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Effects of Moving Cupping Therapy on Hip and Knee Range of Movement and Knee Flexion Power: A Preliminary Investigation

Abstract: Cupping therapy has become more popular in the sports setting because of its simplicity in application, minimal adverse effects, and reduction in pain and muscle tenderness, yet there is little research on its effectiveness for range of movement and power. **Objectives:** The primary aim of this study was to investigate if a single session of moving cupping to the posterior aspect of the lower limb effects hip and knee range of movement and knee flexion power. The secondary aim was to consider participants' views and perceptions of moving cupping therapy. **Methods:** Twenty-one healthy participants (12 male and 9 female) aged between 19 and 31 years volunteered to take part in the study. All participants received 15 minutes of moving cupping therapy to their dominant posterior lower extremity. Hip and knee range of movement and knee flexion isokinetic power measurements were taken prior to and immediately after the moving cupping intervention. Participants also completed a questionnaire based on their experience and perceptions of cupping. **Results:** Results showed a significant increase ($p=<.05$) in hip and knee range of movement measurements by 7% in the straight leg raise and 4% in a popliteal angle test. However, no significant changes were seen in the knee flexion power measures. Data from the questionnaire suggest that despite moving cupping being reported as 'uncomfortable' it is considered acceptable. **Discussion:** Moving cupping therapy may have short term changes to range of movement but not power, though the limitations of this study mean that rigorous studies are required before the effectiveness of moving cupping can be determined.

Key words: Cupping, Range of movement, Knee flexion power, Lower extremity, Goniometer, Isokinetic Cybex dynamometer, Popliteal angle, Straight leg raise.

List of figure captions:

Introduction

Background

Cupping therapy has become popular in the sports setting [1] through prominent figures advocating its use, and because of its simplicity in application and minimal adverse effects [2]. It has been adopted for thousands of years in traditional Chinese medicine to help with blood disorders, pain relief, inflammatory conditions, physical relaxation, and general physical and mental well-being [3]. The technique involves placing a dome-shaped cup (usually made of glass, bamboo or plastic) over an area of skin, and then creating a negative pressure within the cup, either through direct application of heat or through an air pump device. Wet cupping involves making a skin incision prior to placing the cup, which subsequently draws blood, and is more commonly associated with alternative medicine. Dry cupping, however, requires only the cup to be put into place, and then is either left in situ (static cupping) [4], or is moved along the skin with lubricants (moving cupping) [5,6]. The negative pressure inside the cup is purported to lift and separate tissue which assists with the release of the interfaces between the soft-tissues such as skin, fascia, neural tissues, muscles, ligaments and tendons [7], and can create a massage-like effect [6].

Clinical observations of moving cupping (MC) have prompted some therapists to believe it is effective for conditions such as Iliotibial Band and Piriformis syndrome [6], through improving range of movement (ROM) by helping treat pain, deep scar tissues in the muscles, adhesions, and swelling. Normal ROM may be hindered for a number of reasons, including the joint capsule, musculotendinous tissue, scar and fibrous tissue, muscle spasm and skin and fascial restrictions [8]. These restrictions can decrease flexibility, strength, endurance, motor coordination and lead to pain [9]. Maintaining or improving ROM is often a goal of Physiotherapists for promoting the health and quality of a patient's life [10], and it is possible

that increased hamstring ROM could reduce the risk of injury, enhance athletic performance, and assist in rehabilitation following musculoskeletal injury [11].

Furthermore**,** Wan et al. [12] suggested that hamstring optimal lengths are positively correlated to power. Increased power has been associated with preventing leg injuries [13] and consequently, a great deal of research has investigated methods to improve power output and its transference to athletic performance [14]. Typical physiotherapy modalities for increasing ROM include heat, cryotherapy, massage, ultrasound, and electrical stimulation, however, not all patients respond optimally to these modalities, and some of these modalities may be contraindicated [15]. The physiological effects of cupping therapy have been reported to be similar to those of massage and thermal therapy [16]. Immediate vasodilation leads to increased blood flow, which could facilitate healing as well as enabling the elongation and increased motion of taut muscles [2]. As massage and thermal therapy have both been shown to increase ROM [2,17,18], it is possible to accept the idea that MC may also increase ROM and power.

The use of cupping therapy amongst athletes has grown over the last decade. In the 2012 London Olympics and 2016 Rio Olympics many high profile athletes were seen with the cupping marks, suggesting that athletes are using cupping in an attempt to boost their performance. Cockburn [19] reported that the increased use for this type of therapy is thought to be the same reason that freeze tanks or oxygen rich blood injections are used by international sports teams and premiership footballers; to recover in time for the next round of competition. Cockburn [19] concluded that there is currently scant evidence the technique has any detectable benefit in treating any physical malady and that cupping remains a "learning process".

The latest systematic review on cupping [20] concluded that there is only low quality evidence indicating that cupping may be effective for reducing musculoskeletal pain, and no evidence to support its effectiveness for any other conditions. Furthermore, although one study published in 2018 investigated the effects of static cupping (SC) on hamstring flexibility [21], there are no published studies that have explored the effects of MC on joint ROM and power. Given the theoretical potential of MC, but lack of published studies focusing upon effectiveness, we adopted an initial preliminary, case-series study with 21 participants to investigate whether any potential benefit is observable, and if it is considered an acceptable intervention.

Methods

A within-subject case series design, using a convenience sample of twenty-one participants (12 male and 9 female) aged between 19 and 31 years of age volunteered to take part in the study. All participants were recruited from a University based in the North East of England and all underwent the same protocol. The exclusion criteria were as follows: (1) History of a hamstring injury within the last two years; (2) Low back pain in the last two months, or any indication of lumbar or lower limb neurological compromise; (3) Any skin condition or wound in the areas to be cupped; (4) Any blood disorder; (5) Taking blood thinning medication; (6) Unstable cardiac/health condition; (7) Very low/high blood pressure.

Recruitment

All participants were recruited through a University email system where they were sent full details of the study via a comprehensive participant information sheet. Prior to taking part in the study all participants gave informed consent by signing a consent form.

Pre-cupping procedure

Prior to the application of MC, investigator one (DM) and investigator two (CC) ensured that participants had complied with the pre-cupping requirements (inclusion and exclusion criteria), contraindications were eliminated, equipment had been sterilised, participants were reassured/reminded of the potential minor side effects and that lower limb clinical observations had been conducted for any abnormalities. Once participants were determined eligible for the study and gave consent, they performed a five-minute warm-up using a Watt bike in which they were instructed to work at a rate of 70RPM. The choice of warm up was based on recommendations for warm-up exercise [22]. It has been documented that a 5 minute warm up of moderate intensity is likely to significantly improve short-term performance in a range of tasks, which is largely attributable to an increase in muscle temperature [22]. Following the warm up, a baseline measurement of hip and knee ROM and knee flexion isokinetic strength were taken. Hip and knee ROM was measured passively using the straight leg raise (SLR) test and popliteal angle with the participant lying in a supine position on a massage couch. Measurements were taken by either DM or CC by using a standard goniometer to measure SLR (hip flexion angle) or popliteal angle (knee flexion angle).

Measurement protocol for popliteal angle

To measure the popliteal angle, the hip of the tested leg was passively moved to 90 degrees of flexion. Participants were instructed to keep the contralateral leg flat on the massage couch. The assessor then extended the knee to the maximal tolerable stretch of the hamstring muscle as indicated by the participant, with the ipsilateral hip remaining in 90 degrees of flexion. The fulcrum of the goniometer was placed on the lateral epicondyle of the femur, with the stationary arm aligned with the greater trochanter, and the moving arm aligned with the lateral malleolus [23]. The choice of using goniometry to measure joint angles was based on a number of studies

demonstrating high inter-tester reliability for goniometric measurements of the lower extremities [24, 25].

Measurement protocol for SLR

To measure SLR, the assessor lifted the participant's leg by the posterior ankle whilst keeping the knee fully extended. Participants were instructed not to lift the pelvis off the couch throughout the movement. The straight leg was raised as far as possible until the point of maximal stretch as indicated by the participant. The fulcrum of the goniometer was held over the greater trochanter of the leg being tested, while the moving arm was aligned with the midline of the femur, using the lateral epicondyle of the femur as a reference point [26].

Cybex-II isokinetic dynamometer protocol

Knee flexion power was measured by DM using a Cybex-II Isokinetic Dynamometer. Each participant performed one set of three maximal voluntary knee flexion contractions with a rest of three seconds in between each repetition. In order to determine peak torque of the muscle, dynamic isokinetic concentric contractions were measured at 60°/sec, 90°/sec and 120°/sec. Average power is an expression of work per unit of time and is used as an indicator of work rates [27]. The choice of 60°/sec, 90°/sec and 120°/sec was based on the previous work of Croce et al. [28] who documented high reliability of isokinetic strength measurements at these angular velocities. The best or peak measure was recorded. Participants were verbally encouraged to maximize contraction efforts.

Cupping intervention

Following baseline measurements, a standardised MC session was administered by either DM or CC for a duration of 15 minutes. Participants were positioned lying prone on a massage couch with their dominant lower limb exposed. An oil based medium was applied to the

posterior aspect of the entire lower limb to provide a lubricant for the cups to move along. Hand pumped 'Shen Nong Shi' Vacuum plastic cups (4-6 cups with diameters varying from 3cm to 6.5cm) were applied to the soft tissue to perform the MC. Once the suction had been applied with the hand pump to create a negative pressure, the cups were moved in various directions over the soft tissue for a massage-like effect. Once all cups were in place, the therapist would move two cups at a time over the posterior thigh and lower leg, alternating which cups were moved at five to ten second intervals. Immediately following the cupping intervention, the same assessor repeated the objective measurements using the same protocol.

Questionnaire

Once participants had completed testing and all measurements had been recorded, they were asked to complete a questionnaire based on their experience and perceptions of the cupping therapy they received. Due to the fact that there are no accepted questionnaires on cupping, the questionnaire used in this study was created by the authors. Outcomes were recorded on a 5-point Likert item ranging from "strongly agree" to "strongly disagree". The questions included in the questionnaire explored participant's views on various aspects of the MC they received including pain, ROM, discomfort, muscle tension and relaxation. With each question there was space for participants to write any additional comments they had in relation to the question.

Data analysis

Quantitative data were analyzed through the software package SPSS (version 24). Descriptive statistics were used to provide the minimum, maximum, mean, percentage change and standard deviation for the SLR, popliteal angle and peak torque scores at pre and post cupping intervention. A paired-samples t-test was carried out in SPSS to analyse the differences between pre and post scores as well as a 95% confidence interval for difference in population proportions. P-values that were $\leq .05$ were considered statistically significant. Questionnaire

data are presented as the percentage of responses for each question, with the qualitative data from the additional comments analysed using a content analysis approach.

Results

Twenty-one participants (male n=12, female n=9) aged between 19 and 31 years (mean of 25 ± 3.4) took part in the study.

ROM - Pre and post intervention results

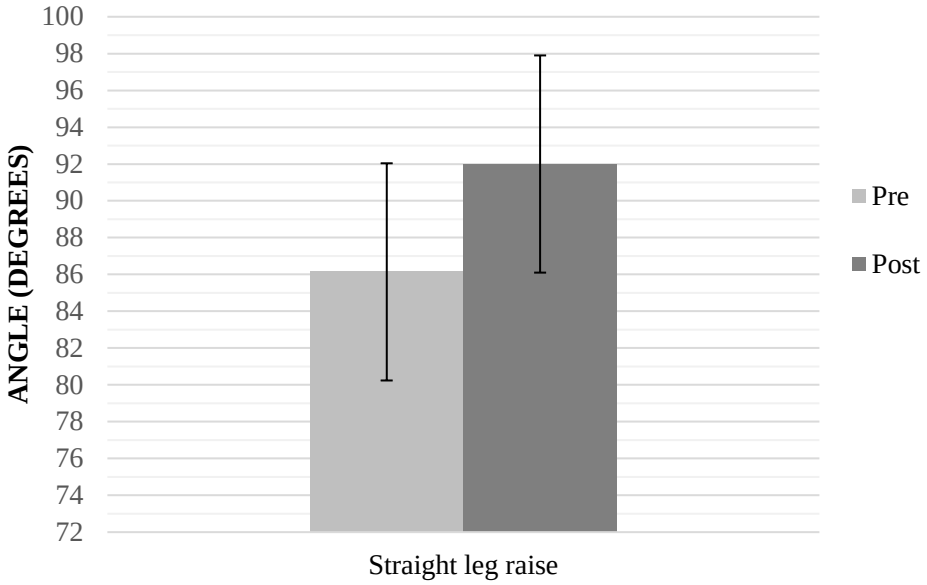

Figure 1.0 Bar chart representing pre and post-cupping mean scores with the 95% confidence interval for hip flexion angle in a SLR position.

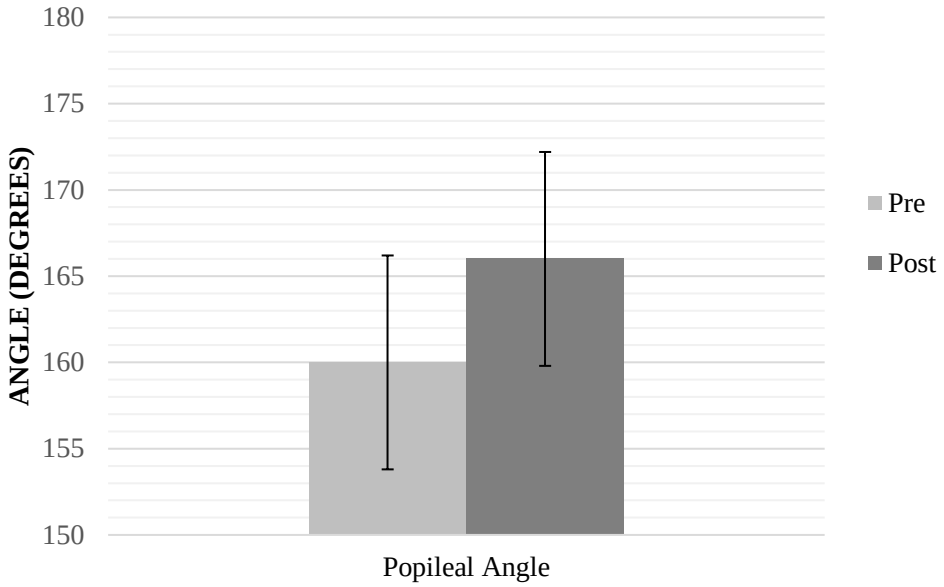

Figure 2.0 Bar chart representing pre and post-cupping mean scores with the 95% confidence interval for popliteal angle.

Figure 1 and Table 1 demonstrate the mean SLR measurement pre-cupping was 86° and the mean measurement post-cupping was 92°, showing an improvement of 7% (6°;p=.005). Figure 2 and Table 1 demonstrate the mean popliteal measurement pre-cupping was 160° and the mean measurement post-cupping was 166° an improvement of 4% (7°; p=.001).

Power - pre and post intervention results

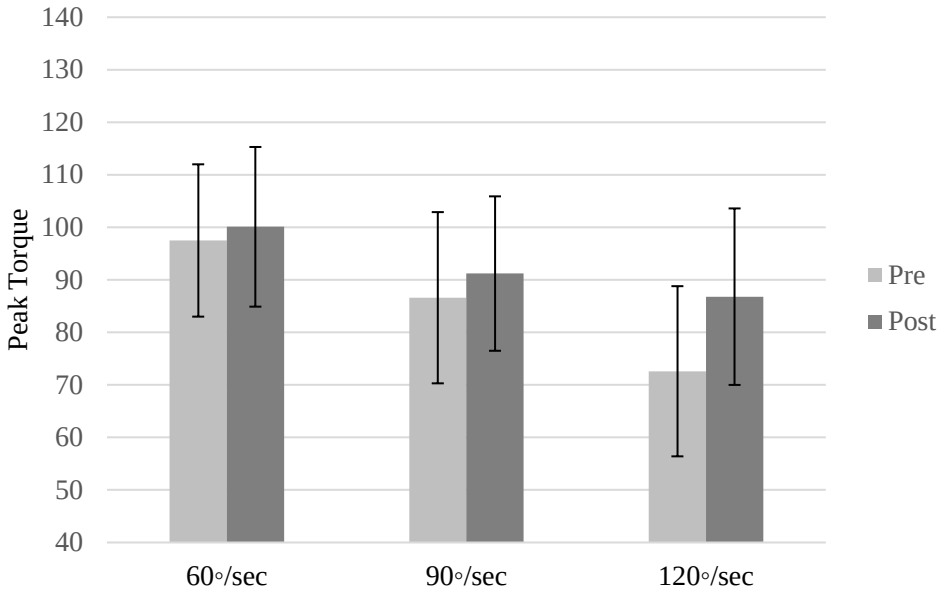

Figure 3.0 Bar chart representing mean scores with the 95% confidence interval for knee flexion peak torque at 60◦/sec, 90◦/sec and 120◦/sec pre and post-cupping.

Figure 3 and Table 1 demonstrate that the mean scores post-cupping for knee flexion peak torque at 60◦/sec, 90◦/sec and 120◦/sec all improved by 2.6° (3%), 4.7° (5%), and 4.2° (6%). However, although an improvement was seen at each velocity, there were no significant changes between pre and post scores (p=>.05).

Summary of quantitative findings

Table 1.0 Summary of pre and post cupping mean ± SD scores for all outcome measures including, differences, P values, changes (%) and 95% confidence intervals.

	Pre - cupping	**Post -cupping**	**Difference (°)**	**Changes (%)**	**P Value**	**95% Confidence Interval**	
						Lower	**Upper**
SLR angle (°) ± SD	86.1 ± 12.9	92 ± 12.4	5.9	7%	**.005**	-9.7	-2.0
Popliteal angle (°) ± SD	159.5 ± 13.6	166.4 ± 10.7	6.9	4%	**.001**	-10.5	-3.2
Peak Torque 60◦/sec	97.5 ± 31.17	100.1 ± 33.3	2.6	3%	.300	-7.3	2.4
Peak Torque 90◦/sec	86.6 ± 35.7	91.3 ± 32.1	4.7	5%	.099	-10.9	0.9
Peak Torque 120◦/sec	72.6 ± 35.6	86.8 ± 36.7	4.2	6%	.217	-11.0	2.7

Questionnaire findings

Figure 4 demonstrates that 86% (n=18) of participants agreed that their movement felt easier after receiving MC. 76% (n=16) of participants reported MC to be uncomfortable, however, the same percentage said they felt relaxed more so than they had pre cupping. All participants said they would receive cupping therapy again in the future and that the bruise like marks would not prevent them from receiving MC in the future. Eighty-six percent (n=18) of participants said they would recommended MC to friends and family. Finally, five themes emerged from the additional comments findings; 1) decreased muscular tension 2) a sense of relaxation following the cupping procedure 3) discomfort over ‘tight’ areas 4) easier movement/flexibility 5) a positive response towards cupping therapy.

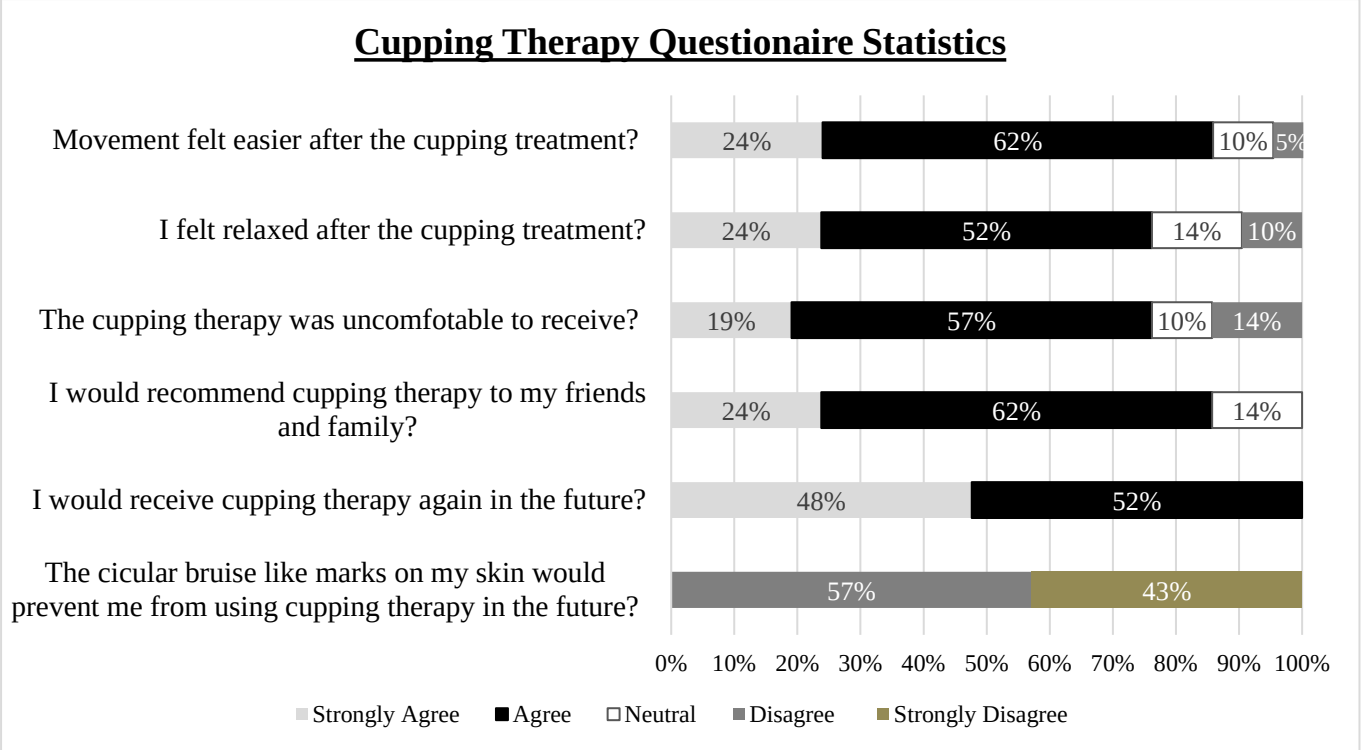

Figure 4.0 Stacked bar chart representing the frequency of responses for each question on the cupping therapy questionnaire.

Discussion

This was a preliminary study, which aimed to investigate the effects of MC on hip and knee ROM and knee flexion power as well as explore participants' perceptions and experiences. Taking into account the overlapping confidence intervals (suggesting that if the test were to be repeated on a larger sample the outcomes may be dissimilar) [29], statistically significant changes to ROM in SLR (7%, +6°, p=.005) and popliteal angle (4%, +7°, p=.001) were noted following 15 minutes of MC, however, there were no significant changes between pre and post scores on the power tests (p=.300, p=.099, p=.217). Data from the questionnaire suggest that despite cupping therapy being reported as 'uncomfortable' it is acceptable; 76% of participants reported cupping therapy to be uncomfortable, however, 100% of participants said that they would receive cupping again in the future.

In contrast, a study in 2018, [21] which had a similar sample size and demographic to our investigation, found that a 7-minute static cupping intervention demonstrated no significant difference in change in hamstring flexibility between participants in the treatment group and those in the control group (t23 = -.961, p = 35). The disparity between our findings and those of Williams et al. [21] could be due to cupping being administered for a longer period in this study, and that MC is different to SC. In addition, our results are comparable to studies undertaken on massage, [17,18] which have found significant increases in joint ROM following a single massage treatment when using similar sample sizes. Crossman et al. [17] found the mean difference in the massage group from pre-treatment to post-treatment for hip flexion, knee extension and SLR was +10.6°, +3.7° and +3.4° respectively, and another study [18] found a significant increase in flexibility tests records by 7.8 ± 6.3 and 7.9 ± 5.1 for Sit and Reach and Toe-Touch tests, respectively (p=<.05), post massage. These changes are comparable to our findings of 7% increase in SLR and a 4% increase in popliteal angle post cupping, and tentatively suggest that MC could have similar effects to massage on hip and knee ROM.

The results presented in Table 1 show that post-cupping scores for knee flexion peak torque at 60◦/sec, 90◦/sec and 120◦/sec improved compared to pre cupping, however, differences were not statistically significant. When compared to studies on the effects of massage on power performance, some have found no significant difference or a decrease in performance [14,18,30] while others have found an increase in performance [31,32]. When looking at the power scores and standard deviation values presented in Table 2, it is clear that there were only minimal increases in all measures after receiving the cupping therapy; resulting in no significant differences (p=>.05). Within sport and particularly elite sport however, these marginal increases could be the difference between winning a medal and being placed last. The

concept known as ‘marginal gains’ is an approach to performance improvement in elite sport [33]. The ethos of making aggregated small gains in many areas to improve overall performance has been said to lead to success [34]. Marginal gains can be thought of as sweating over seemingly insignificant detail [35]. British Cycling's performance director believed that if it is possible to make a 1% improvement in several areas, the cumulative gains could be significant [34]. With this in mind, although the increases in power performance in this study were not statistically significant, certain individuals may respond positively to MCT, and thus benefit their performance.

Five themes emerged from the additional comments finding; 1) decreased muscular tension 2) a sense of relaxation following the cupping procedure 3) discomfort over ‘tight’ areas 4) easier movement/flexibility 5) a positive response towards cupping therapy. The findings from the qualitative aspect of this study are congruent with previous studies [36,37] who suggested that cupping can enhance positive well-being, promote relaxation, and reduce stress perception among adults. This is also supported by research undertaken on the perceived benefits of massage, [38] which has indicated significant improvements in anxiety, depression, vitality, general health, positive well-being.

Limitations

A case series design can be prone to bias as it limits its generalizability to larger populations of patients [39], and our sample of 21 healthy participants aged between 19 and 31 may not be representative of athletes. However it is important to reiterate that this was a preliminary investigation, and therefore, given the current depth of literature on cupping, such a design was appropriate, as it can be helpful in refining new techniques or treatment protocols before they are studied in more advanced trials [40].

Moreover, only one session of MC was administered, and outcomes were only measured once, immediately, post intervention. This prevents us from making conclusions on its potential impact on athletic performance, and therefore future studies should look to explore longer term effects. Finally, the reliability of goniometry via SLR and popliteal angle, and the data collectors also being the analysers could have introduced bias, which may have inflated or supressed the observed changes.

Future research should take outcomes over a longer period, and include measures which focus upon athletic performance, as well as the effects of multiple cupping sessions. Follow up studies should also compare MC to a non-cupping group, for example against massage, stretching, or general exercises, in an adequately powered sample that is representative of an athletic population. There should be assessor blinding and ROM measures which have greater reliability, such as digital imaging [41], electric goniometry [42] or smart phone accelerometry [43].

Conclusion

Although various forms of therapeutic cupping have been performed for thousands of years, this was one of the first studies to investigate the effects of MC on ROM and power. The results from this study tentatively suggest that MC could be a beneficial therapeutic technique in increasing joint ROM and that despite it being uncomfortable it would be considered acceptable. However, given the limitations to this study, future robust studies such as Randomised Controlled Trials are warranted in order to establish whether these effects are observed in larger samples, if the benefits observed are comparable to another intervention, whether these changes to ROM persist, and if the application of MC improve athletic performance.

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