Exercise-induced muscle damage results in muscle soreness and a temporary loss in muscle function. Nutrition interventions can be employed to accelerate recovery and ameliorate soreness, but a strategic approach should be followed.
Exercise-induced muscle damage (EIMD) is a transient phenomenon characterised by the symptoms presented following high-intensity or novel exercise. These symptoms typically include decreased muscle force production, decreased exercise capacity, decreased range of motion and increased muscle soreness.

The symptoms may begin immediately following exercise, typically last up to 7 days and the magnitude depends on the exercise intensity and duration.

EIMD occurs because of micro-damage to muscle fibres and many of the symptoms are related to this damage and the subsequent inflammatory response required to repair the damaged tissue. EIMD should not be viewed negatively and muscle damage and the subsequent repair response is a key part of the adaptation and remodelling process.
WHAT CAUSES EIMD?

A level of muscle damage occurs with all forms of exercise but the extent of the damage will be related to the type and intensity of exercise and the individual's susceptibility to muscle damage. Typically, resistance training, running and high-intensity intermittent exercise are the common causes of EIMD in swimmers. More specifically, eccentric muscle actions under load and/or at fast velocities are likely to cause a greater extent of damage (e.g. the lowering portion of a weighted pull-up or repeated jumping movements).

DOMS stands for Delayed Onset of Muscle Soreness and represents the increased muscle soreness which often occurs 8-24h after damaging exercise. Typically it peaks 24-48h after exercise and subsides within 96h. DOMS is used as a marker for EIMD.

EXERCISE TYPE

A muscle’s susceptibility to damage might also be reduced for subsequent bouts where prior exposure to the exercise has occurred. This may explain the increase in soreness observed when an experienced athlete engages in a novel form of exercise.

EIMD & DOMS
Whilst there are many effective strategies to help manage the soreness and decreased range of motion caused by muscle damage (e.g. active recovery, sleep, stretching, massage etc.) our diet can also play a key role in repair and recovery.

The role of nutrition in EIMD can be split into two areas: **Chronic** & **Acute**

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<th>CHRONIC</th>
<th>ACUTE</th>
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<td>Foods which should be part of the <strong>everyday diet</strong> and exist before, during and after EIMD</td>
<td>Strategies which can be <strong>specifically</strong> employed in <strong>response</strong> to EIMD to promote repair and recovery – Often consumed in excess of normal dietary intakes or in concentrated amounts</td>
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Protein intake is an important regulator of protein turnover and muscle protein repair is a critical component of recovery from EIMD. It’s currently unclear whether an increased protein intake after EIMD accelerates recovery but most certainly a sub-optimal protein intake will compromise muscle repair.

Fruits and vegetables are rich in compounds known as polyphenols. These polyphenols possess antioxidant and anti-inflammatory properties which are beneficial in tissue repair and pain management. Whilst some isolated polyphenols (see acute strategies) may be beneficial in greater amounts, pragmatically, a diet rich and varied in fruit and vegetables may be the best strategy to augment recovery from damaging exercise.

Optimal Protein Intake: 1.4-2.0g/kg

Aim for >7 servings per day
**Omega-3** fatty acids possess strong **anti-inflammatory** properties which work in a similar way to non-steroidal anti-inflammatory medications. So regular and sufficient consumption can help **control the inflammatory response** following EIMD and **speed up recovery**. Key dietary sources are **oily fish** (*salmon, mackerel, trout*), **nuts** and **seeds** (*walnuts, flaxseed, pumpkin seeds*) and **omega-3 enriched eggs** but omega-3 supplementation may be advisable if dietary intake is low.

**Vitamin D** has wide ranging effects but some of its key roles are the regulation of our **immune** system and the **repair** of **muscle** tissue. Research shows improved muscle recovery and inflammatory response following EIMD in **Vitamin-D sufficient** individuals.

As the majority of our Vitamin D is made from **sun exposure** it is important to maintain sufficient Vitamin D levels in the **winter** months and often supplementation is recommended (for more information see the Vitamin D resource).
It’s important to note that much of the research investigating the role of acute nutrition interventions involve the consumption of these foods for many days prior to the bout of damaging exercise. Therefore, it is unclear what impact these may have if only consumed reactively to EIMD.

ACUTE DIET STRATEGIES

Concentrated tart cherry juice has been shown to reduce soreness and accelerate muscle recovery when taken before and after damaging exercise. 30-60ml of juice is often recommended, the equivalent of 100-200 cherries!

There is also emerging support for blackcurrant extract, pomegranate juice, beetroot juice, curcumin and ginger as promising interventions to manage EIMD but the exact dosages and usage remains unclear. In the absence of clear guidance this further supports the consumption of a balanced and varied diet rich in plant-based foods (see the ‘Fruit and Veg for Fast Swimming’ resource for further information).
RECOVERY v. ADAPTATION...

It’s important to note that many of the nutritional interventions highlighted here may modulate oxidative stress and inflammation which are known to be important in the adaptive response to an exercise stimulus.

This leads to the consideration of what is of greater importance; recovery or adaptation from the exercise stimulus.

Undoubtedly, there will be times when recovery must be prioritised (e.g. competition) whereas an increased stress response and subsequent training adaptation may be of greater during general preparation phases. Therefore, swimmers and coaches are encouraged to consider a periodised approach to nutrition and recovery to maximise the potential for training adaptation against the swimmers acute recovery needs in line with the phase aims.

Further Reading
Owens et al (2019) Exercise-induced muscle damage: What is it, what causes it and what are the nutritional solutions?