Muscle soreness is a recurrent complication among athletes of all activity levels. This issue can lead to reduced performance and lack of success on the field. One of the most common interventions used by clinicians to address this dilemma includes compression devices. The effects of compression devices on muscle soreness are currently unknown.

The purpose of this research was to critically appraise the literature to determine the effects of compression garments on muscle soreness.

**METHODS**

**Search Strategy:**
- Terms Used to Guide Search Strategy (PICO)
  - Patient: Athlete OR Adult
  - Intervention: Compression Garment OR Clothing
  - Comparison: No intervention
  - Outcomes: Muscle Soreness

**Compression Garment AND (Creatine Kinase AND Muscle Soreness)**

**RESULTS**

The purpose of this research was to critically appraise the literature to determine the effects of compression garments on muscle soreness.

**CONCLUSIONS**

Future research should explore the amount of pressure that compression garments create on the designated treatment area. Hill et al. noted that compression garments may not create enough pressure to enhance recovery at the cellular level. Another aspect that could be further researched is the idea of finding pain control. This idea may affect the athlete upon utilization of compression garments. Research revealed that compression garments do not significantly impact biomarkers of muscle soreness. Although a reduction in perceived pain may result in improved athletic performance, more research is necessary to address muscle soreness at the cellular level.

**REFERENCES**


**Table 1 - Characteristics of Included Studies**

<table>
<thead>
<tr>
<th>Study</th>
<th>Participants</th>
<th>Interventions Investigated</th>
<th>Outcomes Measured</th>
<th>Main Findings</th>
<th>Level of Evidence: Validity Score</th>
<th>Conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duffield R et al. (2012)</td>
<td>11 rugby players with a mean ± SD: age 20.9 ± 2.7 years, height 176.3 ± 5.8 cm and weight 75.4 ± 6.3 kg</td>
<td>Testing session with and without lower body CG during and after 24-h post exercise. Participants performed a warm-up of 5 min. Blood was drawn to measure creatine kinase (CK) pre-, 2h and 24-h post exercise. Participants performed a 20-m sprint.</td>
<td>Peak twitch force of quadriceps, hamstrings, and knee extensors. CK values and perceived muscle soreness.</td>
<td>A moderate ES (P = 0.08; d = 0.62) was evident for reduced muscle soreness 2h post-exercise (95% CI 6.1 to 13.71) and low 24h post-exercise (2.81 ± 0.3 to 4.9 ± 1; P = 0.01; d = 1.1). No significant differences in C-reactive protein (CRP) or CK (P &gt; 0.05).</td>
<td>Quality of evidence: 4/10</td>
<td>Wearing a CG was associated with better repeated sprint and endurance performance. These results confirm the beneficial effect of wearing CGs during recovery and wearing such garments may be effective.</td>
</tr>
<tr>
<td>Hill JA et al. (2012)</td>
<td>21 trained male rugby union players (mean ± SD: age 20.1 ± 2.1 years, body mass 84.6 ± 8.8 kg). Every participant had at least 5 years training experience and same levels of fitness.</td>
<td>Full leg-length CG was utilised. Each participant completed a series of exercise circuits simulating a game of rugby followed 24 hours later by a 40-m repeated sprint test (10 sprints at 10-s intervals between them) and a 3-km run.</td>
<td>Perceived soreness measured 0-5, fatigue levels, and CK activity determined throughout the study.</td>
<td>No significant changes (p=0.05 and small ES) in CGs for 10m and 20m sprints. There was no significant difference utilising one garment over another. Control group had a higher rating of muscle soreness in arms and legs (p=0.05 and large ES). CK levels were lower in the experimental groups 24h after exercise than the control group.</td>
<td>Quality of evidence: 4/10</td>
<td>Wearing a CG was associated with better repeated sprint and endurance performance. These results confirm the beneficial effect of wearing CGs during recovery and wearing such garments may be effective.</td>
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</tbody>
</table>

**Figure 1:** Lower Extremity Compression Garment

**For an abstract of this poster, please visit duq.edu/athletetraining**
The effects of high-intensity warmups on athletes with diagnosed exercise-induced asthma: a critically appraised topic

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Exercise Induced Asthma (EIA) is prevalent throughout all levels of sports and if not properly identified can be fatal. There is no standard protocol for preventative warmups for athletes with EIA. Proper warmups can help to reduce the incidence of an exercised induced bronchospasm (EIB). Current position statements for preventative warmups in athletes with EIA espouse a slow, progression of activity to optimize preventative benefits. However, consensus in the literature upon which level of warmup intensity is the most effective in preventing an EIB remains elusive.

PURPOSE

The purpose of this critically appraised topic (CAT) was to determine if performing high intensity interval warmups versus continuous moderate intensity warmups before activity reduce the incidence rate and severity of an asthma attack in athletes.

METHODS

Search Strategy: Terms Used in Search Strategy (PICO)

- Patient: athletes with exercise induced asthma
- Intervention: warm up OR preparation
- Comparison: none
- Outcomes: reduce chance of EIB during activity

(Athletes) AND (EIA OR exercised induced asthma) AND (warm up OR preparation) AND (reduce OR decrease)

Sources of Evidence Searched:

- PubMed @ Duquesne
- CINAHL
- ProQuest
- Hand Search through previously reviewed literature for topic at question

Inclusion and Exclusion Criteria: Studies that were included examined differences in warm up procedure with athletes with EIA, were of a level 2 evidence or higher, of the English language, and limited to humans. Articles excluded were those that focused on pharmacological differences in EIA prevention.

RESULTS

Four relevant studies1-5 were located and one study was found but not included because it focused on the pharmacological differences in EIB prevention. The following studies were identified as the “best” evidence and selected for inclusion in the CAT (Table 1). The reasons for selecting these studies were based on the level 2 evidence or higher, of the English language, and limited to humans. Articles excluded were those that focused on pharmacological differences in EIA prevention.

DISCUSSION AND CONCLUSIONS

Our purpose for this critically appraised topic was to determine a proper procedure for athletes with EIA. We believed that a high intensity warmup would be most effective at reducing incidence and severity of an EIB. All four of our studies showed a decrease in the incidence rate and severity of EIB in athletes with EIA. De Bishop et al showed that participants who completed a long run and experienced a decrease in breathing capacity were more likely to experience a bronchoconstriction versus participants that completed an interval warmup. McKenzie et al showed that those who performed a high-intensity interval warmup experienced a period of bronchodilation thus reducing the chance of experiencing EIB. Mickleborough et al determined that high-intensity interval warmups improve pulmonary function to decrease the stress on the athlete’s lungs from exercise. Schnall et al concluded that short runs caused bronchodilation to aid in prevention of an EIB and further stressed the importance of a warmup protocol for athletics.

In athletics, EIA is generally ignored unless the athlete experiences an asthma attack. Instead of being proactive, athletic trainers and coaches instead deal with EIB. Instead of preparing athletes for activities that can decrease the chance of experiencing EIB. The National Athletic Trainers Society suggests the use of a warmup procedure to reduce the incidence of EIB without further explanation on the type of warmup to use.

Also, the article explains in detail the procedure for how to train an athlete experiencing an EIB but does not go into detail on how to prevent these EIBs from occurring.1 This reflects the general attitude toward athletes with EIA such that they are often overlooked until it becomes an emergency situation. Athletic trainers need to educate themselves on the proper procedures for aiding in the prevention of EIB. Another problem that is the line of communication between coaching staff and medical staff has not been opened in order to create an understanding for the importance of a proper warmup technique for athletes with EIA. Therefore, clinicians need to relay this information to the coaches because the warmup procedures are generally the responsibility of the coaches. Current and common warmup procedures consist of moderate intensity for extended periods of time. As found in the studies, this type of warmup is not effective in preventing EIB.

We believe that a high-intensity warmup is needed to aid in prevention of an EIB. To summarize the type of high-intensity warmups used, we suggest completing five to ten 30-second sprints with one to two minutes rest in between sprints, depending on how the athletes respond. The athletes can complete one or two sets with a recommended 5-minute break in between sets. If coaches prefer athletes to participate in a group warmup, the asthmatic athlete should complete this high intensity warmup prior to the group warmup. It is imperative to athletic trainers in preventing the occurrence of EIB and one way to accomplish this is to complete this type of high-intensity warmup regardless of activity the athlete will engage in.

REFERENCES


Table 1 - Characteristics of Included Studies

<table>
<thead>
<tr>
<th>Participants</th>
<th>Method</th>
<th>Patients</th>
<th>Intervention</th>
<th>Outcomes</th>
<th>Measures</th>
<th>Conclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>All four studies</td>
<td>Prospective Cohort</td>
<td>60</td>
<td>warm up</td>
<td>time and distance of a 7-minute run and the peak flow and blood lactate concentrations.</td>
<td>Peak expiratory flow rate (PEFR), forced vital capacity (FVC), forced expiratory flow in one second (FEF25-75%), forced expiratory flow in one second divided by forced vital capacity (FEF25-75%/FVC), and peak expiratory flow and peak expiratory flow divided by forced vital capacity (PEP/FVC) and forced expiratory flow between 25 and 75% of vital capacity (FEF25-75%).</td>
<td>The small falled 1 was seen following the series of short sprints, with a larger falled 2 after the six-minute exercise run with no warm up in tests 1 and 2. Test 3 showed the smallest decrease in post-exercise FEV1 when compared to the participants exercising with no warm up in tests 1 and 2. In test 2, performing the short sprints following a 6-minute run showed a non-increase in PEFR with each successive sprint performed. The outcome measures looked at were FEV1, heart rate, expired ventilation, oxygen uptake and carbon dioxide output. There was a clear mean maximum percentage difference in pre-exercise FEV1 experienced with the control group compared to the high-intensity interval group. There was a clear mean difference between the groups that used the inhaler post-powash vs the group that used the inhaler without post-powash. The severity of EIB was significantly less following the warm up compared to the control. Severity was much greater following the warm up and inhaler use compared to just inhaler use.</td>
</tr>
<tr>
<td>All four studies</td>
<td>Randomized Controlled Trial</td>
<td>32</td>
<td>warm up</td>
<td>time and distance of a 7-minute run and the peak flow and blood lactate concentrations.</td>
<td>Peak expiratory flow rate (PEFR), forced vital capacity (FVC), forced expiratory flow in one second (FEF25-75%), forced expiratory flow in one second divided by forced vital capacity (FEF25-75%/FVC), and peak expiratory flow and peak expiratory flow divided by forced vital capacity (PEP/FVC) and forced expiratory flow between 25 and 75% of vital capacity (FEF25-75%).</td>
<td>The small falled 1 was seen following the series of short sprints, with a larger falled 2 after the six-minute exercise run with no warm up in tests 1 and 2. Test 3 showed the smallest decrease in post-exercise FEV1 when compared to the participants exercising with no warm up in tests 1 and 2. In test 2, performing the short sprints following a 6-minute run showed a non-increase in PEFR with each successive sprint performed. The outcome measures looked at were FEV1, heart rate, expired ventilation, oxygen uptake and carbon dioxide output. There was a clear mean maximum percentage difference in pre-exercise FEV1 experienced with the control group compared to the high-intensity interval group. There was a clear mean difference between the groups that used the inhaler post-powash vs the group that used the inhaler without post-powash. The severity of EIB was significantly less following the warm up compared to the control. Severity was much greater following the warm up and inhaler use compared to just inhaler use.</td>
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</table>

This study demonstrates that repeated short sprints minimize the bronchoconstrictive effect of subsequent warm exercise stress and have a bronchodilation effect on previous EIB. These observations suggest that an exercise program could be devised for asthma which will enable increased physical activity with less risk of bronchoconstriction.
INTRODUCTION

- Exercise Associate Muscle Cramps (EAMC) can be defined as a painful involuntary contraction of skeletal muscle that occurs during or immediately after exercise.
- EAMC is a common problem in active individuals. As clinicians, it is our responsibility to prevent EAMCs from occurring.
- A variety of techniques have been used to prevent EAMC before, during, and after exercise.
- Of these interventions, hydration is a popular strategy in alleviating EAMC.

CLINICAL QUESTION

What is the role of serum-electrolyte levels on exercise associated muscle cramps?

METHODS

Search Strategy:
- Patient/ Client Group: athletes OR active individual
- Intervention: Serum Electrolyte
- Comparison: no intervention AND control
- Outcome: exercise associated muscular cramps AND prevention

Sources of Evidence Searched:
- PubMed @ Duquesne
- CINAHL
- Cochrane Library
- PEDro Database
- Additional resources obtained via review of reference lists and hand search

Inclusion and Exclusion Criteria:
- Inclusion criteria included level of evidence 2 or higher, limited to endurance athletes in English language articles published.
- Exclusion criteria included active individuals not participating in endurance events, examination of hydration status without quantification of serum electrolyte levels or use of a control group.

RESULTS

Three studies were located and categorized as shown in Table 1 based on Levels of Evidence, Centre for Evidence Based Medicine. Additional studies were located but not included in this CAT because they failed to meet the inclusion criteria of our search.

DISCUSSION AND CONCLUSIONS

It is a popular belief that EAMC are related to dehydration or changes in hydration level. Therefore, a popular treatment for EAMC is adequate hydration and replenishing serum electrolyte levels. The purpose of this CAT was to determine if EAMC are related to hydration levels or change in serum electrolyte levels.

All three studies reviewed in this CAT2,3 indicated that there is very limited evidence to support the use of hydration to alleviate lower extremity EAMC in active individuals. Two of the three studies2,3 observed EAMC in triathlons while the remaining study1 observed EAMC in an ultra-distance road race.

Three studies assessed in this CAT measured pre- and post-race weights, serum electrolyte levels and severity of the cramps. The data collected showed no significant clinical changes in participant weight nor serum electrolyte levels. These findings suggest that EAMC are not affected by hydration levels or serum electrolyte imbalances. The use of electrolyte in rehydrating beverages does not result in decrease incidence of EAMC.

Electromyography (EMG) activity of the lower extremity cramping muscle was measured in the Sulzer article.3 The EMG data was compared to a non-cramping upper extremity muscle on the same participant. Sulzer found that the EMG activity of cramping muscle was significantly increased compared with a non-cramping muscle. This finding supports the theory that EAMC may be caused in part by neuromuscular activity possibly associated with muscle fatigue.3

Clinical Importance:
- Changes in hydration status and serum electrolyte levels do not impact EAMC in endurance individuals.
- Independent risk factors for EAMC include history of muscle cramping and prolonged exercise at a relatively higher intensity.

REFERENCES

INTRODUCTION

Cryotherapy is typically used as a recovery method after activity to relieve soreness and assist in performance the next day. However, research shows positive effects of using cryotherapy intermittently throughout activity. 1, 2 Baseball pitchers have recently been utilizing interval cryotherapy, which is thought to improve recovery performance. This new approach of using cryotherapy intermittently can also be applied to other upper extremity open kinetic chain activities to increase performance.

CLINICAL QUESTION

What is the effect of interval cryotherapy on upper extremity open kinetic chain (OKC) activities in adult males?

RESULTS

Three relevant studies were located and categorized in Table 3 (based upon level of evidence). Two of the studies demonstrated the effects of interval cryotherapy in baseball pitching. The last study demonstrated the effect of interval cryotherapy in weight lifting.

Performance is often affected by velocity, accuracy, work, power, and soreness. The shoulder joint is subjected to high stress as a result of repetitive overhead activities, which can cause a decrease in performance. All three studies had a common variable of velocity, which increased after intermittent cryotherapy. As such, intermittent cryotherapy demonstrated an overall increase in performance.

The use of interval cryotherapy has been shown to be beneficial during repeated performances. 1 Bishop et al. noted improvements in pitch velocity and perceived exertion associated with interval cryotherapy during a simulated game. Similarly, Verducci identified improvements in pitch velocity and delays in fatigue as a result of interval cryotherapy. While Verducci states that baseball pitchers typically use cold therapy after activity to decrease recovery time, clinicians should consider using interval cryotherapy during the intermittent activity of overhead athletes involved in upper extremity open kinetic chain activities who strive to increase their performance.

Due to the lack of research involving interval cryotherapy on upper extremity performance, the third article replicated a baseball study to determine if similar results relative to work, velocity and power could be achieved during a weighted arm pull.

REFERENCES