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Effects of cupping therapy on chronic musculoskeletal pain and collateral problems: a systematic review and meta-analysis

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ABSTRACT

Objectives Chronic musculoskeletal pain (CMP) is a prevalent and distressing condition. Cupping therapy, one of the most popular complementary and alternative medicines, has been widely used to reduce CMP. But the evidence remains controversial on the effect of cupping therapy on CMP. The objective of this review and meta-analysis is to assess the effectiveness of cupping therapy in patients with CMP.

Design Systematic review and meta-analysis.

Data sources PubMed, Web of Science, EBSCO, Cochrane Library and CNKI (China National Knowledge Infrastructure) were searched through 20 December 2024.

Eligibility criteria for selecting studies We included randomised control trials that compared cupping therapy for patients with CMP on outcomes (ie, pain intensity, functional disability and mental health).

Data extraction and synthesis Two independent reviewers used standardised methods to search, screen and code included studies. Risk of bias was assessed using the Cochrane Collaboration and Evidence Project tools. Meta-analysis was conducted using random and fixed effects models. Findings were summarised in GRADE (Grading of Recommendations Assessment, Development and Evaluation) evidence profiles.

Results The results showed that cupping therapy (standardised mean difference (SMD)=−1.17; 95% CI=−1.93 to −0.42; p=0.002; I^2=94%) had a significant reduction effect on patients with CMP's pain intensity with moderate quality based on a random-effect model. But cupping therapy had no improvement effects on functional disability (SMD=−0.24; 95% CI=−0.93 to 0.46; p=0.51; I^2=93%) and mental health (SMD=0.08; 95% CI=−0.12 to 0.27; p=0.46; I^2=0%).

Conclusions This study indicates that cupping therapy may be efficient in alleviating pain intensity in patients with CMP with immediate effects. But it cannot improve functional disability and mental health significantly.

PROSPERO registration number CRD42023406219.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The effects of cupping therapy on chronic musculoskeletal pain clinical outcomes were comprehensively synthesised, integrating pain intensity, functional disability and mental health within one study.

⇒ A comprehensive subgroup analysis was conducted based on cupping therapy types, pressure types, painful sites, age groups and treatment frequency, reflecting the broad scope of this study's methodological considerations.

⇒ Only the immediate effects of cupping therapy were analysed, as constrained by the time points of data collection in the included original studies.

BACKGROUND

Chronic musculoskeletal pain (CMP) is a prevalent global issue, associated with a high incidence and significant burden on healthcare systems. In 2019, the estimated global prevalence of chronic musculoskeletal disorders reached 1.52 billion cases (95% uncertainty intervals: 1.43 to 1.60 billion), with an age-standardised prevalence rate of 18 407 per 100 000 people.[1] Furthermore, chronic musculoskeletal disorders accounted for 147 million years lived with disability in 2019 (95% uncertainty intervals: 106 to 195 million) and a high ASYR of 1791 per 100 000 people (95% uncertainty intervals: 1288 to 2367).[1] In addition to the substantial health burden, the treatment of CMP also incurs high financial cost. For example, based on the Chilean health system, the annual expected cost for CMP is US$1387.2 million and equivalent to 0.417% of the national GDP.[2]

In addition to the impact on health, life expectancy and financial burden, CMP usually accompanies restricted daily activities and negative mental health to individuals. Original research has found that the pain threshold and pain tolerance value of patients with chronic back pain were significantly lower than healthy participants, and these lower pain-related parameters may contribute to the persistence of chronic pain.[3] The persistent CMP can interfere with

individuals' physical functions. For example, the reductions in strength and endurance induced by fibromyalgia can lead to the restrictions in participation during leisure-time activities and work-related activities.[4 5] Moreover, individuals' psychological states can also influence the condition of CMP. For example, patients with chronic low back pain (CLBP) with depression experienced significantly more severe pain (5.86±2.27) compared with their non-depressed counterparts (4.34±2.20; p<0.001).[6] Another survey including 122 patients with CMP has indicated that pain interference was negatively correlated with several mental health components (eg, vitality and calmness) significantly.[7] In addition to daily mental states, CMP even causes mental illness. For example, the patients with long-term low back pain, who experienced moderate-to-severe pain dysfunction at the initial assessment, were easier to remain in chronic depression.[8] Therefore, it is necessary to find effective treatments and rehabilitation measures for patients with CMP to alleviate pain and collateral problems, such as functional disability and unhealthy mental states.

Treatment options for CMP generally encompass pharmacological therapies and, where appropriate, surgical interventions, both of which may be accompanied by certain adverse side effects. Some drugs like opioid painkillers have been opposed by current guidelines for CMP, because of the rising rates of opioid overdose deaths and other serious harms.[9] It has been indicated that long-term use of non-opioid drugs for relieving CMP (eg, non-steroidal anti-inflammatory drugs and Cyclooxygenase-2) may produce serious gastrointestinal side effects and increase cardiovascular risks.[10 11] Another usual therapy, the surgical interventions have been proven, to some extent, effective in CMP conditions, especially in osteoarthritis. However, operations usually cause a high prevalence (80%) of postoperative pain.[12] These adverse impacts of drug treatments and surgical interventions result in a growing interest in non-pharmacological measures in response to CMP.[13 14]

Cupping therapy, a type of complementary and complementary medicine, has been widely applied to alleviate CMP, such as chronic neck pain[15 16] and CLBP.[17] The normal impacts after cupping therapy are circular erythematous spots with no painful sensation and no restriction to daily activities. Some researchers have suggested that cupping therapy can improve blood flow,[18 19] which may contribute to its therapeutic effect. The increasing blood flow has been indicated as effective in removing glutamate,[20] lactate and pyruvate,[21] which are biochemical biomarkers in CMP regions. In fact, several researchers have demonstrated the obvious alleviation effects of cupping therapy on patients with CMP's pain intensity.[22 23] For example, Volpato *et al* have indicated that a single-time dry cupping therapy can effectively decrease pain intensity, which is presented by the Brief Pain Inventory (BPI, assessing pain level with 0=no pain/no interference to 10=most pain/most interference) score, in low back (pre-cupping: 4.22±2.53; post-cupping: 1.66±1.97, p<0.05).[22] Wet cupping therapy, another type of cupping therapy adding blood-letting to dry cupping therapy, has also been demonstrated to be effective for reducing CMP.[23–25] Some comprehensive treatments combining cupping therapy and other physical therapies or techniques (eg, pulsatile cupping, cupping massage) have also been demonstrated effective for relieving CMP.[26 27] Compared with separate methods, the integrated approaches may produce better therapeutic effects. But more clinical trials are needed to clarify the differences in the effect of alleviating CMP between these two kinds of approaches.

Although numerous studies have clarified the potential effectiveness of cupping therapy in treating CMP, there still remain the opposite results. For instance, Silva *et al* have indicated that dry cupping therapy is not superior to sham cupping for improving the Numerical Pain Rating Scale (NPRS, assessing pain level with 0=no pain/no interference to 10=most pain/most interference) score (dry cupping therapy: 3.3±2.9 vs sham cupping therapy: 2.7±1.9; Mean $_{\text{between-group differences}}$ = 0.6, 95% CIs=−0.4 to 1.6) in patients with non-specific CLBP.[28] Another study has also revealed that no statistically significant improvement is found in physical function (eg, difficulty in walking) of patients with osteoarthritis after multiple-times wet cupping treatments (pre-cupping: 1.68±0.63 vs post-cupping: 0.906±0.40, p>0.05).[29] Both high pain intensity and poor physical function are harmful symptoms in patients with CMP, while these inconsistent findings cannot identify whether cupping therapy is effective for the improvement of clinical symptoms (eg, pain and physical function) of CMP or not. Considering that CMP has a lasting harmful effect on patients, there is an urgent need to examine studies related to the effectiveness of cupping therapy on CMP scientifically and comprehensively.

The purpose of this study is to evaluate the effect of cupping therapy on clinical outcomes (ie, pain intensity, functional disability and mental health) in patients with CMP through a meta-analysis from a more comprehensive and systematic perspective.

METHODS

Search strategy and study selection

This meta-analysis was reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (http://www.prisma-statement.org/). And the completed PRISMA checklist was provided in the supplementary materials (online supplemental PRISMA checklist). The protocol was registered at PROSPERO (http://www.crd.york.ac.uk/ PROSPERO) before starting the data extraction (registration number: CRD42023406219).

Four electronic databases, including PubMed, Web of Science, EBSCO, Cochrane Library and CNKI (China National Knowledge Infrastructure), were searched respectively for relevant articles until 20 December 2024. The searching criteria were set based on the following

keywords: ("chronic musculoskeletal pain" OR "chronic musculoskeletal disorder" OR "fibromyalgia" OR "osteoarthritis" OR "myalgia" OR "muscle pain" OR "back pain" OR "neck pain" OR "shoulder pain" OR "knee pain" OR "hip pain" OR "chronic pain") AND ("cupping therapy" OR "cupping treatment" OR "dry cupping" OR "wet cupping" OR "cupping massage"). The full search strategies for all databases were shown in online supplemental file 1.

Two independent reviewers (YJ and XD) screened the titles and abstracts of all potentially suitable publications and assessed their eligibility through reading in full. If a disagreement remained after discussion, a third arbitrator (ZB) was consulted for a consensus.

Inclusion criteria

Trials were eligible for inclusion if they met the following criteria with the PICOS principle (population, intervention, comparison/control, outcome and study design): (1) participants were suffering from musculoskeletal pain and/or stiffness for more than 3 months, which is the diagnostic criteria of CMP;[30] (2) participants in the experimental group received interventions related to cupping therapy (eg, dry cupping, wet cupping, pulsating cupping and cupping massage); (3) the comparison intervention was limited to no treatment or sham/placebo interventions during experimental treatments; (4) the outcomes were pain intensity, functional disability or mental health; and (5) only publications designed as randomised control trials (RCTs) were covered.

Exclusion criteria

The exclusion criteria for the selected trials were as follows: (1) reviews, abstracts, protocols, case reports, observational studies, non-English/Chinese publications, non-peer-reviewed articles (eg, academic dissertations and conference posters); (2) no sufficient evidence to judge the duration of disease as a chronic condition (ie, less than 3 months); (3) pain sites containing visceral or orofacial regions; and (4) participants in control groups received other active treatments, such as traditional Hijama technique, standard medical care and ischaemic compression.

Quality assessment

Two authors independently examined the quality of included studies using the Cochrane Collaboration tool. The risk of bias was evaluated as 'low', 'high' or 'unclear' in the seven domains: (1) random sequence generation (selection bias); (2) allocation concealment (selection bias); (3) blinding of participants and personnel (performance bias); (4) blinding of outcome assessment (detection bias); (5) incomplete outcome data (attrition bias); (6) selective reporting (reporting bias); and (7) other bias.[31] If there was a disagreement between two authors, a third arbitrator (ZB) was consulted to reach a consensus.

Data extraction

From each included article, the following data were extracted by two independent reviewers: author(s), publication year, country, subjects' demographical characteristics (eg, age and gender), sample size, pain site(s), duration of CMP, experimental intervention (ie, dosage of cupping therapy), control intervention and the reported outcomes (eg, pain intensity, functional disability or mental health). If there was a disagreement between two authors, a third arbitrator (ZB) was consulted to reach a consensus.

Meta-analysis

In this meta-analysis, the outcome indicators were measured on different tools. For example, the pain intensity was assessed by the NPRS, the Visual Analogue Scale (VAS) or the BPI. The functional disability was measured by the Neck Disability Index (NDI), the Oswestry Disability Questionnaire (ODQ), the Oswestry Disability Index (ODI), the Fibromyalgia Impact Questionnaire (FIQ), the Funktionsfragebogen Hannover Rücken

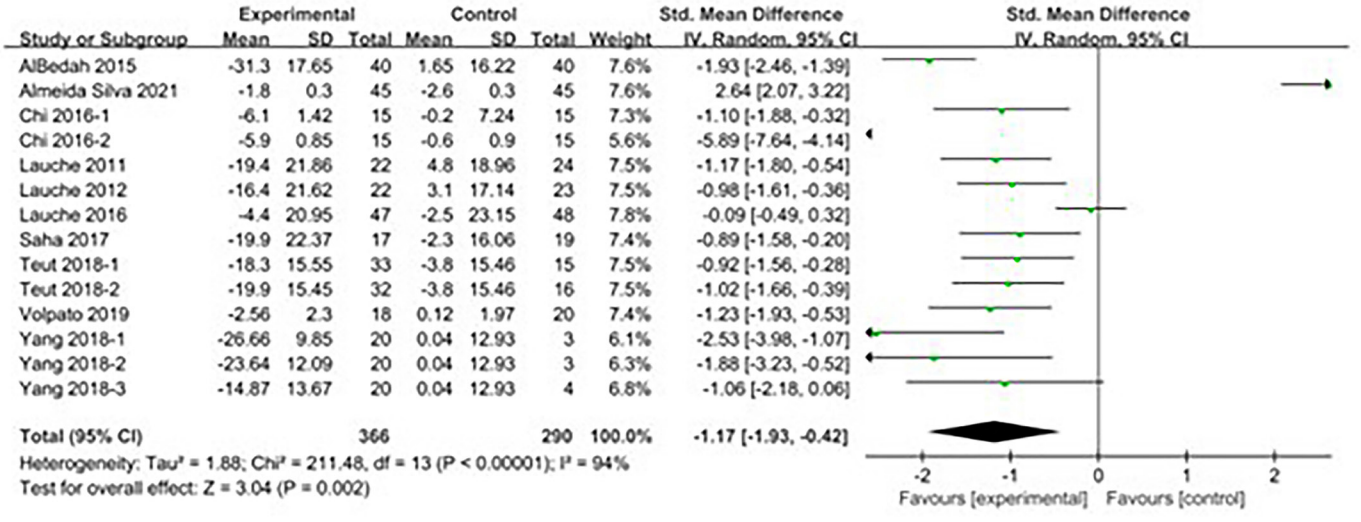

Figure 1 The effect of cupping therapy on pain intensity.

Table 1 The effect of cupping therapy on pain intensity for different subgroups

Subgroups	N	n	SMD	95% CI	P value (subtotal effect)	I^2
Type of cupping therapy	10	656	−1.17	−1.93 to −0.42	0.002	94%
Dry cupping	8	531	−1.13	−2.00 to −0.27	0.01	94%
Wet cupping	2	125	−1.47	−2.39 to −0.55	0.002	80%
Difference between subgroups					0.60	
Type of negative pressure	10	656	−1.17	−1.93 to −0.42	0.002	94%
Pulsation	2	142	−1.31	−1.90 to −0.71	<0.0001	42%
Non-pulsation	8	514	−1.06	−2.04 to −0.08	0.03	95%
Difference between subgroups					0.67	
Frequency of treatments	10	656	−1.17	−1.93 to −0.42	0.002	94%
Single time	4	213	−1.87	−2.71 to −1.03	<0.0001	81%
Multiple times	6	443	−0.48	−1.58 to 0.62	0.39	95%
Difference between subgroups					0.05	
Painful site	10	656	−1.17	−1.93 to −0.42	0.002	94%
Neck/shoulder	5	257	−1.68	−2.38 to −0.98	<0.0001	79%
Back	5	399	−0.42	−1.69 to 0.85	0.52	97%
Difference between subgroups					0.09	
Age of participants	10	656	−1.17	−1.93 to −0.42	0.002	94%
>45 years	5	318	−0.81	−1.20 to −0.41	<0.00001	63%
<45 years	5	338	−1.54	−3.14 to 0.05	0.06	96%
Difference between subgroups					0.38	

Notes: N: the number of included studies; n: sample size.
SMD, standardised mean difference.

(FFbH-R) or the Roland Morris Disability Questionnaire (RMDQ). Meanwhile, the mental health was evaluated by the Short-Form 36 health survey questionnaire (SF-36 mental health). Because of the different measurements of outcomes, the standardised mean differences (SMDs) with 95% CIs were chosen to analyse the compositive effects, and p<0.05 was set as the significant level.

According to the Cochran Handbook for Systematic Review, both the postintervention values (ie, Mean $_{\text{postintervention}}$±SD $_{\text{postintervention}}$) of the outcome and the changes from baseline (ie, Mean $_{\text{of changes}}$±SD $_{\text{of changes}}$) could be used for the summary statistic value in this study.[32] Post-measurement data selected in this study refers to the immediate test results following the final cupping intervention. If studies reported CI instead of SD, we would convert CI into SD.[33]

The heterogeneity among included studies was evaluated by the I^2 index. Low, moderate, high and very high heterogeneity was identified at I^2 ≤25%, I^2 ≤50% and >25%, I^2 ≤75% and >50%, and I^2 >75% respectively.[33] For low or moderate heterogeneity, a fixed-effect model would be chosen. When the heterogeneity was high or very high, a random-effect model would be applied to synthesise the effect size.[34] If I^2 >50% and with a sufficient number of studies (at least 10 studies), the publication bias was detected by the asymmetry of funnel plots or the Egger's test.[35 36]

The subgroup analyses based on cupping therapy types, pressure types, painful sites, age groups and the frequency of treatments were performed. Furthermore, the robustness of the meta-analysis was investigated by the sensitivity analysis with the one-leave-out method. The Review Manager software (Review Manager V.5.3; The Nordic Cochrane Centre, The Cochrane Collaboration) was used to perform the meta-analysis. Finally, the GRADEpro online tool (gdt.gradepro.org) was used to assess the overall quality of evidence in this systematic review and meta-analysis.

RESULTS

Search result

The flowchart in online supplemental file 2 shows the search procedure. From our preliminary search of four databases, a total of 1356 records were returned. Of 1064 non-duplicate records, 29 potentially eligible studies were examined in full-text after screening titles and abstracts. Finally, a total of 34 data points from 10 studies that meet the inclusion criteria were pooled in the quantitative analysis.

The characteristics of included studies

The basic characteristics of the included studies are shown in online supplemental file 3. These articles came

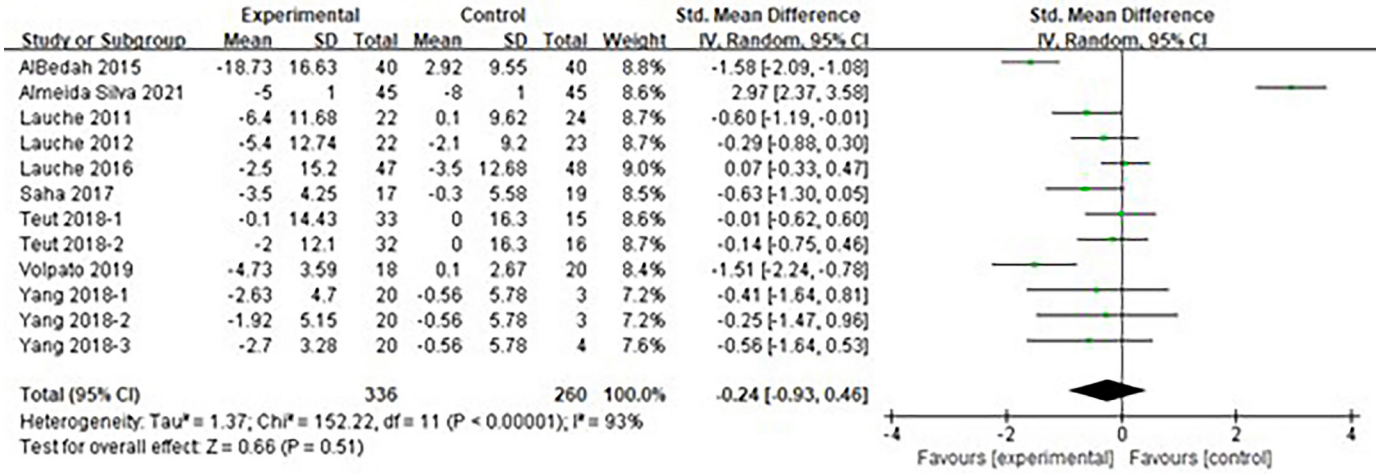

Figure 2 The effect of cupping therapy on functional disability.

from six different countries around the world (ie, Saudi Arabia,[37] n=1, 10%; Brazil,[22 28] n=2, 20%; China,[15 16] n=2, 20%; Germany,[17 27 38–40] n=5, 50%). The subjects in all studies were adults over the age of 18 years. For genders of the recruited subjects, nine studies recruited both males and females in the experimental groups and control groups. And one study included only females in the control group.[27] Among these 10 studies, 5 studies (50%) assessed the effect of cupping therapy on chronic back pain,[17 22 28 37 40] 4 studies (40%) involved chronic neck pain[15 27 38 39] and only 1 study (10%) involved chronic pain in neck and shoulder.[16] The duration of illness varied from 20.0 to 189.6 months in nine articles. Only one article did not report the exact course of the disease.[22]

For experimental interventions, most studies (n=5, 50%) examined the effect of dry cupping therapy, and two studies reported pulsation cupping therapy, which was a modern cupping therapy using a pulsatile negative pressure produced by a mechanical device with a pump.[15 17] Two studies focused on wet cupping therapy.[37 39] And only one study involved cupping massage therapy, which was a treatment with the cupping glasses being moved over the skin surface with negative pressure.[27] For control groups, the interventions consisted of sham/placebo cupping therapy (n=3, 30%),[22 28 40] waiting list control methods (n=5, 50%)[15 17 27 38 39] and resting (n=2, 20%).[16 37]

The pain intensity, as the primary outcome in this meta-analysis, was involved in all studies. As for the secondary outcomes, seven studies reported mental health conditions and nine studies reported functional disability. For the pain intensity, four measurements were used (the Numeric Rating Scale (NRS): n=1; the NPRS: n=1; the VAS: n=7; the BPI: n=1). The functional disability was measured by the ODQ (n=1), the ODI (n=1), the NDI (n=4), the FIQ (n=1), the FFbH-R (n=1) and the RMDQ (n=1). The subjects in six trials accepted mental health tests by the SF-36 (n=6).

In addition, the quality of the included articles was evaluated according to the guidelines provided by Higgins.[31] Online supplemental file 2 showed the risk of bias across all included studies. The quality bias mainly came from the blinding of outcome assessment (detection bias) and the other bias.

The effect of cupping therapy on pain intensity

A total of 14 data points in 10 studies reported the influence of cupping therapy on pain intensity in participants with CMP. Overall, as shown in figure 1, there is a significant difference between experimental groups and control groups based on a random-effect model (SMD=−1.17; 95% CI=−1.93 to −0.42; p=0.002; I^2=94%). And sensitivity analysis showed that the results were relatively robust (online supplemental file 3). The studies are symmetrically distributed on either side of the pooled effect size line, suggesting the absence of publication bias (online supplemental file 2). The Grading of Recommendations Assessment, Development and Evaluation (GRADE) assessment indicated moderate confidence in the estimated effect (online supplemental file 4).

Table 1 presents the effectiveness of cupping therapy on pain intensity for different subgroups. No significant difference was found in the effects of dry cupping and wet cupping (p=0.60). But both of them were useful to reduce pain intensity compared with control groups. Additionally, there was no significant difference between the effect of wet cupping (SMD=−1.47, 95% CI=−2.39 to −0.55, p=0.002) and that of dry cupping (SMD=−1.13, 95% CI=−2.00 to −0.27, p=0.01). For the subgroup analysis based on the different types of negative pressure, both the effects of pulsation pressure and non-pulsation pressure were superior to the effects of control interventions (pulsation vs control: SMD=−1.31, 95% CI=−1.90 to −0.71, p<0.0001; non-pulsation vs control: SMD=−1.06, 95% CI=−2.04 to −0.08, p=0.03). However, there was no significant difference between pulsation pressure and non-pulsation pressure (p=0.67). A subgroup analysis based on the frequency of treatments was also conducted. The results indicated a larger effect of a single-time cupping treatment compared with comparisons

Table 2 Effects of cupping on functional disability for different subgroups

Subgroups	N	n	SMD	95% CI	P value (subtotal effect)	I^2
Type of cupping therapy	9	596	−0.24	−0.93 to 0.46	0.51	93%
Dry cupping	7	471	−0.09	−0.86 to 0.69	0.83	92%
Wet cupping	2	125	−0.95	−2.21 to 0.32	0.14	91%
Difference between subgroups					0.26	
Type of negative pressure	9	596	−0.24	−0.93 to 0.46	0.51	93%
Pulsation	2	142	−0.13	−0.51 to 0.26	0.52	0%
Non-pulsation	7	454	−0.26	−1.24 to 0.73	0.61	95%
Difference between subgroups					0.81	
No. of treatments	9	596	−0.24	−0.93 to 0.46	0.51	93%
Single time	3	153	−0.65	−1.20 to −0.11	0.02	45%
Multiple times	6	443	0.01	−0.99 to 1.01	0.98	96%
Difference between subgroups					0.25	
Painful site	9	596	−0.24	−0.93 to 0.46	0.51	93%
Neck/shoulder	4	197	−0.48	−0.79 to −0.16	0.003	0%
Back	5	399	−0.03	−1.26 to 1.20	0.96	97%
Difference between subgroups					0.49	
Age of participants	9	596	−0.24	−0.93 to 0.46	0.51	93%
>45 years	5	294	−0.23	−0.47 to 0.01	0.06	0%
<45 years	4	278	−0.22	−1.97 to 0.48	0.81	97%
Difference between subgroups					0.99	

N: the number of included studies; n: sample size.
SMD, standardised mean difference.

(SMD=−1.87, 95% CI=−2.71 to −1.03, p<0.0001), with a significant effect (p=0.05) for multiple-times cupping treatment (SMD=−0.48; 95% CI=−1.58 to 0.62; p=0.39). As for the subgroup analysis based on the pain sites and the age of patients, there was a significant improving effect of cupping therapy in patients with neck/shoulder pain (SMD=−1.68, 95% CI=−2.38 to −0.98, p<0.0001) and aged more than 45 years (SMD=−0.81, 95% CI=−1.20 to −0.41, p<0.00001).

The effect of cupping therapy on functional disability

12 data points from nine studies were synthesised to assess the influence of cupping therapy on functional disability in patients with CMP. Figure 2 presents that cupping therapy has no significant effect on decreasing the functional disability in patients with CMP (SMD=−0.24, 95% CI=−0.93 to 0.46, p=0.51, I^2=93%). Sensitivity analysis showed that the results were relatively robust (online supplemental file 3). The distribution of studies in the funnel plot appears approximately symmetrical, indicating that there is no evidence of publication bias (online supplemental file 2). The GRADE assessment indicated moderate confidence in the estimated effect (online supplemental file 4).

As depicted in table 2, dry cupping therapy, wet cupping therapy, pulsation pressure cupping therapy and non-pulsation pressure cupping therapy cannot improve the functional disability in patients with CMP (dry cupping therapy: SMD=−0.09, 95% CI=−0.86 to 0.69, p=0.83; wet cupping therapy: SMD=−0.95, 95% CI=−2.21 to 0.32, p=0.14; pulsation cupping therapy: SMD=−0.13, 95% CI=−0.51 to 0.26, p=0.52; non-pulsation cupping therapy: SMD=−0.26, 95% CI=−1.24 to 0.73, p=0.61). For the frequency of treatments, a significant difference was found in the effect between the single-time cupping therapy (SMD=−0.65, 95% CI=−1.20 to −0.11, p=0.02) and the control group. However, no significant difference was found in the effect between the multiple-times cupping therapy (SMD=0.01, 95% CI=−0.99 to 1.01, p=0.98) and the control group. For the subgroup analysis based on the pain sites, there was a significant improving effect of cupping therapy in patients with neck/shoulder pain (SMD=−0.48, 95% CI=−0.79 to −0.16, p=0.003).

The effect of cupping therapy on mental health

Eight data points from six studies were pooled to evaluate the effectiveness of cupping therapy on mental health in CMP individuals. Figure 3 shows that there is no significant difference in mental health between the cupping therapy group and the control group using a fixed-effect model (SMD=0.08, 95% CI=−0.12 to 0.27, p=0.46, I^2=0%). And sensitivity analysis showed that the results were relatively robust (online supplemental file 3). The studies are symmetrically distributed on either side of the pooled

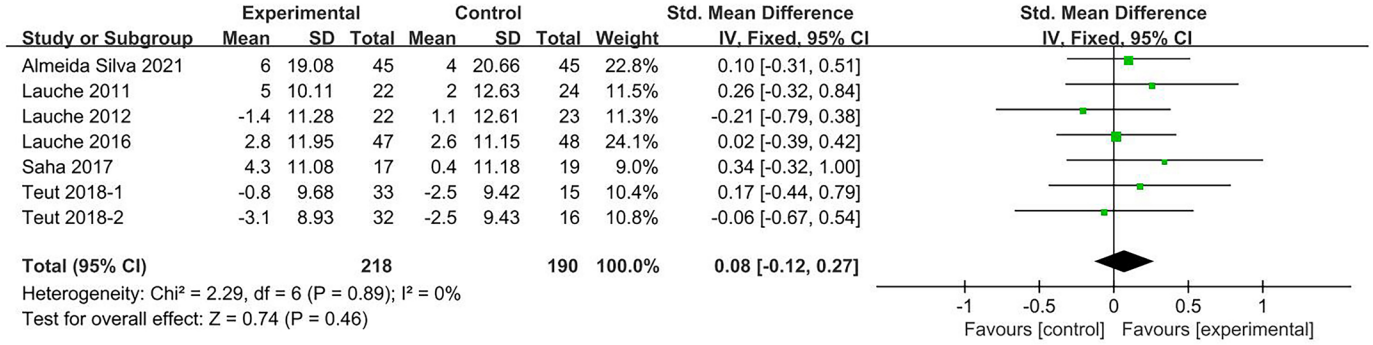

Figure 3 The effect of cupping therapy on mental health.

effect size line, suggesting the absence of publication bias (online supplemental file 2). The GRADE assessment showed high quality of evidence, indicating considerable certainty in the effect estimate (online supplemental file 4).

Table 3 showed the effects of cupping therapy on mental health for five subgroups. With regard to different types of cupping therapy, we did not find a significant effect of dry cupping therapy (SMD=0.11, 95% CI=−0.10 to 0.32, p=0.30) and wet cupping therapy (SMD=−0.21, 95% CI=−0.79 to 0.38, p=0.49) on patients with CMP's mental health. In addition, no significant effect was found when conducting the subgroup analyses based on the types of negative pressure (pulsation: SMD=0.05, 95% CI=−0.38 to 0.48, p=0.81; non-pulsation: SMD=0.08, 95% CI=−0.14 to 0.30, p=0.47), the frequency of treatments (single-time: SMD=−0.21, 95% CI=−0.79 to 0.38, p=0.49; multiple-time: SMD=0.11, 95% CI=−0.10 to 0.32, p=0.30), pain sites (neck/shoulder: SMD=0.12, 95% CI=−0.23 to 0.47, p=0.51; back: SMD=0.06, 95% CI=−0.18 to 0.29, p=0.65) and the age of participants (more than 45 years: SMD=0.07, 95% CI=−0.16 to 0.29, p=0.55; less than 45 years: SMD=0.10, 95% CI=−0.31 to 0.51, p=0.64).

DISCUSSION

This meta-analysis suggested that cupping therapy might have a positive immediate effect on reducing patients

Table 3 The effect of cupping therapy on mental health for different subgroups

Subgroups	N	n	SMD	95% CI	P value (subtotal effect)	I^2
Type of cupping therapy	6	408	0.08	−0.12 to 0.27	0.46	0%
Dry cupping	5	363	0.11	−0.10 to 0.32	0.30	0%
Wet cupping	1	45	−0.21	−0.79 to 0.38	0.49	–
Difference between subgroups					0.32	
Type of negative pressure	6	408	0.08	−0.12 to 0.27	0.46	0%
Pulsation	1	96	0.05	−0.38 to 0.48	0.81	–
Non-pulsation	5	312	0.08	−0.14 to 0.30	0.47	0%
Difference between subgroups					0.91	
No. of treatments	6	408	0.08	−0.12 to 0.27	0.46	0%
Single time	1	45	−0.21	−0.79 to 0.38	0.49	–
Multiple times	5	363	0.11	−0.10 to 0.32	0.30	0%
Difference between subgroups					0.32	
Painful site	6	408	0.08	−0.12 to 0.27	0.46	0%
Neck/shoulder	3	127	0.12	−0.23 to 0.47	0.51	0%
Back	3	281	0.06	−0.18 to 0.29	0.65	0%
Difference between subgroups					0.78	
Age of participants	6	408	0.08	−0.12 to 0.27	0.46	0%
>45 years	5	318	0.07	−0.16 to 0.29	0.55	0%
<45 years	1	90	0.10	−0.31 to 0.51	0.64	–
Difference between subgroups					0.89	

N: the number of included studies; n: sample size.
SMD, standardised mean difference.

with CMP's pain intensity. But cupping therapy cannot improve their functional disability and mental health. Based on the subgroup analyses in pain intensity, dry cupping therapy, wet cupping therapy, pulsation pressure and non-pulsation pressure cupping therapy showed a significant difference when compared with the control group, respectively. In addition, cupping therapy might be effective for decreasing pain intensity and functional disability in patients with chronic neck/shoulder pain rather than in patients with chronic back pain.

Our results demonstrated that cupping therapy might effectively reduce pain intensity in patients with CMP with immediate effects. This might be explained by the neurobiological foundations. It is widely confirmed that both nociceptive afferent fibres (Aδ and C fibres) and mechanosensitive Aβ fibres project in the same way onto interneurons or ascending projection neurons.[41] However, the rate of signal transmission from the mechanoreceptor (Aβ) up to the dorsal horn was faster than that from the Aδ and C fibres, so that the Aβ fibres would activate the corresponding multi-receptive dorsal horn interneuron before the Aδ and C fibres.[42] Based on the theory mentioned above, we speculated that the faster Aβ afferents (ie, mechanosensitive afferent fibres) caused by the negative pressure of cupping therapy could block out pain sensation from the slower pain conducting Aδ and C fibres (ie, nociceptive afferent fibres). This might partly explain the effects of cupping therapy on the pain intensity in CMP individuals. On the other hand, cupping therapy has been indicated to result in vascular ectasia for increasing blood flow significantly,[19] which may be related to the therapeutic effect of cupping therapy on CMP. The increased blood flow under the cup after cupping therapy could play a positive role in the clearance of inflammatory cytokines locally. Several studies have demonstrated that musculoskeletal pain following exercises caused upregulation of transcripts for inflammatory cytokines such as interleukin-1 (IL-1)[43 44] and interleukin-6 (IL-6)[45] in the exercised limbs. These transcripts for inflammation were sensitivity to musculoskeletal sensitisation, which was a preclinical model of muscle pain.[45] In other words, lowering the inflammatory cytokines (ie, IL-1 and IL-6) might imply the alleviation of inflammatory response and the reduction of muscle pain. Therefore, the acceleration of blood circulation caused by negative pressure suction of cupping therapy could accelerate the clearance of inflammatory factors, alleviate inflammatory reactions and thus release muscle pain.

On the other hand, the recovery effect of cupping therapy on their functional disability was not significant. The potential reason might be that the outcomes related to pain intensity in our included studies in this meta-analysis[16 17 40] were usually evaluated in resting state rather than moving state. Nevertheless, the pain in moving state usually impeded patients' daily activities and contributed to the functional disability.[46] Some musculoskeletal pain usually occurred during the moving process with muscle contraction or joint friction and compression. For example, the individual with patellar tendinopathy only experienced pain when the knee was flexed and extended (eg, walking down stairs and jumping).[47] This type of functional dysfunction was attributed to the pain induced by the altered biomechanical relationship between muscles, joints and bones. According to the neurobiological foundation theory, the single-time cupping therapy might impede the pain conduction in patients with CMP at rest state, while it was not sufficient to affect the biomechanical relationships of anatomical structures such as muscles, bones and joints. Hence, patients with CMP still suffered from the functional disability due to the pain produced in moving state.

For another outcome, our results showed that, compared with the control group, cupping therapy had no effectiveness in promoting patients with CMP's mental health. Wet cupping therapy-induced incisions might cause more negative emotions (eg, fear of invasive wound) rather than positive emotions (eg, relaxation or soothing power of cupping therapy) caused by suction treatment. One animal experiment about mood status demonstrated that sheep conducted worse aversive behaviour patterns in response to the pricking stimulus than the slight pressure and kneading stimulus.[48] Moreover, the non-significant group difference between cupping therapy and placebo therapy on mental health has been reported previously (eg, sham cupping therapy). For example, Lauche *et al* applied dry cupping therapy with 50–100 mm-diameter cups and a 10–15 min retention time for 141 patients with fibromyalgia syndrome and used the SF-36 questionnaire to monitor changes in mental health. The findings demonstrated that cupping therapy and sham cupping therapy played similar roles in improving patients' mental health like anxiety, depression and loss of behavioural or emotional control.[40] Among the 10 included studies in our meta-analysis, the SF-36 was used as a tool for assessing mental health (n=6, 60%). After viewing the specific questions in SF-36, we supposed that the subjective questionnaire reflected the mental situations during the past 4 weeks.[49] Hence, the survey after the single cupping therapy immediately could not indicate the effects of cupping therapy on patients with CMP's mental health accurately. This might partly explain the reason that, in our meta-analysis, there is no significant difference in the improvement effect on patients with CMP's mental health between cupping therapy and sham cupping therapy.

To the best of our knowledge, this is the first study to demonstrate and integrate the effects of cupping therapy on clinical outcomes (ie, pain intensity, functional disability and mental health) in patients with CMP. However, there are still some limitations. First, we only considered the immediate effect of cupping therapy, because of the limited original research included in this meta-analysis. Nevertheless, our team has proposed the delayed effect of cupping therapy on muscular performance in one previous study.[50] Hence, we inferred that there was the possibility of the delayed effect of cupping therapy on CMP. Further evidence-based studies are

needed to assess the time effect to prove our speculation. Second, the heterogeneity of the included studies was relatively high because of differences in cupping dose. Therefore, caution should be exercised in interpreting the results of this meta-analysis. Lastly, the results of a meta-analysis are contingent on the studies included in the analysis. The number of studies included in this systematic review is limited (n=10). In the future, as more RCT literatures are available, we will re-examine the evidence. The purpose of this systematic review is to evaluate the available evidence and provide the integrated effect size for the effectiveness of separate cupping therapy on clinical outcomes in patients with CMP.

Conclusion

This systematic review and meta-analysis demonstrates that cupping therapy may be effective in reducing pain intensity for CMP individuals with immediate effects. However, patients with CMP's functional disability and mental health cannot be improved by cupping therapy. Considering the high heterogeneity of the studies, caution is warranted in interpreting the findings of this research.

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