Nutrition for Sport and Exercise

Unit 8 – Sports supplements and nutritional sports aids

Lesson 8.3 – Supplements for improving strength and power
Step 1 – Lesson objectives

In this lesson we are going to look at dietary supplements designed to enhance strength, endurance and recovery.

This lesson will enable you to:

- Advise on a range of dietary sports supplements for improving strength and power
- State the advantages and limitations of protein supplements
- Calculate the appropriate amounts of protein supplements clients require
- Advise clients to meet their protein requirements with a balanced diet and carefully selected sports foods
- Explain what creatine is and who benefits from its use
- Plan a creatine loading strategy
- Inform clients about other legal and illegal supplements

Step 2 – Introduction

The remaining lessons within this unit will highlight some of the most popular supplements taken by recreational exercisers and athletes. Each lesson will look at supplements according to what they claim to do and assess their effectiveness.

The objectives: Nutritional supplements usually have different objectives and claims, such as:

- Improving strength and power
- Increasing muscle mass
- Enhancing performance by improving energy supply, endurance, capacity and recovery
- Losing weight and body fat
- Improving health and reducing the risk of injury and illness

This lesson focuses on supplements taken to improve strength and power.

Assessing effectiveness: It is beyond the scope of this lesson to discuss in detail every popular supplement claiming to enhance strength and power. Instead we will grade them according to their popularity and the scientific evidence supporting their use.

- The first grade is ‘apparently effective’ – this includes popular supplements that have strong and sound scientific evidence
- The next two grades are ‘less effective, more research required’ and ‘ineffective’ – these have less scientific evidence to support them, even though they may still be popular, and we’ll discuss them in less detail

We’ll cite additional source material if you want to find out more about them.
Supporting material: You can download two tables to support the content of this and the subsequent lessons. The tables are:

- Table 1: Selected Nutritional Supplements with an overview of their product claims and strength of evidence of efficacy. This can be found in the Resources section of Lesson 8.1.
- Table 2: Sports Foods and their uses by athletes/clients, which can be found in the Resources section of Lesson 8.2.

Step 3 – Supplements for improving strength and power

The use of dietary supplements is particularly popular with people training to enhance strength and power. Some surveys report that 100% of these types of athletes use one or more supplements.

The most popular supplements for improving strength and power include protein supplements, amino acids, creatine, hydroxymethylbutyrate (HMB), ZMA (zinc/magnesium aspartate) and a group of supplements that are popular but banned by the IOC – prohormones.

Step 4 – What do you think?

Is the following statement accurate?

Because athletes require a much higher protein intake than sedentary individuals of the same weight, they always need protein supplements.

True or false?

Feedback: Although many athletes think that they require a much higher intake of protein than their sedentary counterparts, this is not quite true. They do require more but this intake can easily be achieved through a balanced diet. See the following screens for a discussion of this subject.

Step 5 – ‘Apparently effective’ supplements

The general consensus is that supplements that are ‘apparently effective’ do what they claim. This category includes protein supplements and creatine supplements.

We’re going to look at protein supplements first.

What are protein supplements? Protein supplements aim to provide a concentrated source of protein to supplement normal dietary intake. They come in the form of protein powders made up with milk or water, ready to drink shakes and high protein bars. These usually contain whey protein, casein or soy protein or a mixture of all of them.

What’s good about whey, casein and soy protein? Supplementary dietary protein is often taken in the form of protein powders. Common sources of protein
include milk, whey and casein, egg and soy-based powders. These protein sources are all considered high quality protein in terms of provision of amino acid requirements as they all score 1.0 on the Protein Digestibility Corrected Amino Acid Score (PDCAAS) method of measuring protein quality. The two most popular are whey and casein.

How are the highest quality protein sources identified? Different protein sources and methods of production affect the digestibility of the protein and ultimately the bioavailability of the individual amino acids. Milk derived whey protein is one of the highest quality protein source due to its high content of essential amino acids and BCAAs and their bioavailability. It is rapidly digested and absorbed and shows a sharp increase in blood levels of amino acids.

Are casein and whey absorbed at the same rate? Casein shows a much more gradual and prolonged increase in blood levels of amino acids. This is why it is often referred to as ‘slow’ and whey as ‘fast’. There is no conclusive evidence that whey is a better post-exercise recovery protein in terms of protein gain.

What should I advise clients who could benefit from protein supplements? Individuals engaging in exercise should attempt to obtain their protein requirements through whole foods.

Ingested protein supplements should ideally contain both whey and casein. This provides better digestibility and a balanced provision of amino acid availability as well as protein gains.

Soy protein sources are a good, high quality alternative for vegetarian/vegan clients.

How much protein do athletes require? As you may recall, clients doing strength training require 1.6–2.0 g/kg bodyweight compared with their sedentary counterparts, who only require 1g/kg bodyweight. This is because they have increased muscle protein turnover. However, even these higher requirements can be met through a balanced diet that meets their energy demands.

What do athletes think? Many athletes believe that the more protein they consume the better, despite there being no benefit in raising their intakes above 2.0 g/kg bodyweight.

Your challenge will be to explain this to your clients and to advise them about the correct levels of protein they require. This will obviously depend upon their weight and their training regime and is calculated in grams per kilogram bodyweight.

Step 6 – Calculating a client’s protein needs

Let’s look at calculating the protein needs of a client. The idea is that if they are already getting enough or more than enough protein to meet their requirements, they shouldn’t require supplements.
Roy is a keen bodybuilder. He is considering increasing some of his nutritional shakes. He has already increased to drinking two lots of creatine shake during his workout. He is also asking about the benefits of other supplements he has seen on the internet and in his bodybuilding magazines.

**Roy's protein intake:** Roy weighs 88 kg. As a bodybuilder, his recommended protein intake range is 1.6–2.0 g/kg bodyweight. This is equal to 140.8 g (or 141 g when rounded up) to 176 g of protein. He can achieve this intake level by finding sources of protein that are low fat and provide essential carbohydrate and other nutrients within a balanced diet.

**Roy's supplements:** If you look at Roy's profile, you can see that his protein intake, excluding his protein supplements, is 222 g. If you compare this with his recommended protein intake of 141–176 g, you can see at once that he is already getting enough protein without his supplements.

**Roy's balanced diet:** Appropriate use of sports food supplements as part of his nutritional plan could be considered. But, as Roy’s nutrition adviser, you should advise him that most of the protein he gets from supplements is in excess of the protein intake he needs and so is expensive and ineffective.

**Step 7 – What do you think?**

Remember that for clients doing strength training there is a range of recommended values, from the lower 1.6 g/kg to the higher value of 2.0 g/kg. For a client doing weight training, weighing 120 kg, what is the upper figure for their protein requirement in grams?

**Step 8 – The pros and cons of supplements**

In Roy’s case, the decision that protein supplements were unnecessary was easy to reach because he was already getting more than enough protein in his everyday diet.

However, some athletes may find the sheer volume of protein they need to consume difficult and inconvenient when they are trying to plan meals to fit into a busy day and demanding training schedule.

**Supplements step in:** Because it’s difficult to source high protein foods without a high fat content, athletes may find that their food choices are becoming restricted. As a consequence of this restricted food choice, the client’s intake of other essential nutrients may be threatened. In the minds of many clients, high protein supplements solve this problem by providing an easy and predictable source of protein without any increase in their fat intake. They sometimes imagine that protein supplements will allow them to avoid changing their eating habits.

**What do protein supplements actually do?** So, protein supplements could help clients to meet additional protein requirements and maintain their nitrogen balance. However there is no scientific evidence that, when clients take more than they require, these supplements actually have any ergogenic effect and increase...
muscle mass and strength. In these circumstances they are expensive and ineffective.

**Sports foods during exercise:** In other words, for clients to meet their protein requirements, a diet balanced with some carefully selected sports foods might be more effective than protein supplements. Look at the table: ‘Sports Foods and their uses by clients’ from the Resources folder. This shows that a liquid meal supplement can provide a compact source of carbohydrate, protein and micronutrients. This could help clients to meet their energy and nutrient demands when their activities require high energy, such as heavy muscle-building training sessions.

**Sports foods after exercise:** Another advantage of suitable sports foods over protein supplements is that they can also provide a more balanced recovery meal after exercise, replenishing glycogen stores and topping up protein. Visit Resources to look at ‘Food for thought’, a document which presents recent research on skimmed milk as the ideal recovery drink due to its ratio of CHO to protein and high water content.

We have seen that protein supplements are expensive and unnecessary for increasing muscle mass or strength. Worse still, when a client already has a positive protein and energy balance they can either cause an increase in body fat or limit any sought after body fat reduction.

**Step 9 – Knowledge check**

Earlier in this lesson we compared the qualities of three types of protein commonly present in protein supplements. See if you can match up these proteins with their qualities.

<table>
<thead>
<tr>
<th>Protein</th>
<th>Qualities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casein</td>
<td>Less easy to digest, with a high level of amino acids. Thought to protect against muscle breakdown during intense training</td>
</tr>
<tr>
<td>Whey</td>
<td>Easy to digest, with a high level of amino acids. Best for post-exercise recovery</td>
</tr>
<tr>
<td>Soy</td>
<td>A suitable protein source for those who avoid animal products</td>
</tr>
</tbody>
</table>

**Feedback:** Whey proteins are digested and absorbed more rapidly that the larger casein protein. For this reason whey protein may be better when taken for post-exercise recovery, while casein is thought to protect against muscle breakdown during intense training. Soy protein is a suitable protein source for those who avoid animal products. It may have health benefits as part of a low fat diet, as 25 g of soy protein a day could help reduce cholesterol.

**Step 10 – What do you think?**

In the next steps we are going to look at creatine as a supplement. Perhaps you already know something about it. Can you say which sporting activities creatine is useful for?
• Cross-Channel swimmers
• Long-distance runners
• Sprinters
• Weightlifters

Creatine is most suitable for strength and power clients, as it improves the repeated performance of muscular strength and short-term power activities. For more about the benefits of creatine, see the next few steps.

**Step 11 – Creatine**

The next ‘apparently effective’ supplement we’re going to look at is creatine. It has the advantage of being considered legal by the leading sports governing bodies including the IOC, so clients can use it in preparation for sports competitions. It first became popular during the 1992 Olympics, when British sprint athletes, including Linford Christie, reported its benefits. Research has shown that using creatine as a supplement is beneficial, safe and effective.

**What is creatine?** Creatine is a compound found naturally in meat, poultry and fish. These foods provide around 4–5 g of creatine for every kg you consume. The body is able to manufacture any additional requirement from the amino acids arginine, glycine and methionine. Because vegetarians receive no creatine from their diets, their bodies manufacture all they need.

**How is it taken?** Creatine can be taken as the supplement creatine monohydrate, or added to other supplements or sports foods such as meal replacement drinks.

**Who takes it?** Creatine is taken by athletes who want to increase their strength and power. When they take it at the recommended levels, it has ergogenic effects in short duration, high intensity exercises. These include power-based sprint activities such as jumping, throwing and strength or power training. It produces a 5–10% improvement in performance without any harmful side effects.

**What does it do?** Creatine has three important benefits for strength and power athletes:

• It improves the repetitive performance of muscular strength and short-term power activities
• It aids short bursts of muscular performance
• It provides greater muscular overload to enhance the effects of training

**Is it effective?** Many studies show that creatine is one of the most effective dietary supplements available for increasing body mass and muscle mass during training. Athletes gain muscle mass because creatine enables them to perform more sets/reps of high intensity exercise and train harder than they could manage without it. The result is greater adaptation and increased muscular hypertrophy.

**Is there any weight gain?** Increased gains in weight of 1–2kg in the immediate short term are partly due to increased muscle cell volume resulting from water
retention. Creatine in the muscle cells draws in water and so the size of the cell increases. In the longer term, weight gain is probably due to increased lean body mass resulting from increased capacity for longer training.

**Are there health implications to high dosage and long term use?** In terms of health implication, studies to-date show no adverse effects in healthy adults, but care should be taken and professional advice sought from a health professional if you are working with athletes who have known risks or pre-existing liver or kidney dysfunction.

**Step 12 – Knowledge check**

If a client is a vegetarian and has a shortage of creatine in their muscles, which amino acids does the body use to manufacture it?

- Arginine
- Glycine
- Histidine
- Methionine
- Taurine

**Step 13 – More about creatine**

This step looks at creatine in more detail. The evidence seems to be that it is not necessarily suitable for everyone.

To find out about what doses of creatine your clients could take and when they could take them, download the fact sheet ‘Creatine loading strategies’ from the Resources folder.

**Why creatine is effective?** Creatine is effective because it acts on the phosphocreatine energy systems that power short bursts of high intensity activities such as sprints and weightlifting. High doses of creatine (20–30 g) as a supplement daily for two weeks will increase the levels of free creatine and phosphocreatine in muscle cells by 10–30%. This creatine combines with the phosphorous in the muscle cells to form phosphocreatine. The free creatine and phosphocreatine levels will remain high for weeks after the initial two weeks of creatine supplements.

**Results of creatine supplementation?** Here are the results creatine can offer your clients. Creatine:

- Helps them to sustain maximum effort for longer
- Makes it possible for them to recover faster between repeated, high intensity sets
- Increases protein manufacture and muscle hypertrophy
- Increases lean body mass
- Delays the onset of muscle fatigue by allowing the muscles to tolerate higher levels of lactic acid
• Reduces muscle breakdown that usually follows intense training

It doesn’t work for everyone? Some evidence shows that creatine has no ergogenic effect for some types of strength and power activities like sprint swimmers. Also, creatine doesn’t help in endurance sports, in which phosphocreatine plays little part. The research on the benefits of creatine is conclusive for both sexes. These include improved training adaptation and faster gains in strength, power, and muscle mass and size. The ISSN and the ACSM confirm that creatine is a safe and effective ergogenic aid.

Step 14 – What do you think?

1. Is the following statement true or false?

Before answering this question, make sure that you have read and understood the Fact Sheet on ‘Creatine Loading Strategies’.

When Roy the bodybuilder increases his intake of creatine supplements from one to two 66 g scoops daily, with each scoop containing approximately 20g of creatine, he is correctly following the rapid loading strategy.

Feedback: The rapid loading strategy means that Roy only requires 20–25 g a day over a period of 5–7 days. Any additional creatine he takes will be lost in his urine and he will not gain any extra muscle from the extra scoops.

2. Which of the following strategies for taking creatine is appropriate for someone who wants to use it, but is not competing in the next seven days?

• Rapid loading 20–25 g in a day for the first 4–5 days
• Rapid loading sprinkling 0.5–1.0 g on food 6 times a day over 4-5 days
• 3 g per day over 28 days

Feedback: Since time is not a factor, 3 g per day over 28 days is just as effective and less expensive as rapid loading. Rapid loading 20–25 g daily for the first 4–5 days is effective but expensive and unnecessary. Sprinkling 0.5–1.0 g on food 6 times a day for 4-5 days would not be effective as 4-5 days at this dosage is not long enough for the creatine to reach an effective level.

3. Which of the following options should be observed when taking creatine?

• Add it to carbohydrate-based sports drinks that contains caffeine to speed uptake
• Stop any caffeine intake in foods/drinks for several days before the loading strategy begins and throughout the maintenance phase
• Take levels of 40–60 g for the first 7 days for rapid loading
• Take with carbohydrate, for example sprinkle on food or take with carbohydrate-based drink to enhance uptake
Feedback: Caffeine reduces the ergogenic effect of creatine so coffee is not allowed. Consuming creatine with carbohydrate-based sports drinks containing caffeine to speed uptake does not work for the same reason. Taking 40–60 g creatine for 7 days is a waste, as the highest levels for rapid loading are 20–25 g a day. Higher levels are ineffective and expensive and are removed from the body in urine.

Step 15 – HMB

Other popular supplements that claim to improve muscle strength and power gains include betahydroxy betamethylbutyric acid (HMB), zinc monomethionine aspartate and magnesium aspartate (ZMA), branched-chain amino acid (BCAA) and some amino acids. They also include prohormones – steroid or testosterone boosters – and their related compounds, including docosahexaenoic acid (DHA).

First, we’ll look at the supplements in the ‘possibly effective, more evidence required category’. Among these, ZMA and HMB are emerging as popular and may be effective, although more studies are required to confirm this. HMB is thought to be the more effective of the two, but the evidence is still inconclusive.

What is HMB? HMB is made naturally in the body by leucine, one of the body’s branched-chain amino acids or BCAAs. It is reported to inhibit protein breakdown and so aid muscle repair and growth. This could be useful for reducing exercise-induced muscle damage in resistance training for clients new to exercise, or even for experienced clients after heavy training.

HMB’s ergogenic effects: HMB works best as an oral supplement when taken with creatine. Studies report that it has an ergogenic effect by enhancing muscle growth and strength. The evidence shows that it works best for clients new to resistance training rather than experienced weightlifters.

For trained individuals adaptations occur at a slower rate than in untrained individuals. For this reason HMB will likely be most beneficial over longer training durations of greater than 6 weeks in trained individuals. However, more studies are required to discover all the effects of HMB.

Step 16 – Ineffective and ineffective banned supplements

The remaining supplements include BCAAs, amino acids that are popular with people who use strength and power supplements. In spite of their popularity there is no scientific evidence to support their claims. Other supplements within this category have been banned by the World Anti Doping Agency (WADA), and are illegal and dangerous. These include androstenedione known as ‘andro’, androstenediol, norandrostenedione and dehydroepiandrosterone (DHEA).

For more information look at the tables ‘Selected nutritional supplements: an overview of their claims’, ‘Sports foods and their uses by athletes/clients’, and ‘Summary of popular dietary supplements’. You have probably downloaded these already from the Resources section of Lesson 8.1, 8.2 and 8.3, respectively. You can also look at the ACSM article ‘Nutrition and Athletic Performance’, which can
be found in the document ‘How much: guidelines’ in the Resources folder of Lesson 3.3.

**Step 17 – Lesson assessment**

The following five questions will check your understanding of the key learning points of this lesson and are scored. You must answer each question in 30 seconds or less.

1. Is the following statement true or false?

   Athletes can meet their protein requirements by consuming a diet balanced with some carefully selected sports foods rather than taking protein supplements.

2. Which of the following is not a protein supplement?

   - Lactose
   - Caesin
   - Soy
   - Whey

3. Is the following statement true or false?

   Creatine does not help to improve athletic performance in activities such as the marathon and the Tour de France.

4. In power-based activities such as jumping, throwing and strength or power training, how much does creatine improve performance, as a percentage?

   - 2-5%
   - 5-10%
   - 10-12%
   - 12-15%

5. Is the following statement true or false?

   The evidence shows that HMB works better for experienced weightlifters than for clients new to resistance training.

**Step 18 – Lesson summary**

Now you have completed this lesson you'll be able to:

- Give advice on the supplements suitable for improving strength and power
- Advise on the usefulness of protein supplements
- Assess the appropriate amounts of protein supplements clients require
- Recommend clients to achieve a balanced diet and avoid unnecessary protein supplements
Lesson 8.3 Supplements for improving strength and power

- Give advice on the benefits of creatine and when best to use it
- Plan a creatine loading strategy
- Ensure clients are aware of banned supplements

In the next lesson, you will look at more closely at performance-enhancing supplements.