

1.2 Personalised sports nutrition

1.2.1 DTC testing or a different approach?

Direct To Consumer (DTC) tests have become common. Although genetic testing for diagnostic reasons is mostly done at select medical institutions with existing expertise and extensive research facilities (as technologies advance), self diagnostics are being developed by a number of companies. These companies now offer genetic tests (DTC). You can buy a saliva test kit for as little as £60 (US\$80, 70 Euros). A saliva sample is sent to the company and the sample will run through a gene chip “and sent back both ancestry information and more than 200 health reports indicating one’s risk of getting or carrying the gene mutation for a disease such as cystic fibrosis or breast cancer or their response to drug therapies”. (Hof, 2014. <https://bit.ly/2PxAuQp>) Some of these companies received a serious slap on the hand from the FDA who reiterated that a medical device that provides disease diagnostics is subject to explicit FDA approval. Other firms offer genetic tests through doctors, which gets around the issue of FDA approval.

The Human Genome Project and continuing improvements in DNA sequencing technologies have revolutionized the identification of genetic disorders. These technological “advances have radically changed genetic testing from an expensive and burdensome undertaking to a rapid and less costly option for many purposes. The utility of “next-generation” sequencing has been found to establish the diagnosis for hundreds of genetic disorders.” (Lindor, Thibodeau, Burke, 2017. <https://bit.ly/2QQ7iJg>).

“The ready availability of genomic information has led to the question of whether there would be clinical benefit of sequencing the genome of individuals who are not seeking a diagnosis” (Lindor, Thibodeau, Burke, 2017. <https://bit.ly/2QQ7iJg>).

Could genomic screening in generally healthy people provide anticipatory insights for their health care? Apart from the obvious ethical questions, these methods have also been criticized because there are few studies and little evidence to base conclusions and advice on.

These tests are now being offered to athletes where the interest is primarily in performance rather than overall health. In this field, there are virtually no studies and thus it is even more difficult to draw conclusions with confidence. Existing tests lack specificity, sensitivity and explanatory power. With companies going directly to consumers without the help of a medical

practitioner or other expert, it is up to the company and the consumer to interpret the results of the gene analysis. The consumer is usually not equipped to understand the limitations of the techniques and therefore it is easy to see how results get over or under-interpreted. Also, it is likely that companies have different levels of quality control. This is illustrated by examples that can easily be found on the internet. A reporter ordered test kits from a number of companies and sent in her saliva sample for analysis. The results were not entirely surprising: results were far from uniform and differed greatly between the companies. The conclusions and recommendations varied widely and were opposite in some instances. This is what happens with tests and it is therefore important to realize these limitations. If someone can interpret the outcome with this background, the information can be interesting and fun, but what if people do not have the background?

DTC testing is developing in the right direction. DTC 2.0 is more regulated, has increased medical (expert) integration, more quality control of the analytical process, requires user comprehension validation. However, the strictest regulation will most likely be reserved for the high risk categories. Sport does not fall in those categories.

In order to produce meaningful advice to an athlete based on genetic tests, we need to understand the relationship between relevant genes, the nutrient and performance. Such studies are scarce and in many cases non-existent, and therefore our knowledge about the gene-nutrient-exercise interactions (known as nutrigenomics) is very limited. The path to uncovering gene-nutrient interaction effects on performance is complex. It is clearly a demanding line of research because of the rigorous controls needed on all aspects of an intervention, the large sample size required as we are dealing with expectation of a small effect size, and high research costs. Progress in personalized sports nutrition can occur only if we are committed to carefully planned and well-executed human research in the future. (Parker, 2018. <https://bit.ly/2Bnrj07>).

1.2.2 Personalise based on what really matters

Let's take an example. Current recommendations for carbohydrate intake are between 0 and 90 grams per hour of exercise depending on the goals, the level of the athlete, and the duration of exercise. This is a very large range. From research studies we know that during prolonged exercise there is a dose response relationship (i.e. 60 g/h would result in better performance

than 30 g/h for example). It is possible that genetic differences between individuals affect the response to carbohydrate feeding. Some may benefit more than others. This is pure speculation though because we have no data to support this hypothesis. We could theorize which genes may be responsible for possible differences in response to the same carbohydrate feeding. However, in studies responses have been quite similar between individuals and even if genetic differences exist these differences would be small. The differences in performance between carbohydrate intake rates between 30g/h and 60g/h would be several magnitudes larger. Therefore, it is fair to conclude that, at least in this particular example, the other factors far outweigh the influence of a genetic component.

Although it may be too early to base advice on genomic information, personalised nutrition in sports may have a slightly different meaning. Prescribing appropriate nutrition to an athlete, depends much more on other factors such as exercise intensity and duration than on genetic differences between people. In our definition of personalised nutrition, all factors that influence the nutrition needs of an individual should be taken into account to come up with a personalised nutrition plan.

Factors that should be considered in a personalised nutrition plan.

THE GOALS

- Winning, personal bests, optimal performance
- Making it to the finish line
- Losing weight
- Health
- Gaining muscle

THE EVENT

- Duration of exercise
- Intensity of exercise
- Sport
- Playing position in team sports
- Discipline
- Activity
- Race
- Training

THE INDIVIDUAL

- Genetics
- Body mass
- Fitness
- Differences in sweat rates
- Differences in metabolism

- Different preferences
- Different tolerances

THE ENVIRONMENT

- Weather
- Altitude

Here we will discuss some of the factors in previously listed. Of course, the goal of the athlete is one of the main factors: maybe the most important one. If someone's goal is to lose weight or gain weight, the approach may be the opposite. If an endurance athlete wants to burn fat or train his fat oxidative capacity, the approach will be different from aiming for an optimal performance. A triathlete may want to beat his personal best in a race or he may just want to make it to the finish line in one piece. The nutrition strategy can be quite different.

Next, the event needs to be considered: is it training or racing, is it high intensity or low intensity, is it shorter or longer duration. This will determine energy expenditure but also substrate use. It will determine whether nutrition can have an effect on performance or not. In a team sport we may have different players with different needs. The most obvious one is a goal keeper in football who will have different needs than a central midfielder. An attacking player may have different needs than a defending player.

Then there is the individual him or herself. Body weight and body composition will affect the nutritional needs but also the level of the athlete. A recreational football player will likely need less energy than a professional football player. Individuals have different sweat rates even at the same exercise intensity and same weather conditions. So, we need to take individual sweat rates into account. Individuals may also differ in their metabolism. Although studies confirm these differences there is less evidence at present to suggest different nutritional needs but is certainly not unthinkable.

Another really important factor are personal preferences and tolerances. Allergies and intolerances have to be part of the personalisation of course once they are confirmed medically.

Gastro-intestinal problems are a common issue in sport, especially during very high intensity exercise or long duration exercise. In order to minimise the risk of developing gastro-intestinal problems, it is important to find out if foods influence these complaints and if so which foods should be avoided to minimise the risk. This will be highly individual.

Personal preferences are important. This includes taste of the food or product (flavour profile). Cultural differences need to be taken into account. But we also need to work on personalised solutions for players for common goals. For example, if we recommend an intake of 45 grams of carbohydrate

at half time, some players may want to take this as a drink, some as a gel and water, other in the form of solid foods. There are many ways to achieve this goal and every player may want to get to the goal in a slightly different way.

The practical difficulty with personalisation in a team sport is obvious. It is not possible to cook differently for every player of the team. Therefore we can work with buffets, and provide a range of options together with an education program helping players to make the right choices.

Summary

The concept of "personalized" medicine is being extended to the field of nutrition. It is now accepted that nutrients (i.e., macronutrients, micronutrients) alter molecular processes such as DNA structure, gene expression, and metabolism, and these in turn may alter disease initiation, development, or progression.

Undoubtedly there are also links to human performance and therefore personalised nutrition is gaining momentum within the field of sports sciences. Individual genetic variation can influence how nutrients are assimilated, metabolized, stored, and excreted by the body and this in turn could have effects on adaptation, performance or recovery.

Although the use of nutrigenomics in sports nutrition could potentially be the future, it is important to recognize that the nutrigenomics in sport is in its infancy and there are a number of limitations drawbacks that currently make this technique less useful. On the other hand, studies have demonstrated other ways to personalize nutrition in ways that take into account the goals of the individual, the exercise intensity and duration, the weather conditions and other factors that influence the individual's nutritional needs. This is a different way to take into account the individuals nutritional needs that is simpler and perhaps more relevant to the athlete. Although there is some progress in this field, there is a lot to be discovered and a lot of work that needs to be done before we can really make "personalized sports nutrition" accessible to all athletes.

1.2.3 The personalisation myths

One may wonder why we discuss myths at all. Why spend time on things that do not work or things that are scams. The answer is that these myths and scams are part of the reality and when athletes come to us with questions about fad diets, magic supplements or nutritional science fiction we need to be prepared with an answer. The myths discusses in this course are common ones in a team sport environment and the discussion should

help the reader to dispel myths at an early stage with sound evidence based arguments that will make sense to the athlete.

The myth of the blood type diet

The blood type diet seems to be the ultimate personalized diet. A link between ABO blood group and diet was proposed by P.J. D'Adamo in his book "Eat Right For Your Type" published in 1996. The 'Blood-Type' diets have gained widespread attention from the public with more than 7 million copies sold in over 60 languages, and making the New York Times bestseller list.

In this book, D'Adamo claims that the optimal diet for any one individual depends on the person's ABO blood type. Each blood type supposedly represents genetic traits of our ancestors, including which diet they evolved to thrive on. (Wang, García-Bailo, Nielsen, El-Sohemy, 2014. <https://bit.ly/2LqfeOD>).

Here is an example of what each blood type is supposed to eat:

Type A: Called the agrarian, or cultivator. People who are type A should eat a diet rich in plants, and completely free of "toxic" red meat. This closely resembles a vegetarian diet.

Type B: Called the nomad. These people can eat plants and most meats (except chicken and pork), and can also eat some dairy. However, they should avoid wheat, corn, lentils, tomatoes and a few other foods.

Type AB: Called the enigma. Described as a mix between types A and B. Foods to eat include seafood, tofu, dairy, beans and grains. They should avoid kidney beans, corn, beef and chicken.

Type O: Called the hunter. This is a high-protein diet based largely on meat, fish, poultry, certain fruits and vegetables, but limited in grains, legumes and dairy. It closely resembles the paleo diet.

D'Adamo also recommends various supplements to help with tummy troubles and other issues he says people with type O tend to have.

Thus the "'Blood-Type' diet advises individuals to eat according to their ABO blood group to improve their health and decrease risk of chronic diseases such as cardiovascular disease." (Wang, García-Bailo, Nielsen, El-Sohemy, 2014. <https://bit.ly/2LqfeOD>).

So far the theory. Now where is the evidence? Till recently, these claims were all theory and there was no evidence. This does not stop believers who argue that absence of evidence is not the same as evidence of absence!

Therefore researchers from the University of Toronto embarked on a large scale study with 1,455 study participants to see if there was any merit in the blood type diet. The authors came to a clear conclusion: "The way an individual responds to any one of these diets has absolutely nothing to do with their blood type and has everything to do with their ability to stick to a sensible vegetarian or low-carbohydrate diet,". (Wang, García-Bailo, Nielsen, El-Sohemy, 2014. <https://bit.ly/2LqfeOD>).

The researchers took an existing population of mostly young and healthy adults who provided detailed information about their usual diets and provided fasting blood that was used to isolate DNA to determine their ABO blood type and the level of cardiometabolic risk factors, such as insulin, cholesterol and triglycerides. Diet scores were calculated based on the food items listed in Eat Right for Your Type to determine relative adherence to each of the four 'blood-type' diets.

The associations observed between each of the four blood-type (A, B, AB, O) diets and the markers of health were independent of the person's blood type.

There are many more of these diets and other "personalized" nutrition plans that are not evidence based and are more marketing and finance driven than science driven. For example, the analysis of hair to give athletes a custom nutrition plan accompanied by "special" supplements" by the company is an example of this. Or some of the non-clinical tests out there for allergies or intolerances (usually IgG testing) is another example. This will be discussed in the following section.

There are many more of these diets that make profound claims, but provide no real evidence. The evidence used is often based on selective use of the literature, pseudoscience or even manufactured.

1.2.4 Back to basics

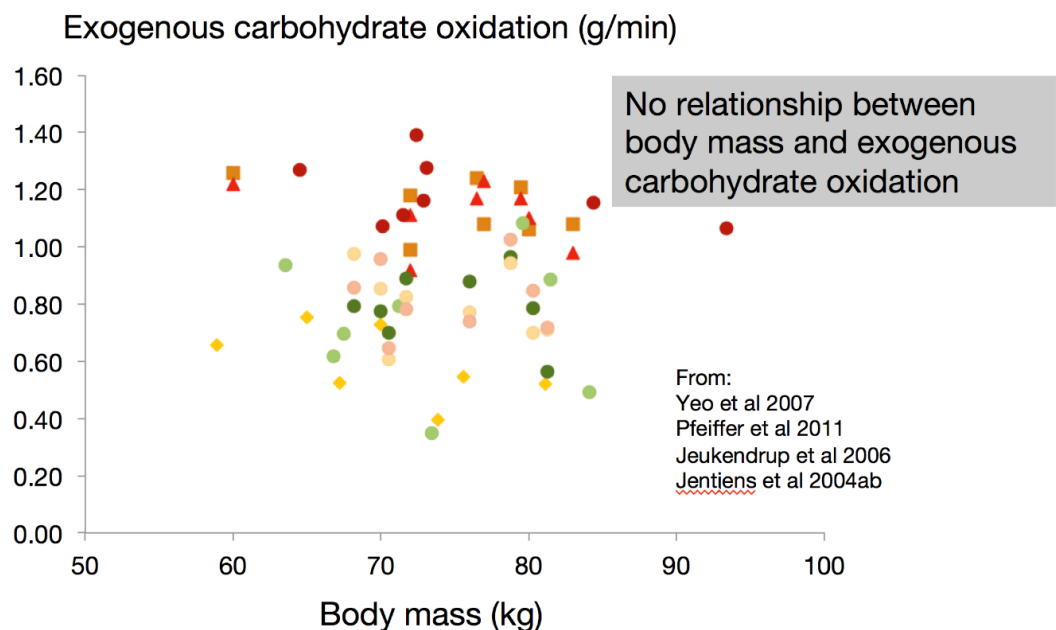
We talked a lot about personalisation and the importance of it. We discussed all the factors that need to be considered in a personalised nutrition plan and also some factors that may be less important. We even discussed some of the myths. However, it is important not to forget that, although no two people are the same, fundamentally we are not that different. Our physiology is largely the same: carbohydrates and fat get absorbed in the same way, regulation of gastric emptying is not different, glycolysis and its regulation are the same and so on.

This means that there are a number of fundamental issues that do not change and do not require personalisation. Carbohydrate is an important fuel for high intensity exercise for every individual! Protein is required for

protein synthesis in every individual. Dehydration can affect performance in every individual.

Sometimes we do not even have to take body weight or composition into account. For example, we studied exogenous carbohydrate oxidation for many years and in a large number of individuals. One of the initial findings was that maximal oxidation rates of ingested carbohydrate was 60 g/h. This was the case in smaller individuals but also in larger individuals. We also found that when certain combinations of carbohydrates were used, this number could be exceeded. But this happened both in smaller and in larger individuals. It was remarkable that in all these studies, oxidation rates between individuals seemed fairly consistent. Some of the individual in these studies were around 60kg and some were around 90kg. Despite weight being 50% different, oxidation rates were similar and there was no obvious correlation between weight and exogenous oxidation rates. In Figure 3 the results from several studies are plotted. Each point is a person in a study with their maximal exogenous carbohydrate oxidation rate.

Figure 3: No correlation between exogenous carbohydrate oxidation and bodyweight. Probably because maximal exogenous carbohydrate oxidation rate is limited by absorption and absorptive capacity of the gut is not dependent on body weight



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Clearly there was no correlation between body mass and exogenous carbohydrate oxidation rates. The explanation we gave was that the main factor determining exogenous carbohydrate oxidation rates is absorption. Absorptive capacity is not necessarily different between smaller and larger individuals and we have suggested that it is more dependent on regular

carbohydrate intake than any other factor. In a later module we will discuss training the gut and we will see that the gut and the absorptive capacity of the gut will vary depending on the diet.

So the take home message is that we are all humans with largely the same physiology. We may need to personalise nutrition to optimise performance, but it cannot be true that different people will get opposite advice for the same purpose.

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