Journal of Athletic Training 2020;55(7):682–690
doi: 10.4085/1062-6050-236-19

www.natajournals.org

Dry Cupping Therapy for Improving Nonspecific Neck Pain and Subcutaneous Hemodynamics

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Context: Dry cupping therapy is a noninvasive treatment commonly used to reduce pain and promote the healing process in various populations, including those with nonspecific neck pain; however, no data are available to support most of this method's true physiological benefits.

Objective: To determine if dry cupping therapy decreased pain and increased subcutaneous blood flow compared with sham cupping and control conditions.

Design: Controlled laboratory study.

Setting: Laboratory.

Patients or Other Participants: A total of 32 participants (age = 22.5 ± 2.8 years, height = 173.3 ± 10.1 cm, mass = 76.6 ± 18.7 kg) with self-reported nonspecific neck pain.

Intervention(s): We used dry cupping and sham cupping interventions and a control condition. For the dry cupping intervention, 1 stationary cup was placed directly over the most painful area for 8 minutes. The sham cupping intervention followed the same procedures as the dry cupping intervention except a sham cup was applied. For the control condition, participants received no treatment.

Main Outcome Measure(s): Subjective pain intensity (visual analog scale); pain-pressure threshold; subcutaneous hemodynamics, including superficial and deep oxygenated, deoxygenated, and total hemoglobin levels; and tissue saturation index.

Results: We observed differences in the visual analog scale score and the superficial and deep oxygenated and total hemoglobin levels (P values $\leq$ .002) immediately postintervention compared with baseline. Post hoc tests revealed that the dry cupping group had less pain than the sham cupping and control groups and higher superficial and deep oxygenated and total hemoglobin levels (P values $\leq$ .008). No differences were found between baseline and 24 hours postintervention.

Conclusions: A single session of dry cupping therapy may be an effective short-term treatment method for immediately reducing pain and increasing oxygenated and total hemoglobin levels in patients with nonspecific neck pain.

Key Words: blood flow, subjective pain intensity, hemoglobin, complementary medicine

Key Points

- Dry cupping therapy reduced neck pain and increased oxygenated and total hemoglobin levels immediately after an 8-minute treatment session.
- Although short-term benefits after dry cupping therapy were observed, all effects were diminished 24 hours after the intervention.
- Researchers should continue to investigate the physiological benefits of dry cupping therapy to better understand and implement this technique in clinical practice.
- Appropriate treatment times, pressure values, and cup placement and sizing for dry cupping therapy must be evaluated to ensure proper treatment.

Nearly two-thirds of the human population experience neck pain at some point during their lifespan.[1] Neck pain is one of the most common musculoskeletal conditions; the true cause of nonspecific (uncomplicated) neck pain is not fully understood but is thought to be multifactorial.[2] The diagnosis of nonspecific neck pain generally occurs when no other diseases or pathologic conditions are present to explain the neck pain.[3] Limited high-quality evidence has supported conservative treatment options for nonspecific neck pain.[4] This has allowed researchers and clinicians to begin investigating the effectiveness of complementary methods, such as cupping therapy, for treating this condition.[5–8]

Traditional Chinese cupping therapy has been used to treat a variety of medical ailments, such as musculoskeletal injuries, dermatologic conditions, and chemical imbalances within the body.[9] Although traditional Chinese medicine has been available for centuries, Western culture has recently demonstrated a growing interest in these complementary methods, such as acupuncture and cupping therapy.[10]

Several theories have been proposed to explain the efficacy of dry cupping therapy. Some have indicated that, by manipulating the negative pressure created from a vacuum mechanism, cupping can distract the skin and its underlying tissues upward into the center of a cup.[11] The suction effect was originally created by igniting a fire within a cup to increase the internal temperature of the cup. As the flame extinguished, the cup was placed on the skin, subsequently cooling the air inside the cup and creating a vacuum between the cup and underlying tissues. A more modern method involves using a handheld pump to extract

the air between the cup and skin to induce a suction effect.[12] Distraction of the skin is believed to increase localized blood flow and enhance tissue healing, reduce perceived pain, and alleviate adhesions within connective tissues.[5,13] However, many of the true physiological mechanisms for this treatment technique have yet to be understood.

Whereas many diagnostic measures are available for assessing blood flow, most of these instruments have associated limitations, such as decreased sensitivity, inadequate depth of measurement, and varying spatial and temporal resolutions.[14] A less costly and noninvasive method for measuring microvascular blood flow is near-infrared spectroscopy (NIRS).[15] This biomedical technology uses light wavelengths in the near-infrared spectrum to estimate changes in the concentration of light-absorbing chromophores, such as oxygenated and deoxygenated hemoglobin, as well as the percentage of tissue oxygen saturation.[16] Monitoring the changes in total hemoglobin, both oxygenated and deoxygenated, can allow for the assessment of microvascular hemodynamics via changes in local subcutaneous blood volume.[16] From a clinical standpoint, using NIRS to assess microvascular blood flow may provide a viable method for determining changes in blood flow after dry cupping therapy.

Current research on dry cupping therapy is very limited; therefore, most of its true physiological benefits have yet to be supported. Although an increase in local blood flow is assumed due to visible coloration changes of the skin, whether blood flow actually increases and whether that increase improves pain after dry cupping therapy is unknown. Given that the prevalence of nonspecific neck pain remains high, treatment options for this condition continue to be explored. Therefore, the purpose of our study was to determine if dry cupping therapy decreased levels of perceived pain associated with nonspecific neck pain and increased localized blood flow of the treated tissues compared with sham cupping and control interventions. We hypothesized that, immediately and 24 hours after dry cupping therapy, associated pain would decrease, and localized blood flow would increase directly beneath the affected cupping location.

METHODS

Study Design

This single-blinded randomized controlled laboratory study was composed of 2 intervention groups—dry cupping therapy and sham (modified) dry cupping therapy—and a control condition. The cupping interventions consisted of a single cupping treatment each. Subjective pain intensity, pain-pressure threshold, and subcutaneous hemodynamic measurements were taken at baseline, immediately post-intervention, and 24 hours postintervention.

Participants

Participants were 32 adults (15 men, 17 women) between the ages of 18 and 40 years (age = 22.5 ± 2.8 years, height = 173.3 ± 10.1 cm, mass = 76.6 ± 18.7 kg). Volunteers were included in the study if they had self-reported unilateral or bilateral nonspecific neck pain within the 2 weeks before the study and a subjective pain-intensity score of at least 30 mm on a visual analog scale (VAS).[5] They were excluded if they had received dry cupping therapy or any other treatment performed to the neck or shoulder region within the 3 months before the study; had a history of head, neck, or shoulder injury within 6 months of the study; had a known blood-clotting disorder, allergy to lubricant, hypertension, diabetes, cancer, pregnancy, cardiac failure, renal failure, allergic purpura, hernia, psoriasis, eczema, rosacea, varicose veins, phlebitis, hepatocirrhosis, allergic dermatitis, sunburn, open wound, or fever; or were taking an anticoagulant. All participants provided written informed consent, and the study was approved by our university's institutional review board.

Instrumentation

A VAS was used to measure subjective pain intensity.[17] It contained a 100-mm horizontal line that ranged from 0 (*no pain*) on the left to 100 (*worst pain*) on the right. As the researcher (S.L.S.) applied gradual overpressure to the treatment location, the participants were instructed to mark an X on the line that best indicated the intensity of their pain immediately after perceiving pain along with a pressure sensation. The distance between 0 and the patient-reported mark was measured and used for data analysis.

The pain-pressure threshold was measured using a digital pressure algometer (model 01163; Lafayette Instrument Company, Lafayette, IN) with a 1.7-cm^2 circular probe and pressure range of 0 to 136.1 kg. We selected this probe because its size was comparable with the thumb of the researcher (S.L.S.), which was used to determine the treatment location. After triggering, or applying pressure, to a specific point within the posterior neck muscles, such as the upper trapezius, the microprocessor attached to the probe of the pressure algometer is designed to measure deep pain-pressure thresholds, or tenderness resistance, in peak force (in pounds or kilograms).[18,19] After the spot of maximal increased sensitivity was determined, the researcher applied overpressure perpendicular to the skin at an approximate rate of 1 kg/cm^2 until the patient orally indicated that pain and a pressure sensation were perceived.[18] The average value of 3 trials was used for data collection.

Subcutaneous hemodynamics were measured using a wireless NIRS device (model Portamon; Artinis Medical Systems, Elst, The Netherlands). The tissue saturation index (TSI) and changes in chromophore concentration, including superficial and deep oxygenated, deoxygenated, and total hemoglobin levels, were used to calculate local blood flow. Concentration changes were monitored at a sampling rate of 10 Hz for 10 minutes. Light absorbance at 763 and 845 nm allowed for the calculation of superficial and deep hemodynamics, respectively, using the modified Lambert-Beer law. Light-transmitting optodes were located at 30, 35, and 40 mm from the receiver, allowing for light penetration between 15 and 20 mm.[20] Values for oxygenated, deoxygenated, and total hemoglobin were reported in micromolar units. We positioned the device directly over the predetermined treatment location and labeled this position using a permanent marker for proper placement in subsequent measurements. Before data collection, the device was secured to the skin using flexible adhesive tape

Figure 1. Near-infrared spectroscopy placement.

and covered with a light-absorbing cloth to reduce any influence of ambient lighting (Figure 1).

Procedures

Before arriving for initial screening, women were instructed to wear loosely fitted tank tops or sports bras that adequately exposed the neck and upper shoulder region. Men were instructed to either wear loosely fitted tank tops or remove their shirts for the session. Participants were also instructed to refrain from consuming any caffeine, alcohol, or other substances that might alter blood flow (eg, nonsteroidal anti-inflammatory drugs) and from engaging in any strenuous physical activity 24 hours before the study. Participants with hair longer than ear length were instructed to place their hair in an elastic band. Upon arrival at our laboratory, participants were told to rest comfortably in a chair for 5 minutes before baseline measurements were obtained. Several descriptive measures, including age, sex, height, mass, duration of pain, resting heart rate, and pulse oximetry, were recorded. To be considered eligible for this study, participants needed a baseline pain score of $\geq$30 mm on the VAS when overpressure was applied to the treatment location.

To determine the treatment location, participants were instructed to lay prone on a treatment table with the head resting comfortably on a face pillow. The researcher (S.L.S.) palpated the length of the posterior neck and shoulder musculature from the base of the skull to the superior angle of the scapula to locate a single treatment location, such as a trigger point. Participants were instructed to orally indicate when a spot was sensitive. This was completed on both sides of the neck until a small and specific area of maximal increased sensitivity was identified within the musculature. Treatment locations varied among participants; however, all treatments stayed within the predefined borders. If participants were eligible for the study, baseline measurements of local subcutaneous hemodynamics, TSI, subjective pain intensity, and algometer pain-pressure threshold were collected.

Interventions

All participants were randomly allocated into 1 of 3 groups: (1) dry cupping, (2) sham cupping, and (3) control. All individuals were assessed at baseline, immediately postintervention, and at 24 hours postintervention. Each assessment consisted of measurements of subjective pain intensity; pain-pressure threshold; superficial and deep oxygenated, deoxygenated, and total hemoglobin levels; and TSI.

Dry Cupping. Biomagnetic Chinese cupping therapy cups (Kangzhu 24-cup Set; Beijing Carezoe Medical Appliance Co, Ltd, Beijing, China) were applied during the dry cupping intervention. We used cup sizes with inner diameters of 3.56 cm (1.4 in) and 4.57 cm (1.8 in). The size of the cup used depended on the size of the treatment location, which varied among participants. For example, we used a cup with a 3.56-cm inner diameter for all treatments from the base of the skull to C7. We used a cup with a 4.57-cm inner diameter for any treatments below C7 to the superior angle of the scapula to accommodate the larger upper trapezius.

Promptly after baseline measurements, the researcher (S.L.S.) applied the cup to the participant's skin directly over the site of maximal increased sensitivity. For both the dry and sham cupping intervention groups, a total of 3 suction pumps were drawn from the cup to secure it to the skin.[21] If the cup lost its suction effect or was released from the skin before the treatment was completed, the examiner promptly reapplied the cup using 3 more pumps. The cup remained attached to the skin for 8 minutes and then was removed by pulling on the release valve. Given that no standardized treatment time exists for dry cupping therapy, this time frame was used based on our clinical expertise.

To control for instrumentation variations (or changes in cup application due to examiner technique), the same researcher applied the cupping treatment throughout the study. Immediately after cup removal, she reapplied the NIRS unit for subcutaneous hemodynamic measurement. After 10 minutes of continuous measurement, the NIRS was removed from the skin, and the subjective pain intensity and pain-pressure threshold were measured again. Participants were instructed not to wash the permanent marker from their skin and to return 24 hours after treatment for a final assessment of subcutaneous hemodynamics, pain intensity, and pain-pressure threshold.

Sham Cupping. For the sham cupping intervention, the researcher (S.L.S.) followed the same protocol as for the dry cupping intervention except that a small hole was placed in the superior portion of the cup to gradually eliminate the suction effect.[21] The hole was created by piercing the top of the cup with a heated 0.4-mm needle.[21] Lee et al[21] validated the use of these cups as a placebo mechanism for a dry cupping therapy intervention. The release in pressure generally occurred within 30 seconds of initial placement, which greatly diminished the cupping effects but still provided a cupping sensation. To enhance participant blinding, tape ensured that the cup remained in contact with the skin even after the suction effect was eliminated. A sham group was included to analyze whether

Table 1. Baseline to Immediately Postintervention Change Scores

Variable	Group	Mean ± SD	*F* Value	*P* Value
Subjective pain intensity	Dry cupping	−20.00 ± 12.62	9.18	.001[a]
	Sham cupping	−2.90 ± 5.36		
	Control	−6.63 ± 9.37		
Pain-pressure threshold	Dry cupping	−0.41 ± 0.99	1.36	.27
	Sham cupping	−0.003 ± 0.90		
	Control	−0.67 ± 0.87		
Superficial oxygenated hemoglobin	Dry cupping	15.18 ± 15.15	8.34	.001[a]
	Sham cupping	1.13 ± 5.05		
	Control	0.008 ± 4.18		
Superficial deoxygenated hemoglobin	Dry cupping	4.79 ± 3.91	6.65	.004
	Sham cupping	1.21 ± 3.02		
	Control	0.34 ± 1.70		
Superficial total hemoglobin	Dry cupping	19.97 ± 18.75	8.59	.001[a]
	Sham cupping	2.34 ± 7.29		
	Control	0.35 ± 5.40		
Deep oxygenated hemoglobin	Dry cupping	12.80 ± 12.23	8.59	.001[a]
	Sham cupping	0.33 ± 4.98		
	Control	0.25 ± 4.36		
Deep deoxygenated hemoglobin	Dry cupping	3.34 ± 3.20	5.21	.01
	Sham cupping	0.66 ± 2.23		
	Control	0.21 ± 1.62		
Deep total hemoglobin	Dry cupping	16.14 ± 15.27	8.17	.002[a]
	Sham cupping	1.00 ± 6.73		
	Control	0.46 ± 5.61		
Tissue saturation index	Dry cupping	5.43 ± 3.00	4.83	.02
	Sham cupping	1.09 ± 4.83		
	Control	1.54 ± 2.61		

[a] Indicates difference ($P \leq .003$).

the placebo effect (perception of treatment) had any effect on subcutaneous hemodynamics, subjective pain intensity, or pain-pressure threshold.

Control. Participants in the control group were evaluated for baseline measurements and postintervention measurements following the same procedures as for the dry cupping intervention group. During the 8 minutes of treatment time, participants in the control group rested comfortably with their head in the face pillow.

Data Analysis

After data collection, the researcher exported each 10-minute subcutaneous hemodynamic measurement for baseline, immediately postintervention, and 24 hours postintervention. Data were recorded each minute (superficial and deep oxygenated, deoxygenated, and total hemoglobin levels and TSI) over the 10-minute collection timeframe, and the average was used for further analysis. Data from 4 participants, 1 from the dry cupping group, 2 from the sham cupping group, and 1 from the control group, were excluded from analysis due to measurement error during the assessment of local subcutaneous hemodynamics.

We calculated change scores for each variable between baseline and immediately postintervention and between baseline and 24 hours postintervention. One-way analyses of variance were used to assess between-groups differences at each of these points for all variables (subjective pain intensity; pain-pressure threshold; superficial and deep oxygenated, deoxygenated, and total hemoglobin levels; TSI). Tukey honestly significant difference post hoc testing was conducted to identify which interventions were different among groups. The α level was set a priori at .05. Given the many analyses, we also calculated a Bonferroni correction, with significance evaluated at $P \leq .003$. Cohen d effect sizes (ESs) for pooled standard deviations and 95% confidence intervals (CIs) were calculated to determine the magnitude of difference among intervention groups for each outcome. Effect sizes were interpreted as *small* ($\leq$0.2), *moderate* (0.3–0.7), or *large* ($\geq$0.8). Statistical analyses were performed using SPSS (version 25; IBM Corp, Armonk, NY).

RESULTS

We observed differences for VAS and superficial and deep oxygenated and total hemoglobin levels immediately postintervention compared with baseline ($P \leq .002$; Table 1). No differences were found between baseline and 24 hours postintervention (Table 2). The Tukey honestly significant difference tests revealed that participants in the dry cupping group experienced a greater reduction in pain than participants in the sham cupping ($P = .001$; ES [95% CI] = −1.73 [–2.74, –0.73]) and control ($P = .008$; ES [95% CI] = −1.21 [–2.11, –0.30]) groups. The reported decrease in pain for participants in the dry cupping group was deemed clinically meaningful, as a decrease of 13 mm is the minimal clinically important difference for the VAS (Figure 2).[22]

Participants in the dry cupping group also demonstrated increases in superficial and deep oxygenated and total hemoglobin levels with large ESs (P values $\leq .007$; Table 3) compared with those in the sham cupping and control groups (Figures 3–6). The calculated minimal detectable change for subcutaneous hemodynamics was 11.08 μM. The smallest change was 12.47 μM, indicating that clinically meaningful increases in oxygenated and total

Table 2. Baseline to 24 Hours Postintervention Change Scores

Variable	Group	Mean ± SD	*F* Value	*P* Value
Subjective pain intensity	Dry cupping	−12.91 ± 17.89	3.12	.06
	Sham cupping	4.60 ± 7.33		
	Control	−5.54 ± 19.52		
Pain-pressure threshold	Dry cupping	−1.07 ± 1.07	3.46	.045
	Sham cupping	−0.25 ± 0.98		
	Control	−1.48 ± 1.20		
Superficial oxygenated hemoglobin	Dry cupping	2.32 ± 9.04	0.69	.51
	Sham cupping	−0.04 ± 9.97		
	Control	−1.93 ± 6.25		
Superficial deoxygenated hemoglobin	Dry cupping	2.47 ± 3.92	0.77	.47
	Sham cupping	0.86 ± 4.46		
	Control	0.69 ± 2.55		
Superficial total hemoglobin	Dry cupping	4.79 ± 12.62	0.78	.47
	Sham cupping	0.82 ± 13.11		
	Control	−1.24 ± 8.29		
Deep oxygenated hemoglobin	Dry cupping	2.06 ± 7.03	0.70	.50
	Sham cupping	−1.62 ± 11.31		
	Control	−1.46 ± 5.28		
Deep deoxygenated hemoglobin	Dry cupping	1.82 ± 2.97	0.84	.44
	Sham cupping	0.12 ± 3.54		
	Control	0.83 ± 2.52		
Deep total hemoglobin	Dry cupping	3.88 ± 9.50	0.81	.45
	Sham cupping	−1.50 ± 13.95		
	Control	−0.63 ± 7.27		
Tissue saturation index	Dry cupping	0.40 ± 7.62	1.03	.37
	Sham cupping	0.45 ± 5.95		
	Control	−4.11 ± 10.93		

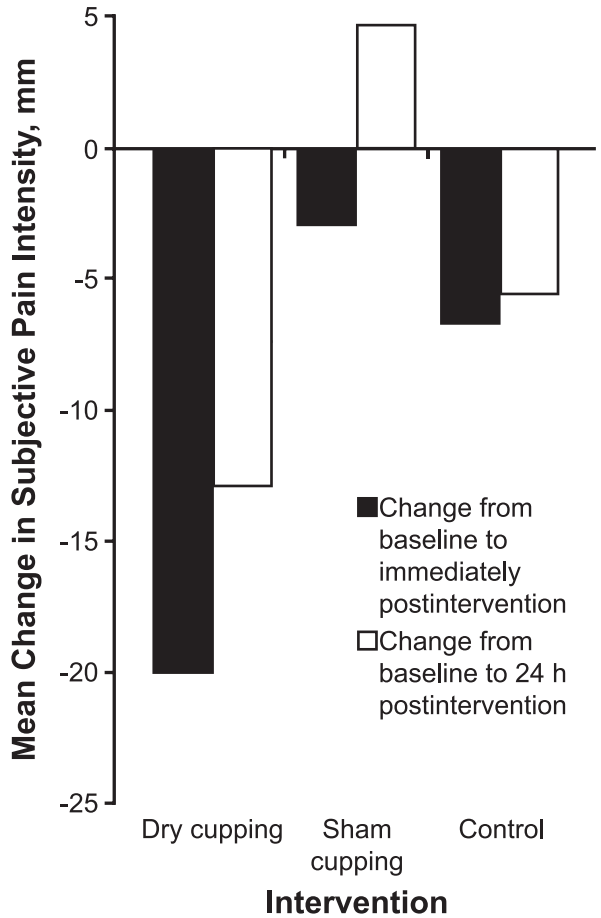

Figure 2. Changes in mean subjective pain-intensity levels among dry cupping, sham cupping, and control groups from baseline to immediately postintervention and baseline to 24 hours postintervention.

hemoglobin levels were achieved for participants in the dry cupping group. The pain-pressure threshold, deoxygenated hemoglobin levels, and TSI did not change during our study.

DISCUSSION

The purpose of our study was to determine if dry cupping therapy decreased levels of perceived pain associated with nonspecific neck pain and increased localized blood flow of the treated tissues compared with sham cupping and control conditions. For subjective pain intensity, individuals treated with dry cupping experienced decreased perceived pain immediately after the treatment compared with those in the sham cupping and control groups. However, at 24 hours postintervention, the levels of perceived pain increased toward baseline among these individuals. These results agree with those of other researchers[5–8,23,24] who investigated subjective pain intensity after cupping therapy and found differences between the treatment and control groups. However, each of these studies[5–8,23,24] included multiple treatment sessions, different cupping locations, or a different version of cupping therapy (ie, wet cupping), limiting the comparisons.

During dry cupping therapy, mechanically increasing tensile stresses via negative pressure inside the cup is believed to cause traumatic dilation of superficial capillaries, leading to rupture of these vessels and eventual ecchymosis.[12,25] The extravasation of erythrocytes and nutrients from the surrounding blood vessels during dry cupping therapy has been suggested to initiate the acute inflammatory response.[26] The process to repair damaged tissue takes place in 3 overlapping stages: the inflammatory

Table 3. Baseline to Immediately Postintervention Tukey Post Hoc Analyses and Cohen d Effect Sizes

Variable	Group (A)	Group (B)	Mean Difference (A–B)	*P* Value	Effect Size	95% Confidence Interval
Subjective pain intensity	Dry cupping	Sham cupping	−17.10	.001[a]	−1.73	−2.74, −0.73
		Control	−13.36	.008	−1.21	−2.11, −0.30
Pain-pressure threshold	Dry cupping	Sham cupping	−0.41	.58	−0.43	−1.29, 0.44
		Control	0.25	.80	0.27	−0.56, 1.11
Superficial oxygenated hemoglobin	Dry cupping	Sham cupping	14.05	.006	1.22	0.29, 2.15
		Control	15.18	.003[a]	1.37	0.44, 2.29
Superficial deoxygenated hemoglobin	Dry cupping	Sham cupping	3.58	.03	1.02	0.11, 1.93
		Control	4.44	.005	1.47	0.53, 2.42
Superficial total hemoglobin	Dry cupping	Sham cupping	17.63	.007	1.21	0.28, 2.15
		Control	19.62	.002[a]	1.42	0.49, 2.36
Deep oxygenated hemoglobin	Dry cupping	Sham cupping	12.47	.004	1.31	0.37, 2.26
		Control	12.55	.003[a]	1.36	0.44, 2.30
Deep deoxygenated hemoglobin	Dry cupping	Sham cupping	2.67	.047	0.96	0.06, 1.87
		Control	3.13	.02	1.24	0.32, 2.15
Deep total hemoglobin	Dry cupping	Sham cupping	15.15	.006	1.26	0.32, 2.20
		Control	15.68	.003[a]	1.36	0.44, 2.29
Tissue saturation index	Dry cupping	Sham cupping	4.34	.02	1.09	0.17, 2.01
		Control	3.89	.041	1.38	0.45, 2.31

[a] Indicates change ($P \leq .003$).

phase, fibroblastic-repair phase, and maturation-remodeling phase.[27] Immediately after a musculoskeletal injury, the inflammatory phase begins with vasodilation, which allows oxygenated blood and various inflammatory cells to invade the damaged tissues.[27] The release of histamine and other inflammatory chemicals to the injured area increases capillary permeability and permits an influx of neutrophils, macrophages, and plasma proteins.[27] Flooding the damaged area with blood, inflammatory cells, and nutrients is

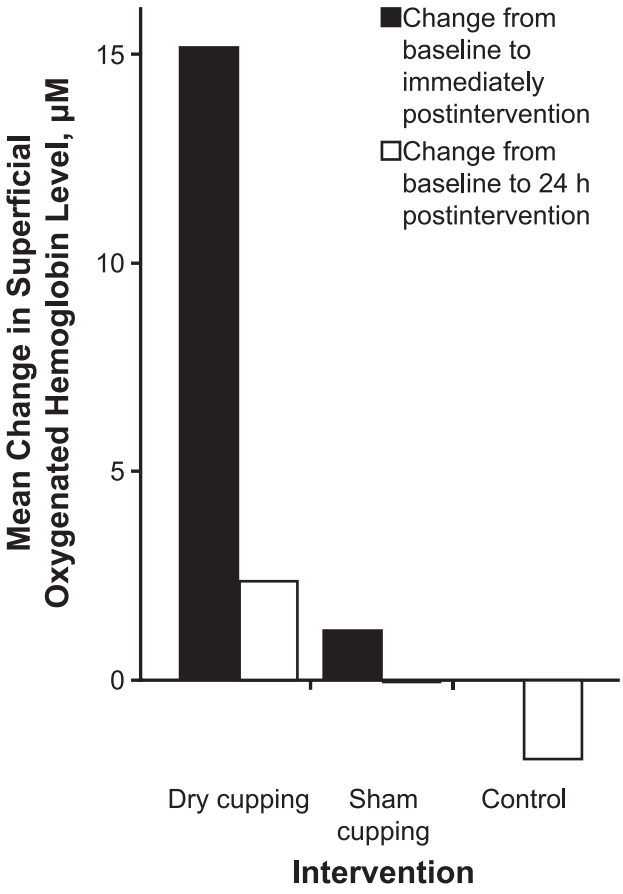

Figure 3. Changes in mean superficial oxygenated hemoglobin levels among dry cupping, sham cupping, and control groups from baseline to immediately postintervention and baseline to 24 hours postintervention.

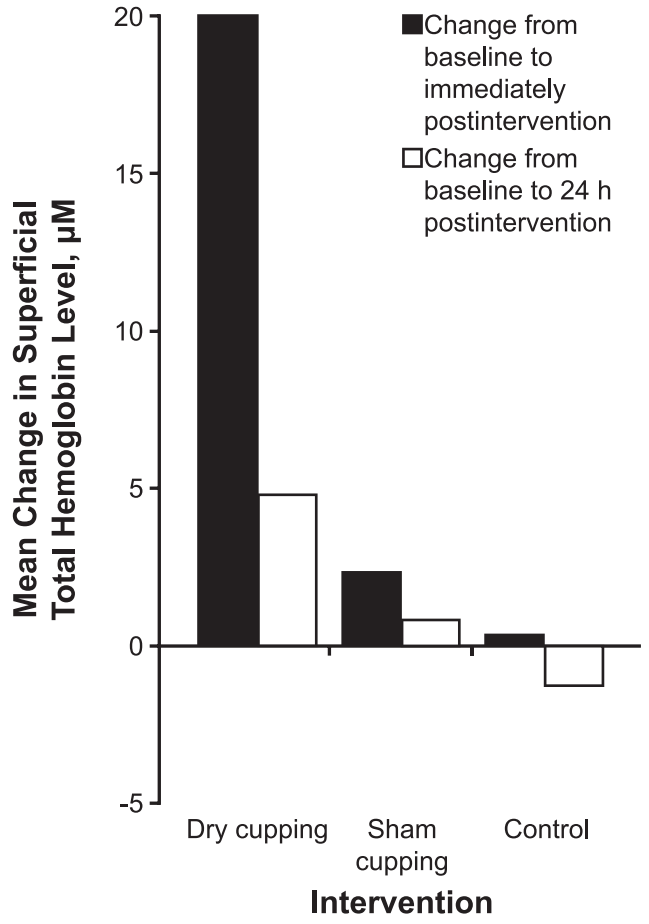

Figure 4. Changes in mean superficial total hemoglobin levels among dry cupping, sham cupping, and control groups from baseline to immediately postintervention and baseline to 24 hours postintervention.

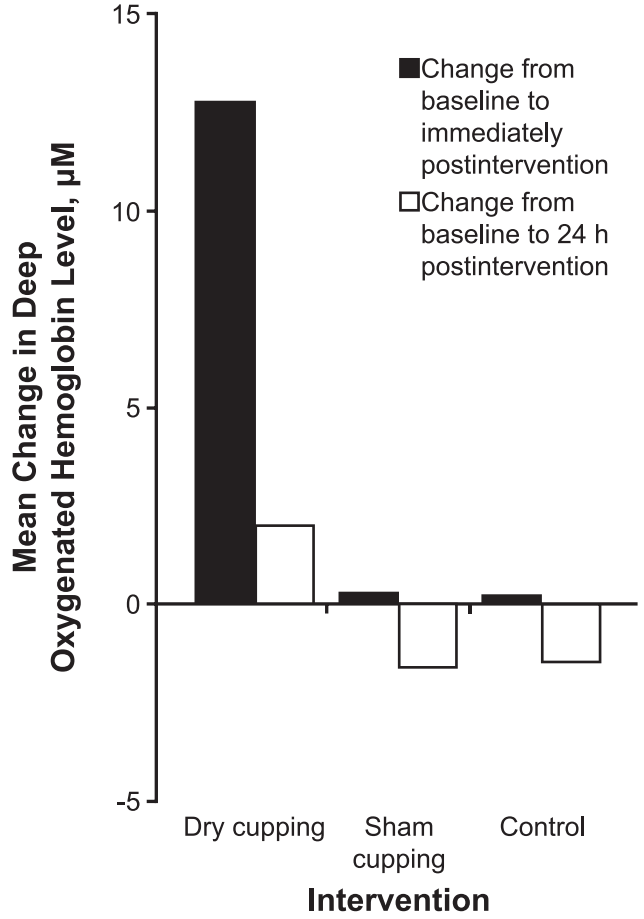

Figure 5. Changes in mean deep oxygenated hemoglobin levels among dry cupping, sham cupping, and control groups from baseline to immediately postintervention and baseline to 24 hours postintervention.

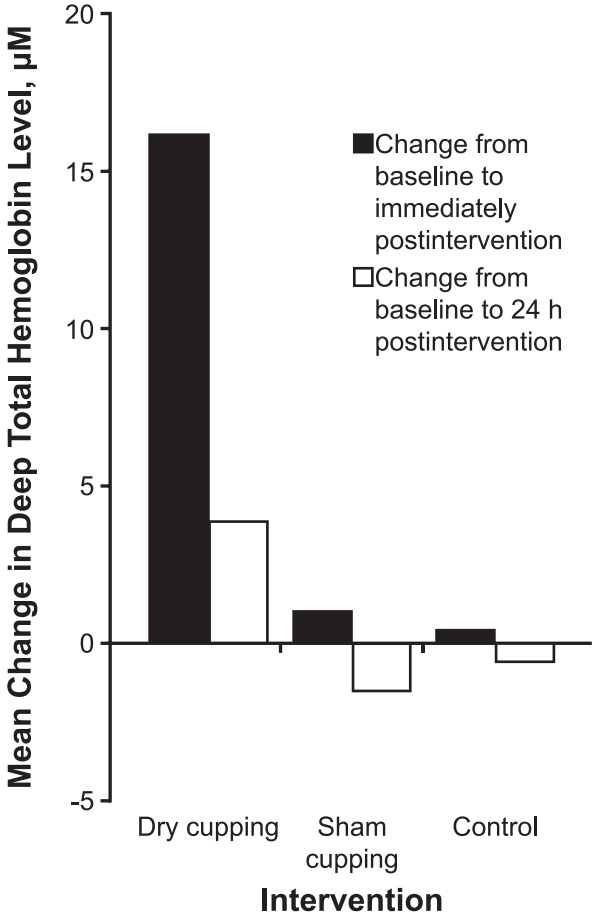

Figure 6. Changes in mean deep total hemoglobin levels among dry cupping, sham cupping, and control groups from baseline to immediately postintervention and baseline to 24 hours postintervention.

necessary for tissue healing and is also a theorized benefit of dry cupping therapy.[27,28]

To the best of our knowledge, no researchers have directly examined if dry cupping therapy achieves these claims. We attempted to noninvasively measure blood flow by assessing changes in oxygenated and deoxygenated hemoglobin levels to determine if dry cupping therapy immediately increases local blood flow after treatment. Our results indicated increases in oxygenated and total hemoglobin levels for the dry cupping group compared with the sham cupping and control groups. An isolated increase in oxygenated hemoglobin levels may support the theory that dry cupping therapy helps to supply the treated tissues with fresh blood to promote healing and reduce pain.[5,13,29] No changes were noted for deoxygenated hemoglobin levels, thus further supporting the claim that dry cupping therapy elevates oxygen-rich blood levels in the treated tissues. We theorize that, because participants were in a consistent, relaxed state, the treated tissues had no increased need for oxygen expenditure; therefore, the deoxygenated levels remained constant. However, this theory is not yet supported.

LIMITATIONS

Our study had several limitations. The blinding of our participants was potentially affected by each person's previous experience with dry cupping therapy. A participant who had experience with this treatment may have recognized the difference between dry cupping and sham cupping, whereas an individual with no experience may not have recognized it. Therefore, it is possible that true patient blinding did not occur. Similarly, the same investigator both applied the treatment and collected the data, consequently eliminating the opportunity for investigator blinding. We assumed that, even if separate investigators had performed these roles, true investigator blinding could not be assumed due to visible coloration changes in the skin after dry cupping treatment.

For outcome measurements, using subjective variables, such as pain intensity and pain-pressure threshold, may also have produced limitations because no true way to objectively measure pain is available. Our method of obtaining subjective pain-intensity data also served as a concerning limitation for this study. For this study to be as clinically applicable as possible, we used manual pressure to elicit pain in the treatment area, which was then measured using a VAS. However, the manual pressure applied per patient may have inadvertently varied, artificially causing the patient to report more or less pain. Such variations could have substantially affected the validity, repeatability, and objectivity of this measurement; there-

fore, the results associated with this outcome measure should be considered with caution. Furthermore, our results are not generalizable to different populations, such as youths or adolescents, the elderly, and athletes, as our participants were individuals between the ages of 18 and 40 years with nonspecific neck pain. Dry cupping therapy also lacks standardized application guidelines, such as treatment time, cup sizing, and appropriate pressure values beneath each cup, so our protocol was restricted to that used in previous research on dry cupping.

Future research is needed, not only to standardize treatment guidelines but also to continue analyzing the physiological effects of dry cupping therapy. Investigators can provide standardized treatment procedures by defining specific protocols for clinicians to follow when applying dry cupping therapy. Analyzing appropriate treatment times, pressure values, cup placement, and cup sizing can help to ensure that proper treatment is being provided to all patients. The physiological mechanisms and theories behind dry cupping must also continue to be evaluated. Whereas we directly examined changes in local blood flow, researchers should determine the long-term effects of dry cupping therapy. Similarly, multiple intervention sessions will provide information about differences in various dependent variables. For future studies in which authors investigate subjective pain intensity after dry cupping therapy, a more standardized and valid method of measuring this variable (ie, pain with a specific amount of pressure, activities of daily living, or range of motion) should be used.

CONCLUSIONS

The results of our study suggested that a single session of dry cupping therapy may be an effective short-term treatment method for immediately reducing pain and increasing oxygenated and total hemoglobin levels in patients with nonspecific neck pain. We have supplied preliminary evidence supporting the current physiological claims behind dry cupping therapy. Researchers should continue to investigate dry cupping therapy to better understand and implement this technique in clinical practice. Nevertheless, dry cupping therapy may be a viable option for clinicians to use when treating patients with nonspecific neck pain.

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