INTERVIEW:

Jorn Trommelen, Ph.D.(c)

You're currently working your way through a Ph.D. at Maastricht University. Can you give us some background on the research you're pursuing and what drew you to these topics?

Our lab is focused mainly on muscle metabolism. Specifically, we investigate how exercise and nutritional strategies can optimize muscle mass and function in a wide range of populations such as older adults, diabetic patients, or athletes. My own research is focused on sports nutrition, especially protein intake to optimize muscle mass gains and recovery in strength athletes, and carbohydrate supplementation to increase performance and recovery in endurance athletes. These are central topics in sports nutrition that every athlete needs to take into consideration: how much macronutrients do I need for optimal performance and recovery, how much protein a day, what type of protein, when should I eat it, etc.?

From the research you have been conducted on carbohydrate oxidation during exercise, what are the practical takeaways that athletes can incorporate into their fueling strategies?

Carbohydrates are the main fuel source during high-intensity exercise. But since only a limited amount of carbohydrates can be stored in the body as glycogen, our glycogen stores are often a limiting factor in prolonged endurance-type exercise. We can support glycogen stores (also called endogenous carbohydrates) with carbohydrate ingestion just before and during exercise (exogenous carbohydrates). But there's a limit to how much carbohydrates can be ingested and oxidized as fuel. The limiting factor appears to be the absorption rate of glucose in the gut. It appears that the pathway of glucose can become saturated at a high glucose ingestion rate. Because fructose is absorbed via a different path in the gut, the combination of glucose and fructose can be absorbed at a higher rate than the same amount of carbohydrates provided as just glucose or fructose. This increases the total amount of carbohydrates that can be oxidized during exercise and glucose-fructose co-ingestion has been shown to increase endurance performance more than glucose alone.

So the practical takeaway is that your carbohydrate supplementation protocol during prolonged endurance exercise should contain a mix of both glucose and fructose to optimize performance. A good rate is 60 g glucose with 20-30 g fructose per hour. But if you're not used to it you may have to try lower amounts to train your gut first.

You've also looked at the effects of ingesting protein before going to sleep on muscle mass. Can you give us a quick introduction into what the pre-sleep protein strategy entails?

We did a study in which we characterized the protein intake of a large group of Dutch athletes competing from the national level up to Olympic athletes. On average, they ingested 1.5 g protein per kilogram of bodyweight, which is in line with the recommendations to optimize muscle recovery and mass. Most of this protein was ingested during the 3 main meals: breakfast, lunch, and dinner. However, very little protein was ingested after the dinner. This means that there's often 10-12 h between dinner and your next protein meal (breakfast). Therefore, an extra protein meal just before sleep might be beneficial to optimize muscle protein synthesis (the process that drives muscle growth and recovery) during the night. We confirmed this in an acute study and also performed a long-term study in which pre-sleep protein increased muscle mass gains compared to a placebo. In our studies, we gave subject extra protein in the pre-sleep group. It's likely that both the additional protein intake and the strategic timing of protein contributed to the increase in muscle mass. The practical takeaway is that athletes may benefit from some extra protein intake and should consider taking it at a strategic time point that optimizes protein distribution throughout the day.

Where do most of the benefits of pre-sleep protein come from - preventing muscle breakdown or building muscle up?

The techniques required to measure muscle protein breakdown would make it very difficult for the subjects to sleep. In general, muscle protein breakdown rates do not differ a whole lot. Nutrition can reduce muscle protein breakdown by about 50% and if you eat just a little amount of protein or carbohydrates it would give this effect (it's due to insulin, specifically). In contrast, protein intake has a much bigger effect on muscle protein synthesis. Therefore, it's likely that pre-sleep protein has a small beneficial effect on muscle protein breakdown, but a much larger effect on increasing muscle protein synthesis. We did measure total protein synthesis and breakdown rates (so not specifically in the muscle but the effect of all tissues combined), and saw that pre-sleep protein has little effect of protein breakdown but did stimulate protein synthesis rates during the night.

How does the timing of a resistance training workout affect the utility of pre-sleep protein?

In our studies, we use intrinsically labeled protein. This protein functions just the same as normal protein but has tracers build into it (these help us detect where the protein is going in the body but have no effect on metabolism). We can combine this with muscle biopsies to measure how much of the protein we gave

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before sleep ends up in the muscle during the night. We observed that some of the amino acids from the pre-sleep protein are being built into muscle tissue during the night. But this amount was increased by 75% when subjects did a resistance-training session earlier in the evening. So clearly resistance exercise enhances the effect of (pre-sleep) protein ingestion on muscle protein synthesis. Previous work has shown this enhancing effect of resistance exercise lasts at least 24 hours. Therefore, the timing of a workout doesn't seem to matter all that much.

What are some of the unanswered research questions around the use of pre-sleep protein you would like to see addressed?

I would like to have a better idea of what the optimal amount of pre-sleep protein is. Our research so far suggests you may need a relatively large dose of 40 g protein. It can also be questioned what type of protein should be ingested or whether it does not matter. For example, should you have a slowly digesting protein source such as casein so that you provide amino acids throughout the whole night? Finally, it can be questioned if other nutrients should be co-ingested or whether just protein is enough. ◆

Jorn Trommelen, Ph.D.(c) investigates muscle metabolism at Maastricht University, the Netherlands. He has won several prestigious awards for his research on protein and carbohydrate metabolism in athletes, including the ACSM GSSI sports nutrition award. He writes evidence-based nutrition and fitness articles at his site NutritionTactics.com. In addition, he shares infographics and discusses new studies on most social media where he can be found as @jorntrommelen (Twitter | Instagram) or on Facebook.