Qian Y. (2024) NURSING PRACTICE AND EFFECT EVALUATION OF CUPPING THERAPY IN THE REHABILITATION OF SPORTS-INDUCED CERVICAL SPINE INJURIES. Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte vol. 24 (94) pp. 251-270.DOI: https://doi.org/10.15366/rimcafd2024.94.017

ORIGINAL

NURSING PRACTICE AND EFFECT EVALUATION OF CUPPING THERAPY IN THE REHABILITATION OF SPORTS-INDUCED CERVICAL SPINE INJURIES

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Recibido 21 de abril de 2023 **Received** April 21, 2023
Aceptado 27 de Noviembre de 2023 **Accepted** November 27, 2023

ABSTRACT

Cupping has been extensively used in the treatment of various medical conditions since antiquity. In this randomized controlled trial, we investigated the effects of wet cupping therapy on the outcomes of football athletes with cervical spine injuries and low back pain. Our study was conducted at the Second Affiliated Hospital of Zhejiang University of Traditional Chinese Medicine involving 40 athletes consisting of 28 males and 12 females. Single blinding was used and participants were divided into an intervention (wet cupping) and a sham group. Our findings showed significant reduction in pain intensity scores from the pre-intervention (7.2 ± 1.5) to post-intervention (4.5 ± 1.2), suggesting a positive effect of wet cupping therapy on cervical spine injuries (Mean Difference [MD] = -2.7 ± 1.3, p = 0.001). Statistically significant increase in functional improvements in the intervention group from pre-intervention (28.3 ± 4.0) to post-intervention (18.9 ± 3.5) due to the wet cupping therapy (MD = -9.4 ± 2.1, p = 0.021). Significant improvements in the range of motion assessed from cervical flexion, cervical extension, cervical lateral flexion, and cervical rotation. Sleep quality based on Pittsburgh Sleep Quality Index (PSQI) scores exhibited a mean difference of -1.4 ± 1.2 which was statistically significant (p = 0.001). Muscle strength of Neck Flexors, Neck Extensors, Upper Trapezius, Rhomboids, Cervical Rotators, Deltoids and Biceps were significantly while minimal adverse outcomes were observed in the intervention group. In conclusion, the application of wet cupping therapy could be an effective treatment for alleviating pain, improving muscle strength, quality of life, range of motion, functional improvements and reducing adverse outcomes in athletes with cervical spine injuries.

KEYWORDS: Cervical spine injuries, Cupping, Pain, Functional Improvements, Range of motion, Muscle Strength and adverse outcomes

1. INTRODUCTION

Athletes are usually subjected to treatments that alleviates pain whether or not they are based on scientific proof. Low back pain refers to a collection of symptoms characterised by soreness, stiffness, muscle tension and pain emanating from the rib cage to the buttock folds and in most cases, involves sciatic pain (Koes, Van Tulder, & Thomas, 2006; Savigny et al., 2009). The lower back of athletes is usually reported as an area of complaints associated with different musculoskeletal issues that leads to pain, low life quality and sometimes disability (Trompeter, Fett, & Platen, 2017; Woolf & Pfleger, 2003). A systematic review and meta-analysis by Ferreira et al (Ferreira et al., 2023), postulated most lower back pain constitutes a global issue and its prevalence is bound to increase in the coming years. Koes et al (Koes et al., 2006) proposed that lower back pain can be temporarily classified as acute (less than 6 weeks), subacute (between 6 and 12 weeks), and chronic (more than 12 weeks). The pathological causes of lower back pain can be classified on the basis of specific low back pain or non-specific low back pain.

Cervical spine injuries are uncommon in sports; however, if they occur, they do cause devastating effects to athletes. They are frequent in athletes associated with contact sports such as wrestling, football and ice hockey with football recording the greatest number of cervical spine injuries (Louis, Audrey, Mark, & Patrick, 2023; Schneider, 1973). In the 1960s, increasing attention towards football related head and neck injuries significantly lowered the incidence of cervical spine injuries due to the advancements in the quality of treatment, proper education and medical healthcare, offseason conditioning and changes in the sports rules. The frequency of serious neck injuries among football athletes was one in every 7000 quadriplegic injuries (Maroon & Healion, 1970; Frederick O Mueller & Blyth, 1979). In the United States, more than 40 cases of sport related injuries to the vertebral column and seven cases of injuries to the spinal cord were reported between 1977 and 2004 (Cantu & Mueller, 2003; F. O Mueller & Cantu, 2004) and the number has consistently increased in the last decades. Head injuries in football were fatal and significant in the 1970s, however, they dropped as the number of cervical injuries constantly increased such as permanent quadriplegia. Wilberger et al (Wilberger, 2000) found that between 1971 and 1975, 259 cervical injuries were recorded among football players correlating to 4.1 in every 100000 football players and out of which 99 cases (1.58 per 100,000 football players) were found with permanent quadriplegia.

Cupping therapy is a therapeutic technique involving a vacuum force that is generated beneath a small vessel placed on the skin’s surface. It is an ancient

medical procedure involving placing cups over distinct parts of the body or certain areas such as the spine, meridians or points of acupuncture within the skin to generate a negative suction pressure (Furhad & Bokhari, 2022). Cupping therapy is often applied in the relief of musculoskeletal pain found in the neck, shoulders and back (El Hasbani, Jawad, & Uthman, 2021; Trofa et al., 2020); however, there are insufficient procedures and guidelines on the adequate duration of treatment, size of cups and the amount of negative pressure together with the application mechanisms (He et al., 2021; Y. Zhou et al., 2020). Previous studies (Hou et al., 2021; Lowe, 2017) have highlighted positive effects of cupping therapy on improving the rate of local blood flow and stretching the underlying soft tissues. These benefits highlight why it is preferred by athletes in reducing muscle soreness and enhancing performance (Trofa et al., 2020). However, there is insufficient studies on the positive effects of cupping therapy on cervical spine injuries.

Conventional medical treatments for cervical spine injuries are limited by their modern effectiveness and efficacy (Garg, George, & Mehta, 2022; Nicol et al., 2023). The major advantage of conservative treatment is to alleviate pain and increase the quality of life of patients (Wolff & Levine, 2002). Surgical treatment techniques for cervical spine injuries are superior compared to conservative treatments with the objectives of stability, decompression and preservation of alignment. However, in certain cases, patients subjected to surgical treatment in degenerative disc disease report significant neck pain (Erin, Raleene, Kiraati, & Mark, 2023). Herbal medicines have been developed as complementary and alternative medicines with the capacity to eliminate adverse outcomes of medications and surgical operations. In China, patients with cervical spine injuries are increasing being treated with herbal medicines that have existed for several centuries (Matos, Machado, Monteiro, & Greten, 2021).

Chinese herbal medicine is a composition of herbs, animal products, minerals and insect products that have combined into a single formula (Abdallah, Zhang, Zhong, & Sun, 2019; X. Zhou, Li, Chang, & Bensoussan, 2019). Traditional Chinese medicine is often derived from plants or specific parts of plants such as leaves, stems or buds. There exist four herbal therapies; (i.) single herb therapies, (ii.) Chinese proprietary medications, (iii.) a mixture of distinct herbs, and (iv.) a combination of western medicine (integrative medicine) (Liu, Yang, Liu, Wei, & Grimsgaard, 2006; Vickers & Zollman, 1999). Traditional Chinese medicines have been established and have long outstanding formulations based on certain tablets, and capsules for either commercial, palatability or convenience purposes (Cui, Trinh, & Wang, 2010). Chinese herbal medicine has been integrated with western medicine to increase effectiveness and efficacy compared to individual treatment alone, for example, injections of Chuanxiong (Rhizoma Chuanxiong), rhubarb (Radix et Rhizoma Rhei), Chuanxiong and Danshen (Radix Salviae Miltiorrhizae).

2. Rationale and Objective

In football, musculoskeletal injuries of the lower back and cervical spine are common and associated with extreme pain, low performance and disability. The prevalence of low back pain is often higher than cervical spine injuries; however, the later has devastating injuries compared to the former. The emergence of cupping therapy as form of traditional Chinese medicine has revolutionised treatment of these injuries by improving the pain levels, range of motion and increasing functional performance of athletes. Thus, our study seeks to investigate the safety and efficacy of cupping therapy compared to conventional rehabilitation approaches of sports induced cervical spine injuries. Lastly, we seek to contribute to the existing knowledge on the integration of traditional Chinese medicine into sports for optimum performance and recovery of athletes.

3. Methods

3.1 Study Design and Participants

Our randomized controlled trial was conducted at the Department of Rehabilitation at the Second Affiliated Hospital of Zhejiang University of Traditional Chinese Medicine. Our single centre study involved 40 females from January 2022 to January 2024 aged 17 years and above. The sample size was determined from a power level of 80% to detect a true effect.

3.2 Eligibility Criteria

The inclusion criteria involved participants who met the following conditions: Football players who were actively engaged in competitive play or training in the last 5 years or retired and were at least 17 years; participants who were diagnosed with cervical spine injuries in the last 6 months (for example, whiplash, disc herniation, facet joint sprains) resulting from football and confirmed by X-ray or MRI imaging upon physical examination by qualified healthcare professional at the hospital; participants diagnosed with moderate to severe pain on the visual analogue scale at the time of screening; participants who consented to participate in the study. The inclusion diagnostic criteria was defined as follows; Grade I, II or III whiplash based on the Quebec Task Force Classification (QTF); confirmed herniation at a specific cervical level (C4-C5, C5-C6) with visible nerve root compression on MRI imaging; Radiography evidence of a facet joint osteoarthritis or synovial hypertrophy with pain at the corresponding joint; for cervical strain or sprain, a confirmed diagnosis of ligamentous injury based on physical examination and MRI without major instabilities. Traditional Chinese Medicine diagnoses for cervical spine injuries such as Bi Syndrome or Qi Stagnation in the Neck were also considered and included in the study. The exclusion criteria involved patients with pre-existing neurological conditions affecting the nervous systems and could

confound the study's findings such as multiple sclerosis and Parkinson's disease; participants with severe cardiovascular or respiratory conditions that posed safety risks during cupping therapy such as hypertension and severe asthma; participants with recent injuries and posed greater risks of treatment using cupping therapy.

3.3 Intervention

Participants were randomly divided into either the intervention or control groups. Each participant was assigned a unique code for identification throughout the study. Single blinding was used for participants through opaque packaging to minimize bias in data collection and analysis. In the intervention group, wet cupping techniques were used for the rehabilitation of sports induced cervical spine injuries. Prior to each session, informed consent was obtained and the participants were comfortably positioned to exposed the affected cervical spine area. All cupping equipment such as cups and tools were sterilised for aseptic conditions. In collaboration with TCM professionals at the hospital, acupoints or tender areas associated with the TCM diagnoses and specific cervical spine injuries were identified and consistently marked across several sessions.

The number of cups ranged from 2 to 6 depending on the severity of injury and were strategically placed on the identified acupoints or tender areas (predominantly in the neck, upper back and shoulders). The initial sessions were short of about 5 minutes and the timing for subsequent sessions were adjusted based on the level of patient tolerance. Wet cupping involved creation of suctions on the skin preceded by smaller incisions using sterile lancet before reapplying the cups to draw smaller quantities of blood. In a week, there were two to three sessions based on the severity of cervical spine injury and availability of the patient. Post-session care was provided for all patients. In the control group, participants underwent a sham cupping with no suction to create a placebo effect. Sham cupping involved the use of cups without suction or drawing blood to ensure that no therapeutic effects were applied to the cervical spine area. Similar to the intervention group, all procedures were conducted aseptically including sterilisation of all cups and tools before and after every session. Post-session care was administered to all patients.

4. Outcomes

Our primary outcomes involved pain intensity, functional improvement and range of motion. In contrast, secondary outcomes involved muscle strength, adverse outcomes and quality of life. Pain intensity was measured using the Visual Analogue Scale where participants were asked to rate their pain intensities from "no pain" to "worst imaginable pain". These measurements were conducted during pre-intervention, post-intervention and during

subsequent follow-up sessions. Functional improvements were measured using the Oswestry Disability Index (ODI), or Neck Disability Index (NDI) that allowed participants to respond to items on the levels of low back pain or neck pain. All scores from NDI and ODI were analysed and quantified. A goniometer was used to measure the range of motion by positioning participants in suitable positions before measuring movement of the cervical spine in various planes. Muscle strength was measured on key muscle groups such as neck flexors and extensors (positioned in a supine posture and instructed to perform a cervical flexion/extension against resistance), in a prone posture for upper trapezius and Rhomboids (strength measurements involved measurements on shoulder elevation and scapular retraction against resistance), cervical rotators to evaluate the strength of the cervical rotator muscles and the strength of biceps and deltoids (force exerted on the shoulder abduction and flexion against resistance). Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI) consisting of self-reported 19 items with scores on a scale of 0 to 3, the total scores ranged from 0 to 21. Adverse outcomes were constantly monitored and reported such as local skin reactions (redness, bruising or irritation), pain or discomfort, headaches or dizziness among others.

4.1 Data Analysis

All analyses were performed using GraphPad Prism version 9.5.1. All the data were reported as mean ± standard deviation with all tests being double tailed tests and $p < .05$, was considered statistically significant. The difference between intervention and control groups was examined using *t*-tests.

5. Results

The study consisted of 28 males and 12 females; in the control group there were 14 males and 6 females with an average age of 28.5 ± 4 years. In contrast, in the intervention group, there were 14 males and 6 females with an average age of 26.5 ± 3.5 years.

5.1 Assessment of Primary Outcomes

Table 1: Pain Intensity as determined by VAS Scores

GROUP	PRE-INTERVENTION (MEAN ± SD)	POST-INTERVENTION (MEAN ± SD)	MEAN DIFFERENCE (POST - PRE)	P-VALUE
INTERVENTION	7.2 ± 1.5	4.5 ± 1.2	-2.7 ± 1.3	0.001
CONTROL	7.0 ± 1.6	6.8 ± 1.5	-0.2 ± 0.8	0.450

Note: *Data was normally distributed and an independent samples t-test was used to calculate mean differences at p <. 05.*

In Table 1 and Figure 2, there were statistically significant reduction in

pain intensity scores from the pre-intervention (7.2 ± 1.5) to post-intervention (4.5 ± 1.2), suggesting a positive effect of wet cupping therapy on cervical spine injuries (Mean Difference [MD] = -2.7 ± 1.3, p = 0.001). In contrast, the reduction in pain intensity scores of the control group from pre-intervention (7.0 ± 1.6) to post-intervention (6.8 ± 1.5) was not statistically significant (MD = -0.2 ± 0.8, p = 0.450).

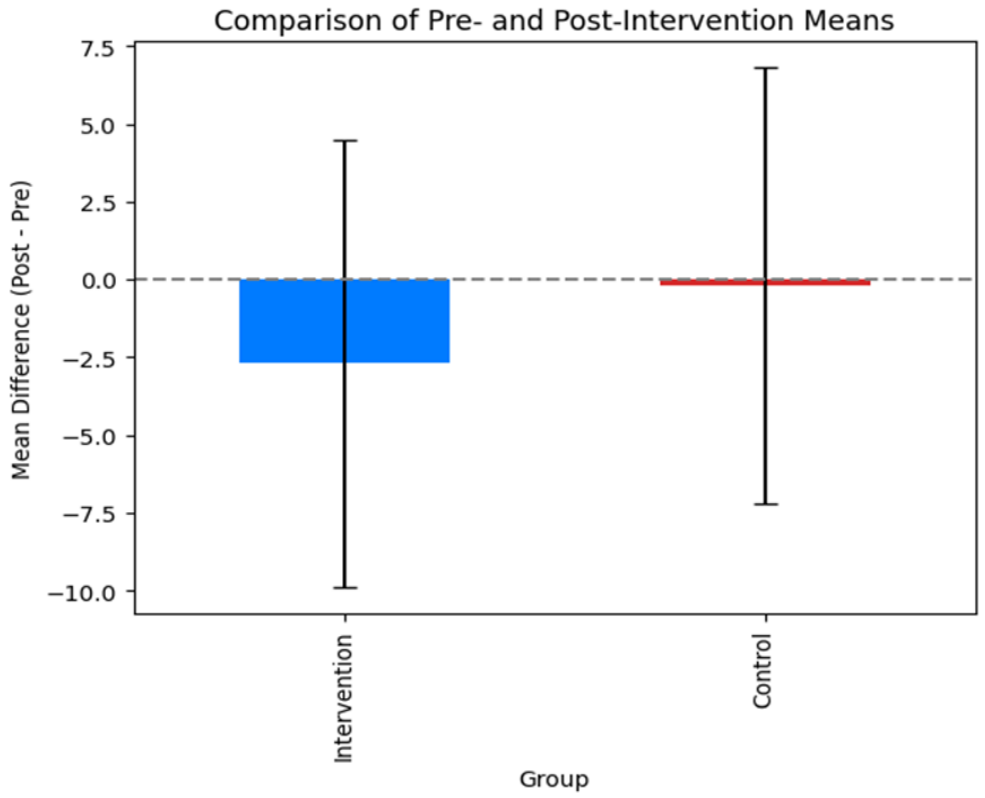


Figure 2: A Standard Bar Chart of Comparison of the Mean Differences between pre-intervention and post-intervention in control and intervention groups.

Table 2: Functional Improvement Based on NDI Scores

GROUP	PRE-INTERVENTION (MEAN ± SD)	POST-INTERVENTION (MEAN ± SD)	MEAN DIFFERENCE (POST - PRE)	P-VALUE
INTERVENTION	28.3 ± 4.0	18.9 ± 3.5	-9.4 ± 2.1	0.021
CONTROL	28.1 ± 4.2	27.8 ± 4.0	-0.3 ± 1.0	0.668

Note: *Data was normally distributed and an independent samples t-test was used to calculate mean differences at p <. 05.*

In Table 2 and Figure 3, we found a statistically significant increase in functional improvements in the intervention group from pre-intervention (28.3 ± 4.0) to post-intervention (18.9 ± 3.5) due to the wet cupping therapy (MD = -9.4 ± 2.1, p = 0.021). In contrast, in the control group, there was a slight increase in the functional status of participants from pre-intervention (28.1 ± 4.2) to post-

intervention (27.8 ± 4.0) which was not statistically significant (MD = -0.3 ± 1.0, p = 0.668).

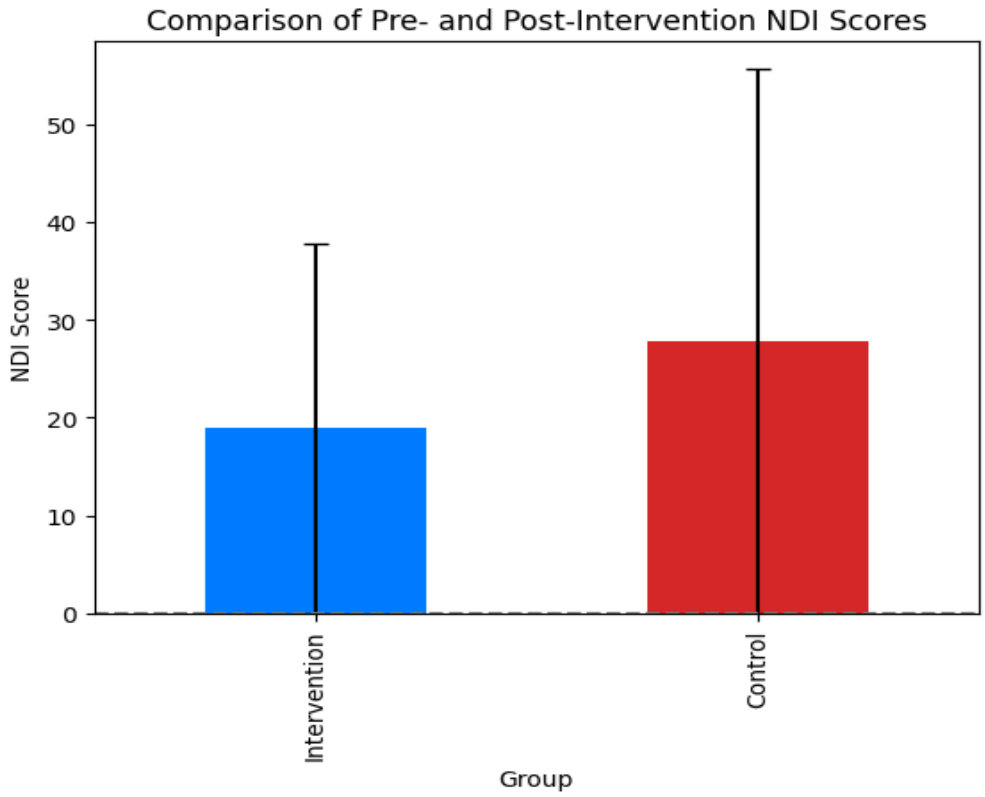


Figure 3: A Standard Column Chart of Comparison of Functional Improvement Based on NDI Scores in the control and intervention groups.

Table 3(a): Range of Motion Measurements between Intervention and Control Groups

GROUP	POSITION	PRE-INTERVENTION (MEAN ± SD)	POST-INTERVENTION (MEAN ± SD)	MEAN DIFFERENCE (POST - PRE)	P-VALUE
CONTROL	Seated Flexion	45.8 ± 5.2°	46.2 ± 4.8°	0.4 ± 1.1°	0.120
	Seated Extension	50.3 ± 6.0°	50.1 ± 5.5°	-0.2 ± 0.8°	0.480
	Lateral Flexion - Left	35.6 ± 4.5°	35.8 ± 4.2°	0.2 ± 0.6°	0.320
	Lateral Flexion - Right	36.2 ± 4.8°	36.4 ± 4.6°	0.2 ± 0.4°	0.270
	Rotation - Left	45.0 ± 5.5°	44.8 ± 5.2°	-0.2 ± 0.7°	0.410
	Rotation - Right	44.7 ± 5.2°	45.0 ± 5.4°	0.3 ± 0.5°	0.180

Table 3(b): Range of Motion Measurements between Intervention and Control Groups

GROUP	POSITION	PRE-INTERVENTION (MEAN ± SD)	POST-INTERVENTION (MEAN ± SD)	MEAN DIFFERENCE (POST - PRE)	P-VALUE
INTERVENTION	Seated Flexion	46.0 ± 4.8°	48.5 ± 5.2°	2.5 ± 1.3°	0.001
	Seated Extension	49.8 ± 5.7°	50.3 ± 5.5°	0.5 ± 1.0°	0.050
	Lateral Flexion - Left	34.5 ± 4.0°	37.2 ± 4.5°	2.7 ± 1.2°	0.003
	Lateral Flexion - Right	35.2 ± 4.2°	38.0 ± 4.8°	2.8 ± 1.5°	0.002
	Rotation - Left	43.5 ± 5.0°	45.5 ± 5.8°	2.0 ± 1.4°	0.012
	Rotation - Right	44.0 ± 5.3°	46.8 ± 6.0°	2.8 ± 1.8°	0.008

Note: *Data was normally distributed and an independent samples t-test was used to calculate mean differences at p <. 05.*

In Table 3 and Figure 4, for seated flexion, the Control group showed a mean pre-intervention angle of 45.8° (± 5.2°), which slightly increased to 46.2° (± 4.8°) post-intervention, resulting in a mean difference of 0.4° (± 1.1°) which was not statistically significant (p = 0.120).

In seated extension, the Control group showed a mean pre-intervention angle of 50.3° (± 6.0°), which marginally decreased to 50.1° (± 5.5°) post-intervention, resulting in a mean difference of -0.2° (± 0.8°) and was not statistically significant (p = 0.480).

Lateral flexion to the left and right demonstrated mean pre-intervention angles of 35.6° (± 4.5°) and 36.2° (± 4.8°) in the Control group, which changed to 35.8° (± 4.2°) and 36.4° (± 4.6°) post-intervention, respectively. The mean differences were 0.2° (± 0.6°) and 0.2° (± 0.4°), which were not statistically significant (p = 0.320 and p = 0.270). For rotational movements, the Control group had mean pre-intervention angles of 45.0° (± 5.5°) and 44.7° (± 5.2°) for left and right rotations, respectively.

Post-intervention, these angles changed to 44.8° (± 5.2°) and 45.0° (± 5.4°), with mean differences of -0.2° (± 0.7°) and 0.3° (± 0.5°) and were not statistically significant (p = 0.410 and p = 0.180). In the Intervention group, participants exhibited improvements in all positions with statistically significant mean differences (p <.05).

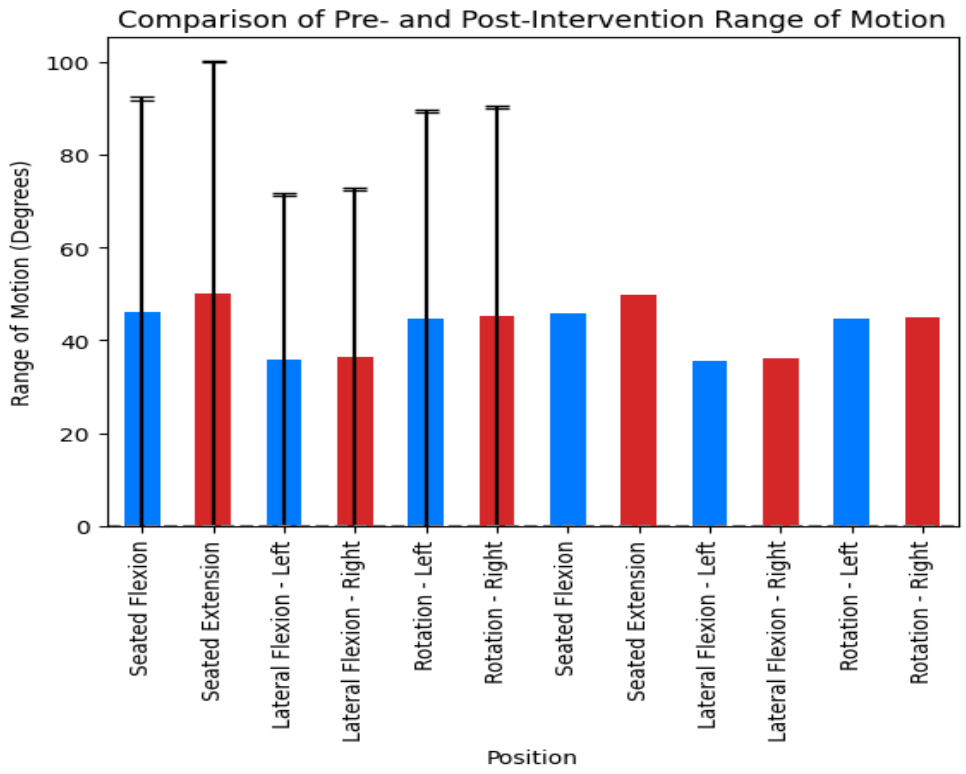


Figure 4: A comparative assessment of Range of Motion Measurements between Intervention and Control Groups.

5.2 Assessment of Secondary Outcomes

Table 4(a): The variations in muscle strength between intervention and control groups

MUSCLE GROUP	CONTROL GROUP	INTERVENTION GROUP	CHANGE (CONTROL)	CHANGE (INTERVENTION)	P-VALUE
NECK FLEXORS (KG)					
PRE-INTERVENTION	12.5 ± 2.0	11.8 ± 1.8	-	-	-
POST-INTERVENTION	12.7 ± 2.2	15.2 ± 2.3	0.2 ± 0.2	3.4 ± 0.5	< 0.05
NECK EXTENSORS (KG)					
PRE-INTERVENTION	14.3 ± 2.5	13.9 ± 2.3	-	-	-
POST-INTERVENTION	14.5 ± 2.4	16.1 ± 2.5	0.2 ± 0.2	2.2 ± 0.2	< 0.01

Table 4(b): The variations in muscle strength between intervention and control groups

MUSCLE GROUP	CONTROL GROUP	INTERVENTION GROUP	CHANGE (CONTROL)	CHANGE (INTERVENTION)	P-VALUE
UPPER TRAPEZIUS (KG)					
PRE-INTERVENTION	18.7 ± 3.5	19.5 ± 3.2	-	-	-
POST-INTERVENTION	18.8 ± 3.7	22.1 ± 3.5	0.1 ± 0.2	2.6 ± 0.3	< 0.001
RHOMBOIDS (KG)					
PRE-INTERVENTION	16.2 ± 2.8	17.8 ± 2.5	-	-	-
POST-INTERVENTION	16.4 ± 2.9	19.3 ± 2.7	0.2 ± 0.3	1.5 ± 0.2	< 0.05
CERVICAL ROTATORS (KG)					
PRE-INTERVENTION	9.2 ± 1.7	8.8 ± 1.5	-	-	-
POST-INTERVENTION	9.4 ± 1.8	11.0 ± 2.0	0.2 ± 0.1	2.2 ± 0.5	< 0.01
DELTOIDS (KG)					
PRE-INTERVENTION	21.0 ± 4.0	20.2 ± 3.5	-	-	-
POST-INTERVENTION	21.2 ± 4.1	23.5 ± 3.8	0.2 ± 0.1	3.3 ± 0.3	< 0.001
BICEPS (KG)					
PRE-INTERVENTION	14.5 ± 2.8	15.8 ± 2.6	-	-	-
POST-INTERVENTION	14.7 ± 2.9	17.2 ± 2.9	0.2 ± 0.1	1.4 ± 0.3	< 0.05

Note: *Data was normally distributed and an independent samples t-test was used to calculate mean differences at p <. 05.*

In Table 4, during post-intervention, in the Neck Flexors, the Control group showed a mean strength of 12.7 kg (± 2.2), while the Intervention group demonstrated 15.2 kg (± 2.3) which was statistically significant (MD = 3.2, $p < 0.05$). Neck Extensors exhibited a mean strength of 14.5 kg (± 2.4) in the Control group and 16.1 kg (± 2.5) in the Intervention group which was statistically significant (MD = 2.0, $p < 0.01$). The Upper Trapezius displayed a mean strength of 18.8 kg (± 3.7) in the Control group and 22.1 kg (± 3.5) in the Intervention group which was statistically significant (MD = 2.5, $p < 0.001$). Rhomboids showed a mean strength of 16.4 kg (± 2.9) in the Control group and

19.3 kg (± 2.7) in the Intervention group which was statistically significant (MD = 1.3, $p < 0.05$). Cervical Rotators had a mean strength of 9.4 kg (± 1.8) in the Control group and 11.0 kg (± 2.0) in the Intervention group which was statistically significant (MD = 2.0, $p < 0.01$). Deltoids exhibited a mean strength of 21.2 kg (± 4.1) in the Control group and 23.5 kg (± 3.8) in the Intervention group which was statistically significant (MD = 3.1, $p < 0.001$). Lastly, Biceps had a mean strength of 14.7 kg (± 2.9) in the Control group and 17.2 kg (± 2.9) in the Intervention group which was statistically significant (MD = 1.2, $p < 0.05$).

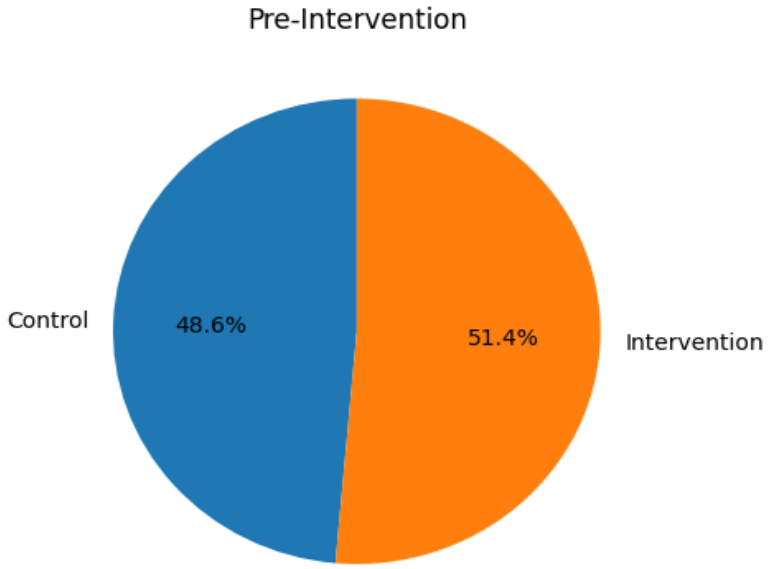
Table 5: Assessment of sleep quality based on PSQI Scores

GROUP	PRE-INTERVENTION (MEAN ± SD)	POST-INTERVENTION (MEAN ± SD)	MEAN DIFFERENCE (POST - PRE)	P-VALUE
CONTROL	8.7 ± 2.1	8.9 ± 2.0	0.2 ± 0.8	0.120
INTERVENTION	9.2 ± 2.5	7.8 ± 1.8	-1.4 ± 1.2	0.001

Note: *Data was normally distributed and an independent samples t-test was used to calculate mean differences at p <. 05.*

In the evaluation of sleep quality based on Pittsburgh Sleep Quality Index (PSQI) scores (see Table 5 and Figure 5), participants in the Control group displayed a mean pre-intervention score of 8.7 (± 2.1), which slightly increased to 8.9 (± 2.0) post-intervention.

The mean difference (post-pre) was 0.2 (± 0.8), and was not statistically significant ($p = 0.120$). Conversely, participants in the Intervention group exhibited a mean pre-intervention score of 9.2 (± 2.5), which significantly decreased to 7.8 (± 1.8) post-intervention. The mean difference (Post - Pre) for the Intervention group was -1.4 (± 1.2), and was statistically significant ($p = 0.001$).



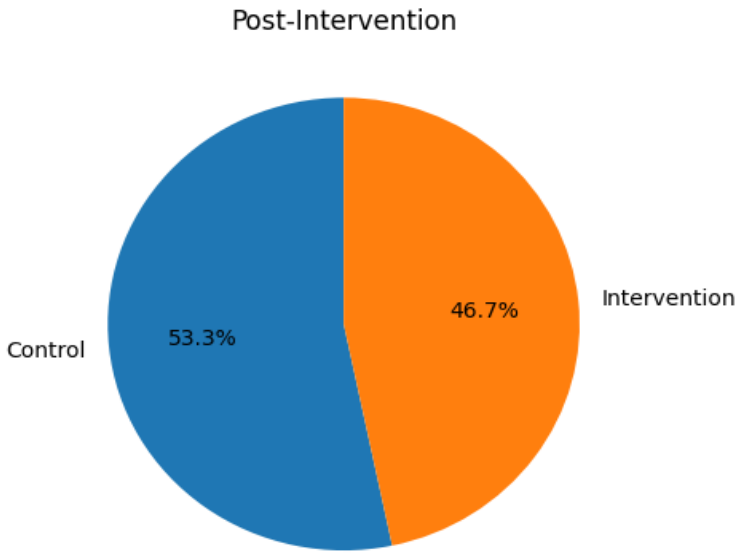


Figure 5: A pie chart showing the Assessment of sleep quality based on PSQI Scores before and after intervention in control and experimental groups.

Table 6: Monitoring of adverse outcomes between control and intervention groups

GROUP	ADVERSE OUTCOME	NUMBER OF PARTICIPANTS AFFECTED	SEVERITY (MILD/MODERATE/SEVERE)	MANAGEMENT	OUTCOME RESOLUTION
CONTROL	Local Skin Reactions	2	Mild	Symptomatic treatment	Resolved after 2 days
	Pain or Discomfort	1	Moderate	Symptomatic treatment	Resolved after 1 week
	Headaches	0	-	-	-
	Dizziness	1	Mild	Observation	Resolved during session
INTERVENTION	Local Skin Reactions	3	Moderate	Symptomatic treatment	Resolved after 3 days
	Pain or Discomfort	2	Severe	Medical intervention	Resolved after 2 weeks
	Headaches	1	Mild	Symptomatic treatment	Resolved after 1 day
	Dizziness	0	-	-	-

In Table 6, participants in the Control group two participants reported mild local skin reactions. One participant reported moderate pain or discomfort.

Additionally, one participant reported mild dizziness. Notably, no participants reported headaches. In the Intervention group, three participants experienced moderate local skin reactions. Two participants reported severe pain or discomfort, and One participant reported mild headaches. No participants in the Intervention group reported dizziness.

6. Discussion

Our findings showed that wet cupping resulted in significant improvements in pain intensity scores, functional status and the range of motion of all participants compared to the sham cupping technique. All our primary outcomes resulted in significant improvements suggesting that wet cupping therapy is highly effective and efficacious in the treatment of cervical spine injuries among football athletes. Our study found significant reduction in the pain intensity scores in the intervention group (-2.7 ± 1.3) compared to the sham group. These findings were aligned with Wang et al (Wang, Cai, Li, & Zhu, 2023) who suggested that cupping therapy alleviates pain scores; however, their systematic review and meta-analysis had very low-to-moderate quality of evidence. Cupping therapy is considered effective in the management of chronic pain, knee osteoarthritis, low back pain, chronic back pain, and herpes zoster. Thus, we propose that cupping therapy is a promising safe and efficacious non-pharmacological therapy that should be widely promoted and accepted by football athletes in the management of cervical spine injuries.

Our findings were consistent with a systematic review and meta-analysis by Shen et al (Shen et al., 2022) who analysed 690 patients from 656 studies who were mainly diagnosed with low back pain. Their findings showed a significant reduction in the pain intensity scores using wet cupping therapy. Moreover, they found that dry and wet cupping therapies resulted in significant reduction in the ODI scores compared to the control groups. A comparison of wet and dry cupping showed that dry cupping had no significant reduction of low back pain compared to the wet cupping technique. We propose that these differences between wet and dry cupping is attributed to the specificity of each technique in managing pain outcomes. Dry cupping has been reported to be efficacious in general pain conditions while wet cupping has been found to be effective in inflammatory related pain conditions such as herpes zoster infections (Furhad, Sina, & Bokhari, 2023).

Our findings on pain intensity scores were consistent with Kim et al. (2018) who found that cupping therapy intervention resulted in significant reduction in pain (MD = -2.42, 95% CI = -3.98 to -0.86) and functional status of patients (MD = -4.34, 95%CI = -6.77 to -1.19). Furthermore, they found significant improvement in the quality of life of patients in the intervention group compared to the sham group (p = 0.001). Therefore, cupping therapy significantly reduces neck pain and its recommended to be used as an effective

treatment strategy for athletes as neck pain leads to several disabilities and treatment modalities such as cupping therapy is of significant importance. Kang et al (Kang et al., 2021) found that non-pharmacological traditional Chinese therapies involving acupuncture, moxibustion and Tui Na have significant positive effects in lowering the effects of fatigue, pain and inflammations. They show that enhanced analgesia results in a significant improvement in the performance of sporting athletes. Cupping therapy involves a combustion and suction procedure using a cup with negative pressure that is designed to exert a pulling effect on the skin's surface. Cupping therapy is effective and safe in alleviating pain, accelerating the recovery of muscles after exercising fatigue, preventing diseases and lowering inflammations (Hong, Liu, & Guo, 2012).

Our analysis of adverse outcomes in cupping therapy showed that in the sham group participants reported various adverse events with two participants reporting mild local skin reactions that was managed with symptomatic treatment. One participant reported moderate pain or discomfort, and one participant reported mild dizziness. No participants in the Control group reported headaches. In the Intervention group, three participants experienced moderate local skin reactions, two participants reported severe pain or discomfort, one participant reported mild headaches, while participants reported dizziness. These findings were consistent with previous studies, who suggested that cupping therapy is associated with adverse reactions such as burns, koebnerization, growth and development of discoid psoriasis plaques. Therefore, we propose that this technique mobilises blood flow and generates a healing effect for cervical spine injuries and other ailments. Cupping therapy on the skin's surface is commonly associated with circular erythema, ecchymosis, petechiae, panniculitis and abrasions.

Cupping is highly efficacious in alleviating pain, fever, menstrual pain, acne, eczema, psoriasis, stroke rehabilitation, and anaemia. Cupping is predominant in Asian cultures, Eastern Europe and Latin America and is considered as an alternative in stimulating acupuncture points in the body. However, there is limited medical evidence on the safety and efficacy of cupping with previous systematic reviews reporting positive outcomes in hypertension, pain and stroke rehabilitation (Kim, Lee, Lee, Boddy, & Ernst, 2011; Lee, Choi, Shin, Han, & Ernst, 2010; Lee, Choi, Shin, Kim, & Nam, 2010). These systematic reviews and meta-analyses have been limited by inclusion of poor-quality studies and methodological shortcomings; hence, there are inconclusive evidence in showing that cupping is effective for a range of diseases involving pain, fever, poor appetite, indigestion, infertility, menstrual pain, acne, eczema, psoriasis, anaemia, haemophilia, hypertension, congestion, and stroke rehabilitation.

Our findings showed minimal adverse outcomes in cupping therapy with cases of mild skin reactions and moderate pain and discomfort. Similarly,

cupping therapy is associated with several complications such as panniculitis, formation of ulcers, hyperpigmentation, koebnerization, and formation of discoid psoriasis and erythema ab igne. Moreover, the lesions generated by cupping have been mistaken for cases of child abuse stigmata since they form discrete and circular burns composed of petechiae and ecchymosis, particularly when moving cupping is applied (Swerdlin, Berkowitz, & Craft, 2007; Yoo & Tausk, 2004). In a previous study by Anh (Anh, 1976), a confusion led to a single case of parental suicide due to adverse outcomes of cupping therapy in 1976.

Our findings showed positive improvements in the range of motion in the intervention group compared to control groups in wet cupping. The range of motion in control and intervention groups was assessed from various positions such as cervical flexion, cervical extension, cervical lateral flexion, and cervical rotation. In contrast, Wood et al (Wood, Fryer, Tan, & Cleary, 2020) performed a systematic review and meta-analysis on dry cupping for musculoskeletal pain and range of motion and found significant differences between intervention and control groups for range of motion. They found that dry cupping had statistically significant effect of lowering chronic neck pain (MD, −21.67; 95% CI, −36.55, to −6.80) and low back pain (MD, −19.38; 95%CI, −28.09, to −10.66). Moreover, they found that dry cupping improved functional status for chronic neck pain (MD, −4.65; 95%CI, −6.44, to −2.85).

For range of motion, low quality evidence revealed a significant difference when compared to no treatment (SMD, −0.75; 95%CI, −0.75, to −0.32). Thus, when compared to wet cupping, dry cupping is equally effective in alleviating pain in patients diagnosed with non-specified low back pain and chronic neck pain. However, there is inconclusive evidence regarding the safety and efficacy of dry cupping therapy. Schaffer et al (Schafer et al., 2020) found that the passive application of cupping therapy for 10 minutes does not improve the flexibility and range of motion compared to sham or control treatment. Cupping therapy for a limited duration does not improve the hamstring flexibility of athletes compared to sham conditions.

Our analysis on muscle strength showed significant improvements in Neck Flexors, Neck Extensors, Upper Trapezius, Rhomboids, Cervical Rotators, Deltoids and Biceps in the intervention compared to control groups. In contrast to a cross-over study design by Yim et al (Yim et al., 2017) who found no significant changes in the cervical spine angles or the turtle neck angles after evaluation using the McKenzie stretching and dry cupping techniques. However, they observed changes in the range of movement of the cervical spine in all directions with no statistically significant changes.

Besides these differences, the cupping therapy proved effective compared to McKenzie stretching and other sham treatments in improving the

range of motion of the cervical spine and pain thresholds.

7. Conclusion

Our findings showed statistically significant effects of wet cupping therapy intervention in improving the outcomes of athletes with cervical spine injuries. Our primary outcomes showed significant improvements in pain intensity scores on the VAS scale, functional improvements and significant improvements in the range of motion assessed from various positions such as cervical flexion, cervical extension, cervical lateral flexion, and cervical rotation.

Similarly, secondary outcomes reported positive improvements in the quality of life, reduction of adverse outcomes and improvements in muscle strength examined from the Neck Flexors, Neck Extensors, Upper Trapezius, Rhomboids, Cervical Rotators, Deltoids and Biceps. Application of traditional Chinese cupping therapy is effective and safe in improving the outcomes of athletes with cervical spine injuries.

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