this prevalent and disabling condition. However, the single-group pre-post design, limited sample size, and absence of control conditions necessitate cautious interpretation and demand confirmation through adequately powered randomized controlled trials before definitive clinical recommendations. Future research should examine independent and combined effects of massage and cupping modalities, assess treatment durability, expand outcome domains beyond mobility parameters, and investigate mechanistic pathways and predictive biomarkers.

Ethical Approval and Consent to Participate

The study protocol received approval from the local institutional ethics committee in accordance with the Declaration of Helsinki principles. All participants provided written informed consent after receiving comprehensive information regarding study objectives, procedures, potential risks, and the voluntary nature of participation.

Consent for Publication

Not applicable.

Competing Interests

The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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Authors' Contributions

All authors contributed equally to the manuscript and read and approved the final version of the manuscript.

Declaration

Availability of Data and Materials: Any datasets generated during and/or analyzed during the current study are publicly available, available upon reasonable request, or if data sharing is not applicable to this article.

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