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April 2018

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CFS453-01

**Running on Plants?**

 “Impossible, they told me. Vegans are spindly weaklings, incapable of anything more athletic than kicking a Hacky Sack. No proteins in plants, you’ll never make it. I heard it all. But deep down, I knew I could do it,” said Rich Roll, a world renown plant-based athlete recognized for completing 5 ironman-distance triathlons on 5 islands of Hawaii in under a week (Roll, 2013). Not only do athletes require a higher caloric intake due to their high expenditure of energy, but also adolescents who are fueling the most important stages of growth. Although some may argue an athlete let alone growing child fueled by a fully vegan diet is at risk of deficiency in various nutrients such as Iron, Zinc, Omega-3, Vitamin B12 and more, it is possible for adolescents to grow to their full potential while performing optimally in sports through the consumption of a plant-based diet full of a variety of nutrient dense foods.

 Unlike vegetarians, vegans additionally do not consume any foods sourced from animals such as dairy, eggs, and honey leaving grains, legumes, nuts, seeds, fruits, and vegetables as their primary sources of energy. Although it may seem restrictive, there are numerous substitutions for all the major macronutrients: carbohydrates, proteins, and fat.

**Macronutrients**

 In terms of carbohydrates, plant-based eaters have a wide variety of options. “The plant-based foods such as vegetables, fruits, and grains are high in carbohydrates, and they can serve as a primary source of energy for endurance athletes” (Mandali, 2011). Not only do carbohydrates provide quick energy, they are also important as “key fuel for the brain and central nervous system and a versatile substrate for muscular work where it can support exercise over a large range of intensities due to its use by both anaerobic and oxidative pathways.” Because vegan diets are naturally high in carbohydrates, this way of eating can be extremely beneficial to athletes requiring much energy for training. Especially for athletes requiring large amounts of carbohydrates for long grueling workouts, the plant-based diet can be even preferred. For the adolescent athlete, it is important to follow the Daily Recommended Intake plus any additional carbohydrates needs due to both fueling training and growth.

 While also experiencing pubescent development, many teenage athletes have certain protein needs to build muscle in order to achieve athletic goals. Protein is “necessary to support metabolic adaptation, repair, remodeling” (Nutrition and Athletic Performance, pg. 510). According to the Academy of Nutrition and Dietetics, Dietitians of Canada and the American College of Sports Medicine recommend 1.2 to 2.0 grams of protein per kilogram of body weight per day for athletes, depending on training (Protein and Athlete, n.d.). Because these adolescents are not only breaking down muscle during workouts, additional protein may be needed to build muscle to support regular muscular development. Protein requirements for vegans can easily be achieved through the consumption of legumes, tofu, soy products, meat alternatives, nuts, seeds, and grains. In terms of bioavailability, “meat, dairy, eggs are 94% to 97% digestible, but grains and beans are only 75% to 85% digestible” so vegan teens may need to increase protein intake even more (Nutrition and Athletic Performance, pg. 510). If necessary, “when whole-food protein sources are not convenient or available, then portable, third-party tested dietary supplements with high-quality ingredients may serve as a practical alternative to help athletes meet their protein needs. (Nutrition and Athletic Performance, pg.511). Whether it be through consumption of whole foods or side supplementation, meeting protein needs should be achievable for any adolescent competitor.

 The final macronutrient, fat, provides satiety, large amounts of energy (due to high caloric value), and is important for cognitive and physical development. Because most plant-based foods tend to be higher in carbohydrates, the variety of foods containing high fat content are smaller. However, the Academy of Nutrition and Dietetics states that for athletes, diets higher in carbohydrates offer advantages over fat because “it provides a greater yield of ATP per volume of oxygen that can be delivered to the mitochondria” (Nutrition-and-Athletic-Performance, pg.508). Nevertheless, it is not recommended fat be discarded as a macronutrient as “consuming less than 20% of energy intake from fat does not benefit performance and extreme restriction of fat intake may limit the food range needed to meet overall health and performance goals” (Nutrition and Athletic Performance, pg.523). To meet the Recommended Daily Intake, examples of plant fats include nuts, nut butters, seeds, chia seeds, oil, and avocado.

**Micronutrients**

 Micronutrients usually require more attention from those desiring to support growth and an athletic lifestyle in a healthy way. Monitoring intake of micronutrients such as zinc, iron, calcium, Vitamin D, Vitamin B12, Omega-3, and Riboflavin in the vegan adolescent are key to preventing nutrient deficiency.

 Zinc, a key nutrient which plays a role in the immune system, protein and DNA synthesis, cell division/growth, and injury recovery, has the potential to be low in vegans due to it being less bioavailable in plant foods (Zinc, n.d.). The phytic acid found in zinc acts as an inhibitor to its absorption so eating many foods high in zinc such as fortified cereal, baked beans, chickpeas, cashews, peas are necessary (Zinc, n.d.). To lessen the effects of the phytic acid and increase bioavailability, soaking beans, grains, and seeds in water or by consuming more leavened grain products (due to the leavening breaking down part of the phytic acid), more zinc can be readily absorbed (Zinc, n.d.). Adequate intake for adolescents range from about 8mg to 11mg (Zinc, n.d.). In conclusion, those consuming a vegan diet should be aware of consuming enough due to the phytic acid decreasing bioavailability. Therefore, further increases in Zinc intake may be required.

 A vital nutrient throughout all stages of life, iron, works in both hemoglobin and myoglobin carrying oxygen throughout the blood to muscles. Deficiency in iron, resulting in low oxygen carrying capacity in the blood, can be extremely harmful to the development of an adolescent especially for young females beginning menstruation. Similar to zinc, plant-based sources are not as readily absorbed by the body being also inhibited by phytic acid contained in whole grains, legumes, lentils, nuts, polyphenols found in coffee, certain vegetables, and soy protein (Barr, 2004, pg.698). In order to increase the bioavailability of non-heme iron, iron found in plants, incorporate Vitamin C with iron-rich foods: fortified cereals, dark green leafy vegetables, nuts, seeds, and dried fruit (Mandali, 2011, pg.45). In order to prevent deficiency, vegan teenage athletes should be tested regularly and aim for an iron intake greater than their RDA which is >15 mg for female adolescents and >8 for adolescent males (Nutrition and Athletic Performance, pg.512).

 As adolescents go through stages of transformation, it is important proper fuel not only be available for growth but also as an athlete, be available for maintenance and repair. Calcium works in the growth, maintenance, and repair of bone tissue; regulation of muscle contraction; nerve conduction; and normal blood clotting (Nutrition and Athletic Performance, pg.513). As a growing active teen, low amounts may result in the likelihood of low-bone mass and stress fractures (Mandali, 2011). According to the National Institutes of Health, eating a vegan diet full of Dark Green Leafy Vegetables, fortified cereals, fortified orange juice, tofu, calcium-fortified soy milk or yogurt should sufficiently meet the daily recommended intake (Calcium, n.d.)

 Unlike micronutrients seen previously, Vitamin B12 is not naturally found in any vegan foods its primary source being that of meat. The teenage athlete (14-18 years old) requires about 2.4 micrograms of B12 a day” (Mandali, 2011). To avoid inadequate intake, fortified foods such as cereals, meat alternatives, soy or rice beverages, and soy products provide suitable alternatives (Craig, 2009). Like protein, supplementation may be desired.

 While the omnivorous teenage-athlete may not be concerned about reaching the Omega-3 RDI, one consuming a vegan diet should be made more aware of the potential for under-consumption. According to the National Institutes of Health, omega-3, an important component in our cell membrane, is high in [retina](https://ods.od.nih.gov/factsheets/Omega3FattyAcids-Consumer/) (eye), brain, and sperm cells while also playing a part in the blood vessels, [lungs](https://ods.od.nih.gov/factsheets/Omega3FattyAcids-Consumer/), [immune system](https://ods.od.nih.gov/factsheets/Omega3FattyAcids-Consumer/), and [endocrine system](https://ods.od.nih.gov/factsheets/Omega3FattyAcids-Consumer/) (Omega-3-Fatty Acids, n.d.). Adolescent needs may be appropriately met through the consumption of flax seeds, chia seeds, walnuts, avocadoes, nut butters, fortified soy products, and oils (Omega-3 Fatty Acids, n.d.). As always, specific amounts should be based on the individuals RDI.

 Our body works using the fat, protein, and carbohydrates we consume in order to produce all the energy we need. Riboflavin assists working at getting energy from the foods we consume. Because, riboflavin is a water-soluble B vitamin, it is not stored in the body and must be eaten every day (“Food Sources of Riboflavin”, n.d.). According to Gregory Cox in *The American Journal of Clinical Nutrition*, sources include grains, soy products, mushrooms, spinach, fortified cereals, yeast-extract spreads (i.e. Marmite and Vegemite).

**Supplementation**

 Using whole food sources for micronutrients and macronutrients are preferred when consuming a vegan diet. However, supplementation can sometimes be optimal for convenience and prevention of potential deficiencies. For example, due to the small amount of options that Vitamin B12 are found in, supplementation may be preferred if the adolescent does not like meat alternatives or processed cereals fortified with B12.

 Another supplement, frequently discussed in journals concerning athletes and/or vegans, are the possible benefits of the supplementation of creatine. According to David Nieman, in the *American Journal of Clinical Nutrition*, creatine, primarily found in meat, fish, and poultry, is a small source of ATP stored in the muscles used as an immediate source of energy in cases of anaerobic high-intensity exercise (Barr, 2004). An athlete performing various exercises at 100% effort for 20 seconds followed by complete rest for 10 seconds would be an example of anaerobic high intensity interval training. Barr sites in an experiment involving vegetarians and omnivores supplemented with creatine, results found vegetarian subjects experienced greater “increases in muscle creatine, bench-press strength, type 2 muscle fiber area, and whole body lean mass than subjects who consumed placebo” than that of the omnivores most likely due to having low creatine stores (Barr, 2004). Although the study only involved vegetarians and omnivores, not vegans, because creatine is found in meat, the effects should be the same due to vegans not consuming meat either. Overall, creatine is not a necessary supplement for the vegan athlete but may be of interest to one trying to reach optimal performance in sports involving short high intensity.

**Disordered Eating**

 Through the proper integration of a variety of foods and optional supplementation, the vegan adolescent athlete should be absolutely capable of thriving. However, for those supervising or in care of these athletes the reasoning behind the dietary choice should be considered. It is often that athletes choosing this lifestyle may be hiding behind a disordered relationship with food. Many adolescent athletes are likely not seeing a Sports Dietitian, so it is important parents and coaches overseeing these athletes be aware of possible signs of deficiency. Coaches should look for sign of disordered eating patterns, weight fluctuations, and abnormal fatigue in adolescent athletes (Mandali,2011). Adolescent athletes restricting their energy intake through use of the vegan diet may stunt growth through malnutrition.

 The Female Athlete Triad, a common disorder amongst developing female athletes, occurs as a result of disordered eating leading to menstrual irregularities and osteoporosis (Bernstein, pg. 337). This may occur due to the vegan female athlete naturally consuming a larger proportion of calories from carbohydrates over fat and/or attempting to stay lean or reach a certain weight for athletic performance. External factors such as social media’s emphasis on retaining a lean body may influence the athlete’s mindset. Long term risks include sports related injuries, bone loss, stress fractures, and infertility (Barr, 2004). It is vital female athletes maintain a certain fat percentage to retain their menstrual cycle, and to prevent osteoporosis, maintain the RDI of Calcium and Vitamin D.

**New Vegans**

 Young athletes new to following a vegan diet should be monitored due to the increase in fiber naturally occurring in plant foods. The increase in fiber may make the young adult feel full, but he/she may not be meeting the required amount of energy, especially due to high caloric expenditure in sports. “The consumption of adequate energy, particularly from carbohydrates, to match energy expenditure, is important so that amino acids are spared for protein synthesis and not oxidized” (Nutrition and Athletic Performance, pg. 508). If not, it may result in “unwanted loss of muscle mass; menstrual dysfunction and hormonal disturbances; suboptimal bone density; an increased risk of fatigue, injury, and illness; impaired adaptation; and a prolonged recovery process (Nutrition and Athletic Performance, pg. 521).

**Conclusion**

 Although possibility of deficiency seems easier with the consumption of a vegan diet, all required macronutrients and micronutrients required may be met. Through the consumption of a nutrient dense variety filled diet, any adolescent should be able to meet their Recommended Daily intake. If some nutrients prove harder to reach such as Iron, Protein, or Vitamin B12 supplementation may be recommended to prevent any possibility of malnutrition. To ere on the safe-side, vegan athletes may benefit from comprehensive dietary assessments and education to ensure their diets are nutritionally sound to support training and competition demands (Nutrition and Athletic Performance, pg. 520). Contrary to what many believe, adolescent athletes eating a large variety of fruits, vegetables, and legumes have the potential to have increased benefits over the omnivorous athlete such as a reduction in oxidative stress due to high antioxidant intake and a reduction in chronic disease and mortality rates (Nieman, 1999). As a future dietician, adolescent athletes meeting their Recommended Daily Intake, through the consumption of a nutrient dense, varied diet, will be able to fuel both their growth and athletics optimally.

Barr, & Rideout. (2004). Nutritional considerations for vegetarian athletes. *Nutrition,* *20*(7), 696-703.

Calcium. (n.d.). Retrieved March 13, 2018, from https://ods.od.nih.gov/factsheets/Calcium-HealthProfessional/.

Cox, G. (2001). The vegetarian athlete. *International SportMed Journal,2*(2), 1-8.

Craig, W. (2009). Health effects of vegan diets. *The American Journal of Clinical Nutrition,* *89*(5), 1627S-1633S.

Bernstein, M., & McMahon, K. (2018). *Nutrition across life stages*. Burlington, MA: Jones & Bartlett Learning.

Roll, R. (2013). *Finding Ultra: rejecting middle age, becoming one of the worlds fittest men*. Place of publication not identified: Random House.

Food Sources of Riboflavin (Vitamin B2). (n.d.). Retrieved March 01, 2018, from https://www.dietitians.ca/Your-Health/Nutrition-A-Z/Vitamins/Food-Sources-of-Riboflavin-(Vitamin-B2).aspx

Mandali, S. (2011). Coaching the Vegetarian Athlete. *Journal of Physical Education, Recreation & Dance,* *82*(2), 44-56.

Nieman, David C. (1999). Physical fitness and vegetarian diets: Is there a relation? *American Journal of Clinical Nutrition,* *70*(3), 570S-575S.

Nutrition and Athletic Performance. (n.d.). Retrieved March 01, 2018, from https://www.eatrightpro.org/practice/position-and-practice-papers/position-papers/nutrition-and-athletic-performance

Omega-3-Fatty-Acids.(n.d.).RetrievedMarch13,2018.from https://ods.od.nih.gov/factsheets/Omega3FattyAcids-Consumer/

Protein and the Athlete - How Much Do You Need? (n.d.). Retrieved March 13, 2018, from https://www.eatright.org/fitness/sports-and-performance/fueling-your-workout/protein-and-the-athlete

Rogerson, D. (2017). Vegan diets: Practical advice for athletes and exercisers. *Journal of the International Society of Sports Nutrition,* *14*(1), Journal of the International Society of Sports Nutrition, Sept 13, 2017, Vol.14(1).

Zinc.(n.d.).RetrievedMarch13,2018,from https://ods.od.nih.gov/factsheets/ZincHealthProfessional.