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EFFECT OF HOT WATER IMMERSION AND CONTRAST WATER THERAPY ON MARKERS OF EXERCISE INDUCED MUSCLE SORENESS AMONG UNIVERSITY FOOTBALL PLAYERS

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ABSTRACT

Delayed-onset muscular soreness (DOMS), the sensation of pain and stiffness in the muscles that occurs 1 to 5 days after unaccustomed exercise would have negative effect on muscular performance. It was suggested that hot water immersion (HWI) may help with faster strength recovery, but more research is needed to prove this. Similarly, contrast water therapy (CWT) have potential for improving performance recovery, but further investigation is necessary. The purpose of this study is to investigate the effects of HWI and CWT on muscle soreness in university football players after a match. This quasi-experimental study involved eleven (N=11) participants that were assigned to underwent HWI and CWT. The participants immersed their lower body for 20 minutes in hot water immersion (40-42°C) while for contrast water therapy, the participants were immersing their lower body in hot water (40-42°C) for 1 minute, followed by cold water (14-16°C) for 1 minute with total of 3 cycles. The participant's pain scale and ROM were recorded at four time periods which were immediately after match, 24 hours, 48 hours, and 72 hours after match. The effects in muscle soreness scores between the two groups were analyzed using repeated measure ANOVA. The results indicated that both CWT and HWI had a significant effect on pain scale (PS) and range of motion (ROM) between the four-time period ($p<0.05$). However, there is no significant difference in effect between HWI and CWT. Conclusions: In conclusion, HWI and CWT are effective to reduce muscle soreness among football players.

Keywords: Hot Water Immersion (HWI), Contrast Water Therapy (CWT), Pain Scale, ROM

INTRODUCTION

Intermittent sports exhibit diverse rules and regulations, yet they all follow a comparable pattern of play, involving intermittent high-intensity movements and the application of sport-specific skills throughout an extended duration (Baker, Rollo, Stein & Jeukendrup, 2015). However, engaging in high-intensity exercise and participating in the competitive season of intermittent sports like football can lead to musculoskeletal and metabolic issues, as well as result in delayed onset muscle soreness (DOMS) for the athlete. DOMS, characterized by feelings of pain and stiffness in the muscles, typically occurs 1 to 5 days after undertaking unaccustomed physical activity. This condition can adversely impact muscular performance due to reduced effort and the muscles' innate capacity to generate force (Armstrong, 1984). According to Nahon, Lopes and Neto, (2021) the meta-analysis findings on

interventions targeting pain linked with DOMS indicated that the strategies of contrast, cryotherapy, active exercises, and compression were statistically significantly more effective in enhancing outcomes compared to a lack of intervention. The popularity of using water immersion in a pool or water bath for recovery. It has been pointed out that there are four primary types of water immersion: cold immersion, hot immersion, alternating-temperature immersion also known as CWT. Wilcock, Chronin and Hing, (2006) found that water immersion may cause physiological alterations in the body, potentially enhancing exercise recovery.

The incorporation of recovery modalities into an athlete's training regimen is of utmost importance, as they are essential for optimizing performance and reducing the risk of injury (Miranda-Comas, Zaman, Ramin & Gluck, 2022). Various modalities, encompassing methods like active recovery, cryotherapy, massage, and foam rolling, aid in alleviating muscle soreness and fatigue, enhancing flexibility and range of motion, and promote faster recovery after rigorous training sessions or competitions (Van Hooren & Peake, 2018).

For centuries, heat therapy in the form of hot baths and saunas has been employed, with numerous accounts of improved quality of life and overall well-being (Beever, 2010). The method of HWI can be employed to speed up post-exercise recovery (Cochrane, 2004). HWI, a popular post-exercise recovery technique among high-performance athletes, involves immersing oneself in water above 35 degrees Celsius (Cochrane et al., 2004). CWT incorporates alternating between immersions in cold and hot water, which can help to reduce swelling by causing blood vessels to contract and expand alternately, a phenomenon referred to as the "pumping action" (Argus, Broatch, Petersen, Polman, Bishop & Halson, 2017). Due to the limited quality of the included studies, more rigorously designed research is essential to reach definitive conclusions regarding the efficacy of cold and heat therapies in treating delayed onset muscle soreness (Wang, Li, Zhang, Yan, Huang, Chen, Yang, Han, and Ma, 2022). Therefore, further research is needed to understand the effects of HWI and CWT can induce muscle soreness among football players.

METHODOLOGY

Sampling

Total of eleven (N=11) UiTM Negeri Sembilan's football players aged 18-25 years old were participated in this study. The convenience sampling technique was used, whereby the researcher recruited available and willing participants from the UiTM Negeri Sembilan football team. Informed consent was obtained from all participants prior to the commencement of the study with explanation on the study objective and potential benefits. All procedures were conducted in accordance with the Declaration of Helsinki and approved by the Institution's Ethics Committee.

Instrumentation

Pain Scale

The researcher measured the pain scale using the visual analogue scale (VAS). The VAS is a widely used and validated self-report measure of pain intensity that involves rating pain on a scale from 0 to 10, with 0 representing no pain and 10 representing the worst possible pain. The VAS was administered to the participants before and after the intervention. The participants will be asked to rate their pain intensity at rest and during movement on a scale from 0 to 10 (Delgado et al., 2018).

Range of Motion

The researcher used a goniometer, a device that measures joint angles. AROM will be measured by having the participants move their joint through a full range of motion using their own muscle power. PROM will be measured by having the researcher move the joint through a full range of motion while the participant remains passive. The researcher took measurements after match and as well as at 24, 48,

and 72 hours after treatment (Dos Santos, 2017).

Procedure

A football match which is typically 90 minutes will result in physiological changes in the body and can induce muscle soreness. Some of the physiological changes that occur include the depletion of muscle glycogen. As the match progresses, the body's stored energy in the form of muscle glycogen is gradually depleted (Hoff & Helgerud, 2004). This leads to a decrease in energy levels, which can cause muscle fatigue and soreness. The researcher considered controlling the same physical condition baseline before each intervention, which was that the participants regularly trained according to their team training schedule given by the coach. The participants were involved in light training 1 day before a football match. Next, the participants played 90 minutes of a competitive football match. Using a pain scale and knee range of motion, the researcher assessed the muscle soreness of the participants following the match. After assessing the markers of exercise-induced muscle soreness, they undertook two recovery techniques: HWI and CWT. The interventions were conducted on separate days, with 1 match per 1 intervention only. The participants undertook other interventions after the next match. The HWI intervention was conducted in a bathtub or pool filled with water at a temperature of 40-42°. The participants were instructed to immerse their entire body in the water for 20 minutes (Versey et al., 2013). The CWT intervention was conducted in a bathtub or pool with alternating hot and cold water. The participants were instructed to immerse their entire body in hot water (40-42°C) for 1 minute, followed by cold water (14-16°C) for 1 minute, for a total of 3 cycles (Ślaga et al., 2018). The researcher then assessed the pain scale and knee range of motion 24, 48, and 72 hours after the interventions (Delgado et al., 2018; Dos Santos et al., 2017). The researcher compared the results between the hot water immersion and contrast water therapy to understand the effectiveness of the two recovery techniques as recovery strategies for reducing muscle soreness.

Statistical Analysis

Descriptive analysis was used to contrast demographics features and the masticatory behavior of the participants. Differences between the mean scores of HWI and CWT were assessed using repeated measure ANOVA. Analysis of data was conducted using SPSS software (version 27), with statistical significance will be accepted at $p < 0.05$.

RESULTS

All the results presented that there was a significant effect of CWT and HWI for all the biomarkers which pain scale (PS) and range of motion (ROM) between the four-time period. Table 1 showed that the main effect of pain scale, AROM and PROM was significant which the value was 0.001. This proposes that there was a change in all the biomarkers between the treatments across the four time periods.

Table 1. Effect of CWT and HWI on Pain Scale (PS), Active Range of Motion (AROM), Passive Range of Motion (PROM)

Effect	Sig	Eta Square
PS	0.001	0.987
AROMR	0.001	0.973
AROML	0.001	0.978
PROMR	0.001	0.985
PROML	0.001	0.982

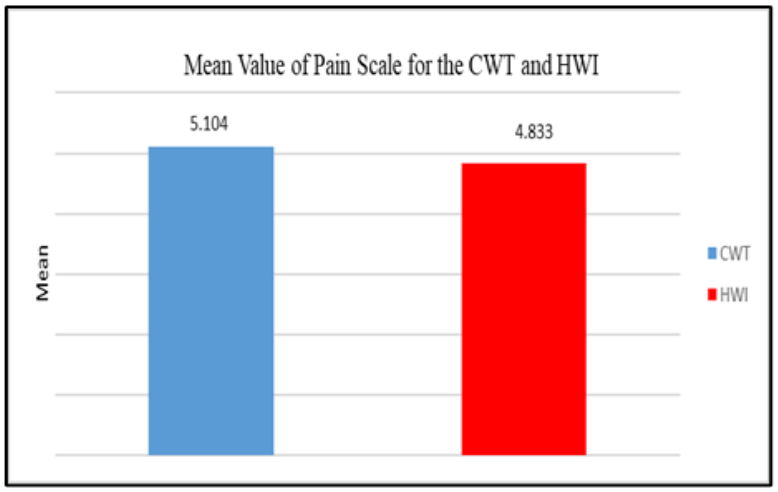

Figure 1. Mean Value of CWT and HWI on Pain Scale (PS)

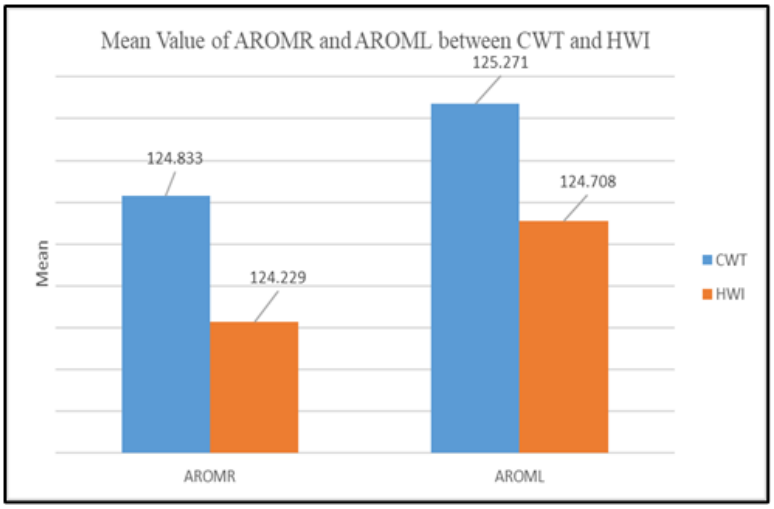

Figure 2. Mean Value of CWT and HWI on AROMR and AROML (degree^{o})

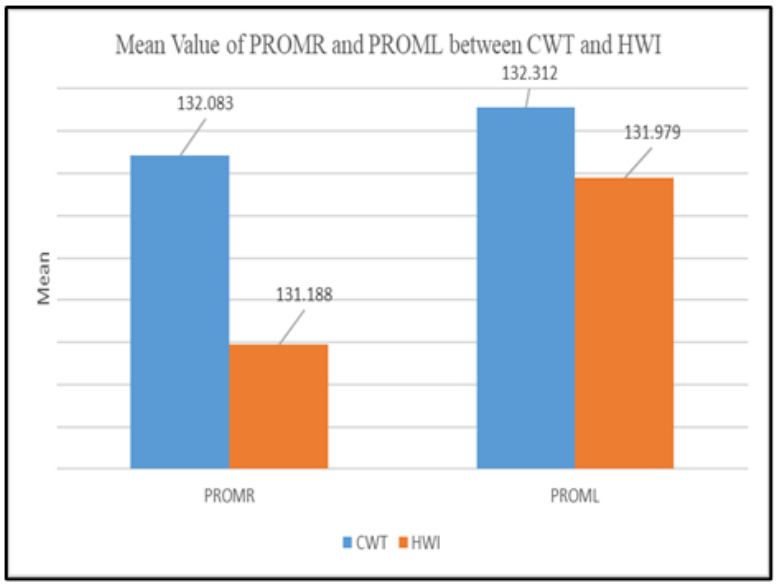

Figure 3. Mean Value of CWT and HWI on PROMR and PROML (degree^{o})

Figure 1 shows each treatment has changes which was a decrement for four-time period. From the mean (M) value, it showed that hot water immersion HWI group has the lowest value for PS which was 4.833 while CWT group has the value of 5.104 respectively. Figure 2 demonstrates each treatment has changes which was an increment of AROM for four -time period. From the mean (M) value, it showed that CWT group has slightly value for AROM which is 124.833o for AROMR and 125.271o for AROML compared to HWI has the value of 124.229o for AROMR and 124.708o for AROML. Figure 3 presents the mean value of PROMR and PROML between CWT and HWI. According to the data, it showed that CWT group has slight value for PROM which is 132.083o for PROMR and 132.312o for PROML compared to HWI has the value of 131.188o for PROMR and 131.979o for PROML. However, there were no significant differences for pain scale, AROM and PROM between HWI and CWT, $p > 0,05$.

DISCUSSION

The findings from the current investigation revealed a slight decrement in pain scale values across four time periods in both treatment groups, with the HWI group registering a marginally lower mean value (M = 4.833) compared to the CWT group (M = 5.104). These results could suggest a slightly better performance of HWI in alleviating perceived soreness, although not to a significant degree, showcasing that both treatments might be beneficial in managing pain symptoms to a similar extent. The findings of this current study are in line with what were found in previous study by Wilcock et al. (2006), Bender et al. (2005), Atkinson (2006), and Malanga et al. (2015), HWI offers a holistic approach to managing pain, promoting circulation, and accelerating tissue recovery. As further investigations reveal, the therapeutic potential of HWI is likely to gain even more prominence in clinical settings.

HWI can also be applied as recovery method for pain relief. According to Wilcock et al. (2006) found that HWI helps in decreasing the loss of muscle tissue temperature, stabilizing tissue temperature, promoting circulation and metabolism in the affected area, and reducing peripheral nerve excitability, thereby relieving patient pain. Furthermore, HWI has proven to be an efficient method for pain relief in certain situations.

In terms of AROM, both groups showed an increment over the specified time periods. It is important to note that the CWT group registered slightly higher values for both AROMR and AROML compared to the HWI group. This increment, though slight, might suggest a marginal benefit of CWT in enhancing active mobility post-treatment, a factor that might be attributed to the contrasting temperature exposures possibly facilitating better muscle recovery and flexibility. The impact of HWI on muscle contracture appeared to be minimal, and the facilitative aspect of recovery from muscle contracture in the combined therapy possibly originated from the influence of prolonged stretching (Vaile, Gill & Blazevich, 2007).

In addition, present findings gave an optional to the athletes to choose the methods during recovery session either HWI or CWT. The overlapping effectiveness of the two treatment modalities hints at the potential for individualized treatment plans, where the choice between HWI and CWT could be based on individual preferences or specific situational contexts, thereby offering a flexible approach to managing muscle soreness post-physical exertion. It can be concluded that the effectiveness of CWT and HWI in pain reduction varies depending on the application method compared to the traditional immersion contrast bath technique (Elias, Wyckelsma, Varley, McKenna and Aughey, 2013)

Moreover, while both hot water immersion and contrast water therapy exhibited beneficial effects in reducing muscle soreness and enhancing range of motion, neither treatment showcased a significant advantage over the other. Future studies could potentially explore larger sample sizes, extended treatment durations, or integration with other therapeutic modalities to further clarify the distinct benefits and potential interactions of these treatment approaches for muscle recovery.

CONCLUSION

In conclusion, this study suggests that both HWI and CWT are suitable to be used as recovery method that players can apply to reduce muscle soreness. The choice of suitable treatment during recovery help the coaches, therapies and player select a suitable recovery method for their athletes' training regimen. This insight is valuable for coaches to train their athletes more effectively because the optimal treatment will be applied to them and coaches will not face any issues relating to injury and rehabilitation for the athletes to return to training and competition with optimize performance.

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