RESEARCH COMMUNICATION

Comparative study of cold compress and liniment treatment as an adjunct to massage therapy for exercise-associated muscle cramps (EAMC) among young athletes in the Philippine setting

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ABSTRACT

Exercise-associated muscle cramps (EAMC) is prevalent among athletes during training or competitions where they are subjected to strenuous activities for a prolonged period. To manage this painful condition, health practitioners have used numerous treatment modalities having massage done with adjunct application such as cold compress or liniment. Studies show that it is debatable which combination of treatment modalities is more effective on people affected by EAMC. Hence, this study aimed to present evidence-based data to show if there is a difference in the effectiviteness of the two modalities in treating EAMC. A total of thirty-two (32) athletic participants were enrolled in this study and a total of 40 treatment trials were included in the analysis of data. Each participant performed strenuous exercises meant to induce muscle cramps. The onset of muscle cramps was identified using a set criteria. After which, treatment was applied and the length of time that the cramp was resolved was recorded. Determining relief from muscle cramps was based on the characteristic of muscle hardness and the level of pain by using a numerical rating scale. Results showed that though majority of the participants verbalized preference for the ice treatment, analysis of data using one-way ANOVA revealed that there is no evidence to prove that there is a difference in the effectivity among the treatment modalities performed. In conclusion, though all modalities performed were able to relieve the EAMC, the use of adjunct treatment in addition to massage and stretching may have a placebo effect component, which improves the patient's perception of greater efficacy.

Keywords: *exercise, cramps, cold compress, liniment, massage, physiology*

Introduction

Background of the Study

More Filipinos are now trying to follow healthy living by increasing physical activity through engaging in sports. Some pursue a more serious dedication in integrating sports as part of their daily life, while others join weekend sporting events as part of their social outlet.

In general, exercise helps in improving and maintaining one's physical fitness [1]. It is beneficial not only to the musculoskeletal system but also has a positive effect on adipose tissue mobilization, level of high-density lipoprotein cholesterol (HDL-C), and psychosocial response to stressors [2,3].

However, one complication of exercise is muscle cramping. Exercise-associated muscle cramps (EAMC) are reported to be more frequent in long-duration and high-intensity events due to physiological response of the skeletal muscle [4,5,6]. Even elite athletes sometimes succumb to debilitating cramping episodes and they compete with concern, knowing that these painful, involuntary muscle contractions can appear without warning or apparent cause [7,8,9,10]. EAMC has been reported to occur frequently among triathletes, marathon runners, rugby players, and cyclists among others [4,11].

EAMC can last from a few seconds to minutes, even hours [12]. The resulting pain can be immobilizing to the affected area. Depletion of oxygen in fatigued muscle can lead to cramps due to lack of adenosine triphosphate (ATP), shifting the fuel source from glycolysis to fermentation which leads to lactic acidosis [13].

Theories regarding EAMC include altered neuromuscular control due to increase excitation and decreased inhibition of motor neurons during fatigue and hyperexcitability of motor neuron axon terminal induced by mechanical deformation [14]. Furthermore, the hydration status and electrolyte levels contribute to developing EAMC [14,15].

There is a variety of treatments and prevention strategies used for EAMC with varying outcomes. The most basic treatment is stretching of affected muscle through massage [16]. Sporting events participants who pay for their entry fee often request for adjunct treatment in addition to massage and stretching to relieve EAMC. A long history of folk remedies with anecdotal promotion from athletes contributes to the belief of these remedies' efficacy which may provide a placebo effect [11]. For the event organizer, this is an additional operational cost that can become significant if you have more than 10,000 weekend fun run participants requesting for the adjunct treatment.

Cold compress application has been used even by our ancestors for alleviating inflammation, pain, and muscle spasm among others [17,18,19,20,21]. It lowers tissue temperature causing vasoconstriction which aids in flushing out waste products and also reducing metabolism demand in the affected area [22,23,24]. Based on several studies, cold compress application reduces inflammation, edema, and pain sensation which is said to shorten recovery from the symptoms of cramps [25,26,27].

Another popular adjunct treatment is the use of oil-based liniment which stems from the popularity of alternative medicine that is deemed natural and non-invasive. Essential oils are a mixture of different types of chemicals that provide a characteristic pleasant odor [28]. Once applied, it is absorbed into the deeper layers of the skin where it helps relieve pain and swelling. It is usually prescribed for muscle pain, sprain, and strains [28,29].

Problem Statement

To alleviate the symptoms of EAMC, experts have often used two treatment options: cold compress and topical application of liniment in combination with massage therapy. However, there is no sufficient data to prove which one is better [9]. Furthermore, this study sought to examine if there is a significant advantage in using adjunct treatments in addition to massage and stretching.

Objectives

The study aimed to evaluate two of the most commonly used adjunct treatments for exercise-associated muscle cramps (EAMC): cold compress and liniment treatment. Using numerical pain scale and length of time to recovery from EAMC as indicators, the study intended to present evidence of a significant difference in the effectivity of the two modalities in treating EAMC and compare them with the efficacy of treatment using massage and stretching alone.

Significance of the Study

The study would benefit both leisure and seasoned athletes who are susceptible to EAMC as they push themselves to the limit while engaging in high-intensity physical activity. This study can also be used by health practitioners in explaining to their patients the rationale of their choice of treatment in alleviating EAMC.

Scope and Delimitation

The study excluded individuals who are not engaged in regular aerobic exercises for at least six hours a week. Subjects who have neurological impairment, cardiovascular impairment, or any injuries of the musculoskeletal system three months prior to the trials were excluded.

Methodology

Ethics Statement

The study was performed in accordance with the Declaration of Helsinki and the De La Salle University Code of Research Ethics. All the participants and the parents or guardians of under-aged participants signed a written informed consent prior to enrollment in the study.

Participants

Thirty-two (32) senior high school student-athletes between 17-19 years old were enrolled in the study. The participants are active members of either the school varsity teams or amateur sports clubs.

All the participants in the study were found to be healthy based on medical history and physical examination by a licensed physician. The vital signs of the subjects were monitored during the experiment to ensure their safety and well-being [30].

Procedure

Due to the limited number of participants, each participant was subjected to at least two treatment trials done on separate occasions. The subjects were randomly assigned to treatments of either (1) cold compress with massage, (2) topical application of liniment with massage, or (3) manual massage alone.

The experiment proper was conducted in the indoor gym of the Enrique M. Razon Sports Center of De La Salle University - Manila. The trials were conducted between 4 pm to 6 pm from November to February. In all trial sessions, the weather was dry and sunny.

Each research team member was trained by a licensed physical therapist on how to implement the muscle cramp induction protocol, assess muscle stiffness due to cramps, and use the pain scale for the assessment of the severity of pain due to muscle cramps. Furthermore, the research team members were trained by the research physician on how to take blood pressure using an Omron digital sphygmomanometer, and how to use a digital finger pulse oximeter.

Subjects were asked to perform repetitive exercises to induce cramps according to the prescribed protocol [15]. These repetitive exercises include two rounds of tiptoe sprints, twenty calf raises per foot, and 20 front-to-back jumps, with repetition of sets as needed. The criteria for determining cramps include the subject's perception of acute pain, stiffness of the muscle area, and physical bulging or knotting of the muscle [31]. The subjects were not allowed to drink water or electrolyte beverages during muscle cramp induction protocol and treatment application phase.

Upon the onset of cramping, the subject's vital signs were monitored again and the subject communicated the level of pain using a Numerical Rating Pain Scale from 0 to 10, with "10" defined as sharp, intense, and immobilizing pain, "2" being dull tolerable pain, and "0" as having no pain at all [32]. In case of malignant increase in blood pressure (systolic blood pressure greater than 180mmHg or diastolic blood pressure greater than 110mmg) or sign of arrhythmia, the experiment would have been terminated immediately [30].

Fortunately, no untoward events occurred. The subjects were then given their assigned treatment as previously mentioned until the pain perception subsided down to an estimated pain scale of 2 or less, in addition to the palpated muscle hardness. The time duration from onset of cramps up to muscle recovery was recorded.

Despite the availability of a variety of pain scale assessment tools, a review of research studies and articles shows that a numerical rate scale is the best tool to evaluate pain among adult patients with no cognitive impairment [33].

Research Design

This research is an experimental study that used a randomized controlled trial. Participants were randomly assigned to either of the two intervention groups or the positive control group. The randomization of the assignment was performed by drawing lots. The use of massage alone as treatment served as the positive control.

Data Analysis Strategy

The data collected from the interventions were analyzed using one-way analysis of variance (ANOVA) to show if there is a significant difference in the length of time to recover from the symptoms of exercise-associated muscle cramps (EAMC).

Results

Among the 32 participants enrolled in the study, there were 21 male and 11 female subjects, majority of them being 18 years old (Figure 1). Due to the voluntary nature of participation, there were more male subjects recruited in the study than females.

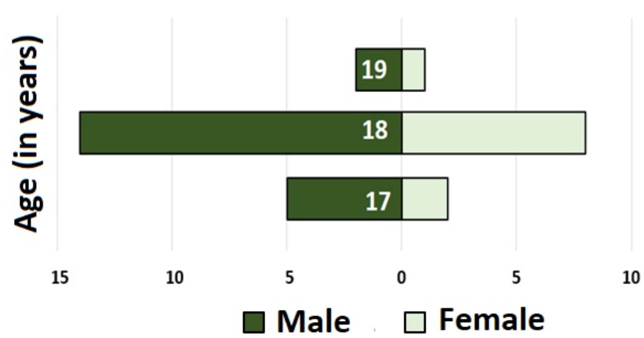

Figure 1. *Demographic distribution of participants according to age and sex.*

Each subject is actively engaged in at least one sport for a minimum of one year. Most of the participants have been engaged in their primary choice of sports for at least five years. Swimming (19.05%) was the most common sport, followed by basketball (16.7%), football (16.7%), badminton (14.3%), and martial arts (7.1%) among others. (Figure 2)

Under the supervision of the research physician, the research team member monitored the vital signs of the participants before exercise and right after the onset of cramps. Participants medically cleared to proceed with the experiment had a mean heart rate of 84.85 ± 14.7 beats per minute, and a mean systolic and diastolic blood pressure of 114.38 ± 11.6 mmHg and 70.68 ± 12.0 mmHg, respectively (Table 1). There was a physiologic increase in the blood pressure right after terminating intense exercise in all participants after achieving EAMC, followed by quick recovery of vital signs after few minutes of rest [30].

Originally, a total of 51 participants out of 88 invited individuals voluntarily showed up for the experiment. Two (2) participants were eliminated due to high blood pressure or pulse rate even before the start of trial while one (1) participant decided to quit in the middle of the experiment. Eight (8) participants failed to induce muscle cramps; hence, they were not able to undergo treatment. Excluding the eliminated participants, the success rate of inducing EAMC among the participants was 83.3%.

Out of the 40 successful inductions of EAMC, 13 participants were treated using cold compress with massage, 14 participants were treated using massage with liniment application, and 13 participants were treated with massage only.

The average length of time it took to muscle recovery was noted to be 93.85 ±42.92 for cold compress with massage, 146.92 ±116.96 for liniment with massage, and

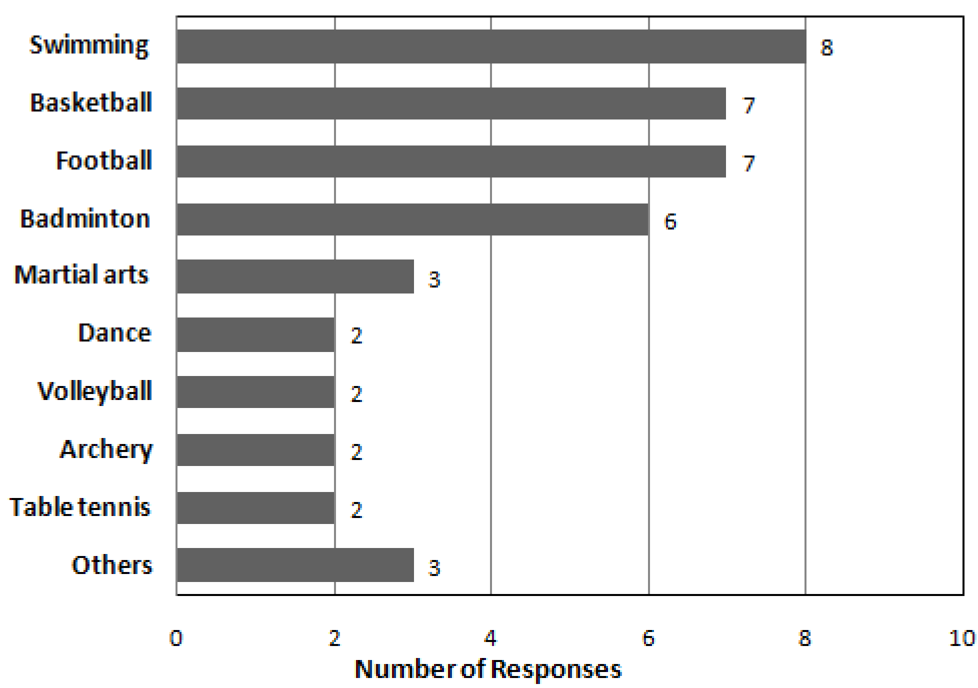

Figure 2. *Multiple response frequency distribution of the sports involvement of the participants (n=42)*

Table 1. *Average heart rate and blood pressure of the participants before exercise and immediately after terminating exercise upon onset of exercise-associated muscle cramps. (n=40)*

Vital Signs	Before Exercise	After Exercise
Mean Heart Rate (beats per minute)	84.85 ±14.7	107.98 ± 16.2
Mean Systolic Blood Pressure (mmHg)	114.38 ± 11.6	121.33 ± 11.8
Mean Diastolic Blood Pressure (mmHg)	70.68 ± 12.0	71.60 ± 11.8

96.0 ±76.96 for massage only (Figure 3). When compared using the one-way analysis of variance (ANOVA) with a confidence level of 95%, the result showed a p-value of 0.23 (Table 2). Hence, there is no enough evidence of a significant difference in the effectiviteness of the three treatment modalities.

Discussion

Despite the lack of statistical significance, the use of cold compress or liniment together with massage was perceived by the subjects as both effective treatments. The soothing effect and ability to alleviate the symptoms of exercise-associated muscle cramps are congruent with previous studies reviewed [18,19,20,21,28,29].

Both treatment adjuncts have been employed for generations passed on from our forefathers. The perceptions of enhanced efficacy may be partly attributed to the placebo effect. The placebo effect occurs when a fictitious medical mediation causes improvement in a patient's condition because of the factors associated with the patient's perception of the intervention. However, the

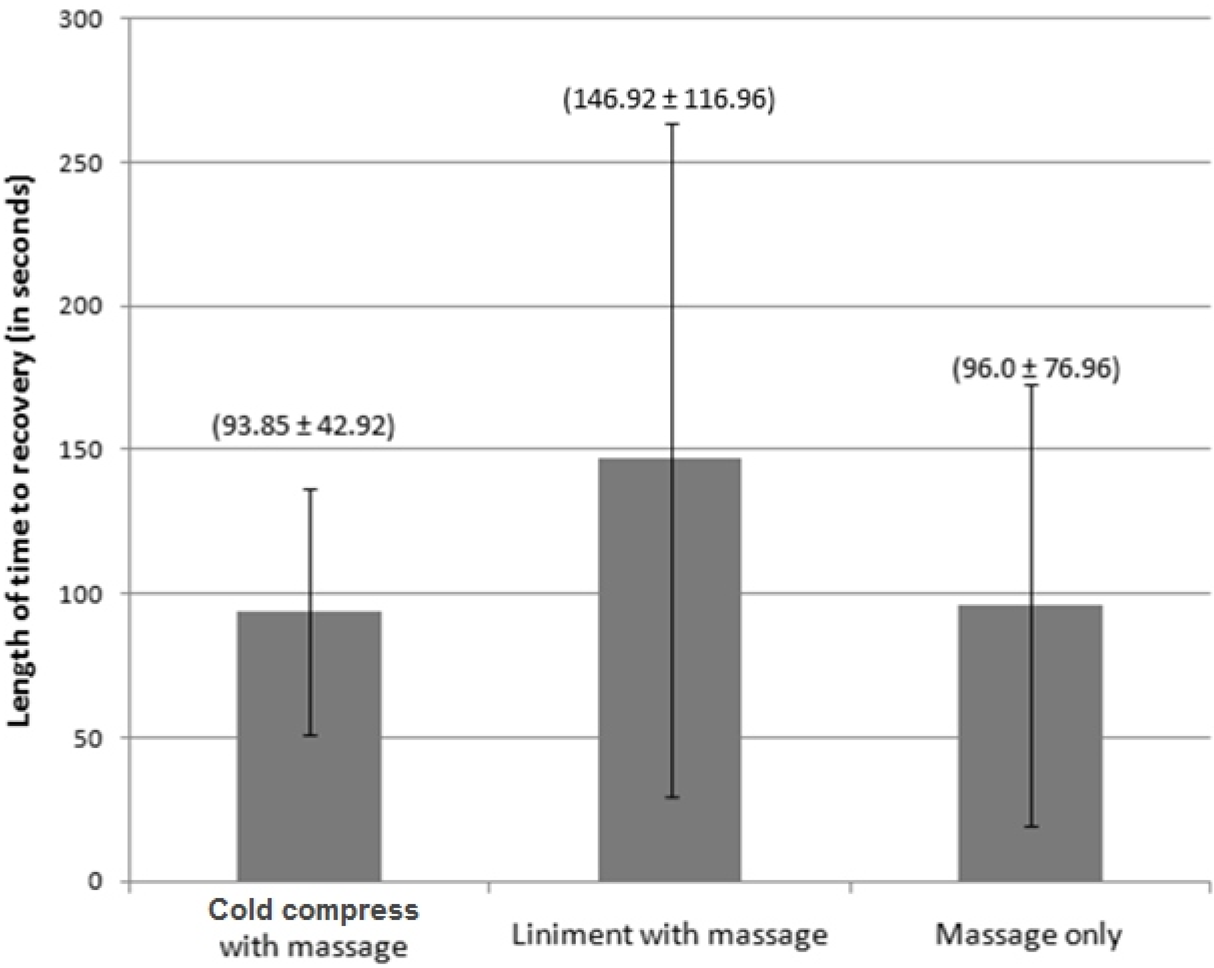

Figure 3. *Average length of time to recover from exercise-induced muscle cramping among the three implemented treatment modalities.*

Table 2. *Comparison of the average length of time to recover from exercise-induced muscle cramping among the three implemented treatment modalities using one-way analysis of variance (ANOVA) (p <0.05)*

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups Within Groups	18877.2596 226262.115	2 37	9438.6298 6115.1923	1.5434	0.2271	3.2519
Total	**245139.375**	**39**				

placebo effects are not limited to such interventions for even treatments that have been proven their effectivity may also bring about a placebo effect [34,35,36].

Conclusion

The lack of a statistically significant difference between the lengths of time to achieve relief from the symptoms of exercise-associated muscle cramps using the three modalities in the experiment indicates that choosing one treatment over another will not significantly alter the result. In the end, all the subjects were able to find relief of their cramps and that the duration of achieving this relief is not significant; therefore, the modalities are equally effective in relieving exercise-associated muscle cramps. The use of adjunct treatment in addition to massage and stretching may have a placebo effect component which improves the patient's perception of greater efficacy.

Recommendation

For future studies, it is recommended to enroll a larger number of subjects and perform more trials per treatment to improve the validity of results. The authors also recommend using a cramp-inducing protocol by using equipment such as the electronic muscle stimulator to increase the success of inducing EAMC [37]. A data acquisition device is also recommended to have a precise determination of induction of muscle tetany and its recovery [38].

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