BIO ACCENT

BAOJ Nutrition

Gillian R Hart , BAOJ Nutrition 2018 4: 2
4: 052

Review

Gut Microbiota, IgG-Guided Elimination Diet and Sports Performance

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Abstract

It is estimated that 20-60% of athletes suffer from the stress caused by overtraining and inadequate recovery [1]. The prevalence of stress is thought to be higher in, but is not exclusive to, endurance sports such as swimming, cycling, rowing, triathlon and long distance running. Although the symptom of stress is somewhat ill defined, the impact of stress on an athlete can include fatigue, performance decline, insomnia, change in appetite, irritability, anxiousness, loss of motivation and poor concentration [2]. These are thought to be impacted by increased inflammation, prevention of nutrients from being fully absorbed and a weakening of the immune system.

Maffetone and Laursen [3]. Recently emphasised the fact that athletes are fit but often not healthy. The main reasons cited? Excess high training intensity or training volume and/or impact of diet. Often the brain is motivated by the "no pain, no gain" mentality, with physical, biochemical and mental-emotional consequences. The hypothalamic-pituitary-adrenal axis and the autonomic nervous system play key roles along with communication between the gut microbiota (gut bacteria), gut-brain axis and their interaction with food consumed.

Every individual has their own distinctive pattern of gut microbiota whose functions include enhancing the way nutrients and vitamins are absorbed, converting the food we eat into valuable by-products, working with the immune system protecting against inflammation, and increasing ability to access fat as fuel. If the gut microbiology is not optimised then this can lead to increased gut permeability; the movement of gut microbiota and their products, and incompletely digested nutrients such as food proteins. Gut permeability or "leaky gut" has been directly linked with a number of conditions such as digestive complaints, low energy, low mood and musculo-skeletal problems; symptoms of food intolerance and which are all too common in athletes.

Food Intolerance

Considering the impact of exercise onthe way nutrients and vitamins are absorbed, the immune system, the gut microbiota and the movement of gut microbiota and their products, and incompletely digested nutrients such as food proteins, it is not surprising that athletes are susceptible to food sensitivities because the stress of constant training. A stressed or over-trained body will be less and less able to accommodate foods that are contributing to inflammation and this will, in a vicious circle, further impact performance. The resulting "leaky gut" further increases the probability that larger food particles can enter the blood stream and this creates the potential for those food particles to trigger a food-specific IgG immune response with detrimental impact: It is well documented that elimination diets based on food-specific IgG measurement have been shown to be beneficial for conditions such as IBS [4,5,6] inflammatory bowel [7,8] weight gain [9,10] low mood [11,12], joint pain [13], respiratory problems [14] and migraine [15].

Studies looking at the impact of food intolerance and the use of a personalised IgG-guided elimination diet on sports performance include one trial involving first team members from top rugby league club Wigan Warriors in the UK. After 3 months of supported dietary changes, 67% evidenced performance improvement as a direct result of their new diet [16]. Another study which utilised an elimination diet based on a food intolerance test, showed significantly improved health, body composition and faster lowering of heart rate after cardiopulmonary testing in a group of professional athletes [17]. In addition, those from football and

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Sub Date: April 17th,2018, **Acc Date:** April 23th, 2018, **Pub Date:** April 24th , 2018.

Citation: Gillian R Hart (2018) Gut Microbiota, IgG-Guided Elimination Diet and Sports Performance. BAOJ Nutrition 4: 052.

volleyball athletic teams showed improvements in concentration and memory after IgG-guided elimination diet after just 2 weeks of dietary changes [18]. In 2012, Lewis *et al.* [9] published a study that looked at the effect of eliminating immunologically reactive foods from the diet of overweight individuals. Participants lost, on average, 5kg in weight and 8cm in waist circumference over a 90 day period. In addition to the positive changes associated with body composition there was a significant drop in diastolic blood pressure and substantial improvements in both physical and mental quality of life.

Pathophysiology

It is widely known that regular, moderate exercise can impart beneficial effects for the intestinal microbiome, irritable bowel syndrome symptoms, and inflammatory bowel disease and depression [19,20] reflecting the influence of exercise on the brain-gut-microbiome axis. Moderate exercise can also produce an anti-inflammatory effect [21]. High-intensity training or prolonged endurance training, on the other hand, can have very negative effects on these and other entities [2].

In more detail, the redistribution of blood flow with exercise, significantly reduces blood flow to the gut, leading to hyperthermia, ischaemia and hypoperfusion that can also contribute to damage to the intestinal mucosa, causing intestinal barrier disruption, followed by an inevitable inflammatory response [22]. It is the compromised gastrointestinal system that can have a negative impact on exercise performance and subsequent post-exercise recovery due to impairments in the uptake of vital fluids and nutrients. The loss of epithelial integrity and increased intestinal permeability leads to the translocation of larger food particles, immune reactivity and inflammation; food intolerance. This in turn disrupts post-exercise recovery and exercise training routines [23]. Approaches that reduce inflammation are key. It is widely documented that gastrointestinal complaints are common in athletes, especially in endurance athletes, with 30-50% of athletes affected [24]. A study in long-distance triathletes showed that up to 93% suffered [25]; gastro-intestinal symptoms include cramps, bloating, diarrhoea and nausea [26]. Female athletes report a higher prevalence of irritable bowel syndrome and more gastrointestinal symptoms modulated by the menstrual cycle. Management of gastrointestinal problems in the athletic population is widespread and includes training adjustments, dietary measures, and taking medications to manage symptoms [27]. Fatigue and mood disturbances are also common amongst athletes [1,2].

Gut Microbiota

Few studies to date have assessed the gut microbiota of highly fit athletes in detail, but this is beginning to change [28]. In one study,it was shown that exercise training induces compositional and functional changes in the human gut microbiota, compared to those who are sedentary, but that these changes are also dependent on obesity status. These exercise-induced changes in the microbiota were largely reversed once exercise training ceased [29]. It is now known that the microbiome of professional athletes, in this case a group of rugby players, differs from that of more sedentary individuals in composition, particularly at the metabolic level [30]. A more recent study has provided the first look into the gut microbiomes of cyclists [31], with significant correlations between the gut microbes present in professional cyclists and those which correlate to high exercise load.

It is likely that multiple factors influence how the gut communities of athletes are structured including the type of exercise, amount of exercise, diet, host immunity, host metabolism, and the physiological aspects of the human gut including bile acid secretion and transit time. Scheiman and colleagues from Harvard are working to determine whether or not these changes to the gut microbiota can provide positive benefits. For example, whether elite athletes have collections of gut microbes that help them get stronger, run farther, and recover faster than those who are more sedentary. One microbe isolated from elite athletes excels at breaking down lactic acid. On comparing the bacteria from ultra-marathoners to those found in rowers training for the Olympics. They found a type of bacteria in ultra-marathoners that can help break down carbohydrates and fibre, which is key during a 100-mile run, that wasn't present in the rowers, suggesting that different sports may foster niche microbiomes [32]. Anything that can impact the balance of the microbiota, whether diet, food intolerances, stress or environmental factors, will alter performance and so designing diets that are personalised and targeted to an individual's requirements are key.

Mitochondria

It is also interesting to consider the role of the "powerhouse" of the cell, the mitochondria, as this is important during high metabolic activities such as endurance exercise. Compared to other athletes, endurance athletes have a higher number and volume of mitochondria in the skeletal muscle in order to meet energy needs [33]. New research shows a bidirectional communication exists between the gut microbiota and mitochondria, and the mitochondria also have a prominent role in the modulation of gut functions such as intestinal barrier protection and the mucosal immune response. Thus, a dysregulation of mitochondrial functions can also affect the gut microbiota through the perturbation of the normal intestinal habitat allowing bacterial and food antigens to penetrate the epithelium and stimulate the immune response. Another possible perturbation in the microbiota habitat induced by mitochondria occurs through the modifications of immune system responses [34]. All very relevant when considering the requirement for managing food intolerances.

Conclusion

Diet plays a key role in an active person's preparation, competition and recovery strategies. It's important to establish a nutrition strategy that meets an individual's dietary requirements, while still maximising

performance.Many athletes aggressively eliminate foods as a one-size-fits-all solution. These restrictive diets sometimes bring short-term improvements, but they are difficult to maintain and often leave athletes undernourished and underperforming. There are many, often conflicting, nutritional strategies that may enhance exercise or training leading to improved health and performance, but there are few that are targeted to compensate food-specifically for each individual.

Diet is key to improving gut condition, and food intolerances, measured by food-specific IgG antibodies, can indicate that gut damage has occurred and promote inflammation across the body. These reactions can exacerbate the effects of stress and can result in a negative spiral of symptoms that take a holistic approach to resolve. Dietary optimisation is needed as part of a sports programme and an optimal diet requires a personalised approach, taking food reactions into account. Food-specific IgG testing can be used to help understand the root cause and guide such an approach.

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