PEER-REVIEWED

SPORTS NUTRITION FOR STUDENTS WITH FOOD ALLERGIES & INTOLERANCES: NAVIGATING THE COMPLEXITIES

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Abstract

Food allergies (FA) among children and adolescents are becoming more prevalent, particularly in the U.S. A significant number of adverse food reactions occur at school. As nutrition resources, trainers and coaches must be aware of common FA issues as well as providing dietary guidance that will do no harm. For physical education teachers, a curriculum-based approach like Health Optimizing Physical Education may help to increase FA awareness and serve as a potential resource for those with FA. This paper will discuss general dietary recommendations for school-aged children, the differences between FA and food intolerances, as well as important considerations when providing dietary guidance to those with FA. Additional resources are also provided.

"A need has been identified to educate health professionals and the public regarding the prevalence of food allergies as well as foods that are most likely to trigger food allergies."

Proper nutrition is crucial for any form of physical activity and optimizing athletic performance. Fitness trainers and coaches, in particular, often serve as nutrition resources for their athletes (Torres-McGehee et al., 2012). It is estimated that as many as 79% of fitness professionals provide nutrition advice to their clients (Skopinceva, 2017). Given this, along with the relatively recent increase in food allergies (FA) particularly among children, it is imperative that coaches and fitness trainers are familiar with the epidemiology of and treatments for FA. In addition, it is important that schools create critical consumers by providing quality health and physical education. For physical education teachers, a curriculum-based approach like Health Optimizing Physical Education may help to create these knowledgeable consumers (Metzler et al., 2013a; Metzler et al., 2013b).

It is estimated that every 3 minutes, an individual is sent to the emergency room because of a FA (Clark et al., 2011). The Centers for Disease Control and Prevention (CDC) has estimated that the incidence of FA in those under 18 years of age has increased by 50% between 1997-2011 (Jackson et al., 2013). This spike in food allergies, particularly among children and adolescents, is considered by some an epidemic (Feng & Kim, 2019; Gupta et al., 2013). It has been estimated that between 16%-18% of food allergy reactions happen at school (Sicherer & Mahr, 2010) and more than 10% of schools of reported at least one case of anaphylaxis (Nowak-Wegrzyn, et al., 2001; Sicherer et al., 2001; White et al., 2015).

Several theories have been proposed for this increase in FA prevalence, but no consensus has been reached. Currently, approximately >300 million individuals experience a form of FA worldwide, of which approximately 15 million are in the U.S. Among U.S. patients, approximately 6% are children/adolescents (5-17 years) however, this estimate includes those that self-diagnose (Messina & Venter, 2020). FA may significantly reduce quality of life among both children and their caregivers (Gupta et al., 2013). Specifically, those with food allergies may be more likely to be bullied, depressed, experience anxiety or even post-traumatic stress syndrome (PTSS) (Feng & Kim, 2019). In fact, it has been estimated that only 4% of teachers reported first-hand knowledge of bullying among students with FA, despite the fact that 45.4% reported being bullied because of their FA (Rajan & Laubach, 2013). A need has been identified to educate health professionals and the public regarding the prevalence of FA as well as foods that are most likely to trigger a FA. Therefore, instructors need to be aware of these issues and serve as potential resources to their students and their families.

Food Allergies vs. Food Intolerances/Sensitivites

A food is defined as any substance intended for human consumption, regardless of the amount of processing (Boyce et al., 2011). However, other substances that may be ingested, either directly or indirectly, such as pharmaceuticals, cosmetics, and tobacco products are not considered foods.

Food Allergies. The origins of food allergies are largely unknown. Some have theorized that genetic susceptibility (particularly, the filament-aggregating protein, or filaggrin gene) in combination with early exposures to specific foods and antibiotics may contribute to the development of FA particularly in children (Collins, 2016; Tezza et al., 2013). Correlations between comorbidities and FA do exist (Boyce et al., 2011). For example, children with asthma or a history of recurring ear infections may be more likely to suffer from FA

(Boyce et al., 2011; Garg et al., 2014). However, what is known is the FA response involves the activation of the immune system and, specifically, IgE antibodies (Shils & Shike, 2006). Food allergens (which are typically naturally occurring proteins or chemical haptens found in the offending foods) trigger the production of IgE antibodies in those that are susceptible along with the rapid onset of FA signs and symptoms (Boyce et al., 2011; Messina & Venter, 2020; Shils & Shike, 2006). IgE antibodies then sensitize white blood cells, particularly mast cells and basophils (Shils & Shike, 2006). Upon re-exposure to the allergen, these sensitized cells release histamine, prostaglandins, and leukotrienes that stimulate the immune system cascade. The IgE-mediated onset of symptoms may include one or more of these systems: gastric (vomiting, diarrhea, cramping), dermal (hives, itching, eczema), respiratory (difficulty breathing, wheezing), and oral (tingling, itching). Food-induced anaphylaxis is the result of the failure of multiple organ systems likely due to the chemical mediators released by mast cells and basophils (Boyce et al., 2011). The severity of symptoms is based on two factors: i) sensitivity of the individual, and ii) amount of food ingested. Therefore, a highly sensitive individual that consumes a large serving of the offending food(s) will likely have more severe symptoms. Of note, those that experience respiratory symptoms after exposure are more likely to suffer from anaphylaxis.

Food Intolerances/Sensitivities. Food intolerances, such as lactose intolerance, do not involve an IgE-mediated immune response (Messina & Venter, 2020; Shils & Shike, 2006). Rather, food intolerances are often caused by defects in gastrointestinal enzymes and trigger an IgG- or IgA-mediated response (Ortolani & Pastorello, 2006). IgG and IgA antibodies are the most prevalent in the body and are often the body's first line of defense against foreign pathogens (Woof & Kerr, 2005). While these responses involve different immunoglobulins, symptoms of food intolerance may be similar to those presented during a FA. As opposed to triggering the immune cascade, these symptoms tend to be less severe and there is virtually no risk of anaphylaxis ("Food Allergy", 2021).

Common Sources of Food Allergies. There are eight common foods that trigger over 90% of allergic reactions in those sensitized (Boyce et al., 2011; Shils & Shike, 2006). These include (listed in order from highest to lowest prevalence): i) all species of shellfish, ii) milk, iii) peanuts, iv) tree nuts, including almonds, walnuts, pecans, cashews, Brazil nuts, macadamias, pistachios, hazelnuts, hickory nuts, chestnuts, and pine nuts, v) eggs (yolks and whites) of all avian species, vi) all species of fish, vii) wheat, viii) soy, and ix) sesame (Gupta et al., 2013; Gupta et al., 2019; Shils & Shike, 2006; Warren et al., 2019). Of these, the most common FA in children are peanuts, milk, shellfish, and tree nuts (Gupta et al., 2018). Among adults, the most prevalent FA are shellfish, milk, peanuts, and tree nuts (Gupta et al., 2019).

"Approximately 40% of children with a diagnosed food allergy are allergic to multiple foods"...

Some milks, such as goat milk, may be less allergenic when compared to cow's milk (Roncada et al., 2002). However, if a milk allergy has been reported, it is recommended that the individual abstain from consuming all animal-derived milks. Regarding tree nuts, coconuts, kola nuts and shea nuts are rarely allergenic (Shils & Shike, 2006).

Approximately 40% of children with a diagnosed FA are allergic to multiple foods (Gupta et al., 2018). Fortunately, many children will outgrow their food allergies over time (Boyce et al., 2011). Many children will be able tolerate eggs, soy, milk and wheat by the time they reach adulthood. However, allergies to tree nuts tend to persist.

Most allergenic foods are rich protein sources. Protein is a necessary component of a nutri-

tious diet and is important for optimal growth and cellular repair. The Dietary Guidelines for Americans 2015-2020 state that school-aged children and adolescents require approximately 19-52 grams of protein each day (Medicine, 2006). Given that common allergens are food-based proteins, children and adolescents with FA may avoid many common sources of dietary protein. As a result, many may not meet these recommendations. In fact, growth impairment and macro- and micronutrient deficiencies are quite prevalent in children with FA (Mehta et al., 2013). Additionally, children with FA may be smaller for their age when compared to their counterparts (Flammarion et al., 2011).

Food Allergy Diagnosis. Given there is no cure or treatments for FA, identification of offending foods and their avoidance is of utmost importance (Boyce et al., 2011). An individual's healthcare provider (ideally a clinician that specializes in food allergies) should determine which allergy tests are most appropriate. The most valid and reliable methods for FA testing include skin-prick tests and food elimination diets (Niggemann & Beyer, 2007). Typically, both are used in combination to determine those foods that are most likely to lead to allergic reactions. A food elimination diet requires the removal of one or a few specific foods and monitoring onset of specific signs and symptoms after the reintroduction of foods one at a time (Boyce et al., 2011). Double-blind placebo-controlled food challenges are considered the gold standard for diagnosing FA. However, others have reported issues with both of these methods, particularly given that cross-contamination may occur as well as issues of dietary compliance (Niggemann & Beyer, 2007). Skin prick tests may also be used to determine which foods are allergenic, but this needs to be used in combination with elimination diets and oral food challenges (Boyce et al., 2011). Diagnostic blood tests are not considered to be reliable or valid due to their high false-positive rates (Boyce et al., 2011). FA blood tests are testing food-specific IgE antibodies present in the body, however, there is an estimated 50-60% false positivity rate which may be the result of undigested food proteins or food proteins with similar molecular structures ("Blood Tests", 2021).

Providing Guidance to Those with Food Allergies

As nutrition resources, trainers and coaches must be aware of the common FA issues as well as providing dietary guidance that will do no harm. Therefore, complete avoidance of foods that are known to trigger an allergic response is critical. Similarly, some oils may not be allergenic based on the methods of processing. Whereas, others may continue to be highly allergenic. The quantity of food protein removed during processing may be the most important factor. Navigating these intricacies while providing dietary guidance can be complicated and contradictory at times. However, there are some important considerations that will likely apply to all, regardless of the specific FA they may experience:

- Nutrition guidance must always involve the parent(s) or caregiver(s). Fear reduction and improving self-efficacy may be worthwhile discussions. (Collins, 2016)
- Managing food allergies should incorporate a comprehensive approach that includes prevention, caution, and preparation for a reaction. (Collins, 2016) If a student has been identified with a true FA, coaches may need to discourage all student athletes from bringing the suspect food(s) to practice, games, the locker room, and other team gatherings to avoid exposure and potential reaction.
- Food allergies are considered a disability and reasonable accommodations must be made. (Collins, 2016)
- Those with food allergies should have an Emergency Anaphylaxis Plan. (Collins, 2016)
- Encourage careful reading of Nutrition Facts Labels. Depending on the severity of the FA, trace amounts of the allergen may trigger a reaction. Therefore, it is wise to look carefully at the ingredients listed. Ingredients are listed in order by weight, such that the first ingredient listed is what the product contains most of by weight.
- Do not rely on packaging statements such as, "may contain", "does not contain", "made in a facility that processes". The Food Allergen Labeling and Consumer Protection Act (FALCPA) does not validate the accuracy of these claims. These claims are provided voluntarily

by the manufacturer (Boyce et al., 2011)
- Encourage the client or student to speak to their doctor about whether it is safe to consume specific oils, particularly those made from foods that are allergenic. Some are safe to consume, whereas others may trigger potentially life-threatening reactions (Hefle, & Taylor, 1999; Crevel et al., 2000; Hoffman, & Collins-Williams, 1994; Taylor et al., 1981; Bush et al., 1985).

To avoid cross-contamination between allergenic and non-allergenic foods, proper hand washing after contact with allergenic foods is important. Soap and running water appear to be most effective. Hand sanitizers may not be as effective and therefore are not recommended. When cleaning commonly used food preparation surfaces (countertops, sinks, cutting boards, etc.), cleaning sprays and sanitizing wipes appear to be most effective. (Perry et al., 2004). However, it should be noted that in order to be most effective, cleaning wipes should contain a commercial cleaning detergent such as Clorox® or Lysol® (Perry et al., 2004). Additionally, cleaning sprays that contain detergents (i.e., Formula 409®) appear to be more effective. If cross-contamination is a recurring issue, separate food storage and food preparation spaces for use by those with FA may be needed. (Collins, 2016).

Fitness trainers and coaches often serve as nutrition resources for their athletes. Given this, along with the relatively recent increase in FA particularly among children and adolescents, trainers and coaches can better serve clients and students by providing accurate nutrition education while supporting their self-efficacy and overall quality of life. In addition, schools provide an important role in preparing both athletes and non-athletes in proper physical activity and nutrition practices through health and physical education. A curriculum model that is well outlined, such as Health Optimizing Physical Education that encourages collaboration among teachers (ex. physical education and health) and experts (ex. teachers, local and state health agencies, coaches, dietitcians, etc.) may be beneficial to create critical consumers during school age and beyond (Metzler et al., 2013a; Metzler et al., 2013b).

Additional Resources

- Center for Disease Control and Prevention Voluntary Guidelines for the Management of Food Allergies in Schools and Early Childhood Education
- Food Allergy Management and Education by St. Louis Children's Hospital
- Food Allergy & Anaphylaxis Connection Team's Food Allergy School Curricula Programs: http://www.foodallergyawareness.org/education/school_curricula_ program-2/

References

Blood Tests. Food Allergy Research and Education. (2021). Retrieved 12 April 2021, from https://www.foodallergy.org/resources/blood-tests.

Boyce, J. A., Assa'ad, A., Burks, A. W., Jones, S. M., Sampson, H. A., Wood, R. A., Plaut, M., Cooper, S. F., Fenton, M. J., Arshad, S. H., Bahna, S. L., Beck, L.A., Byrd-Bredbenner, C., Carmargo, C. A., Jr., Eichenfield, L., Furuta, G. T., Hanifin, J. M., Jones, C., Kraft, M.,... Yawn, B. P. (2011). Guidelines for the Diagnosis and Management of Food Allergy in the United States: Summary of the NIAID-Sponsored Expert Panel Report. Nutrition Research, 31(1), 61–75. https://doi.org/10.1016/j.nutres.2011.01.001

Bush, R., Taylor, S., Nordlee, J., & Busse, W. (1985). Soybean oil is not allergenic to soybean-sensitive individuals. Journal of Allergy and Clinical Immunology, 76(2), 242–245. https://doi.org/10.1016/0091-6749(85)90709-2

Clark, S., Espinola, J., Rudders, S. A., Banerji, A., & Camargo, C. A. (2011). Frequency of US emergency department visits for food-related acute allergic reactions. Journal of Allergy and Clinical Immunology, 127(3), 682–683. https://doi.org/10.1016/j.jaci.2010.10.040

Collins, S. C. (2016). Practice Paper of the Academy of Nutrition and Dietetics: Role of the Registered Dietitian Nutritionist in the Diagnosis and Management of Food Allergies. Journal of the Academy of Nutrition and Dietetics, 116(10), 1621–1631. https://doi.org/10.1016/j.jand.2016.07.018

Crevel, R. W., Kerkhoff, M. A., & Koning, M. M. (2000). Allergenicity of refined vegetable oils. Food and Chemical Toxicology, 38(4), 385–393. https://doi.org/10.1016/S0278-6915(99)00158-1

Feng, C., & Kim, J. H. (2019). Beyond Avoidance: the Psychosocial Impact of Food Allergies. Clinical Reviews in Allergy and Immunology, 57(1), 74–82. https://doi.org/10.1007/s12016-018-8708-x

Flammarion, S., Santos, C., Guimber, D., Jouannic, L., Thumerelle, C., Gottrand, F., & Deschildre, A. (2011). Diet and nutritional status of children with food allergies. Pediatric Allergy and Immunology, 22(2), 161–165. https://doi.org/10.1111/j.1399-3038.2010.01028.x

Food Allergy. The American Academy of Allergy, Asthma and Immunology. (2021). Retrieved 12 April 2021, from https://www.aaaai.org/conditions-and-treatments/library/allergy-library/food-allergy#:~:text=A%20food%20allergy%20involves%20the,is%20no%20risk%20of%20anaphylaxis.

Garg, N., & Silverberg, J. I. (2014). Association between childhood allergic disease, psychological comorbidity, and injury requiring medical attention. Annals of Allergy, Asthma, and Immunology, 112(6), 525-532. https://doi.org/10.1016/j.anai.2014.03.006

Gupta, R., Holdford, D., Bilaver, L., Dyer, A., Holl, J. L., & Meltzer, D. (2013). The economic impact of childhood food allergy in the United States. JAMA Pediatrics, 167(11), 1026–1031. https://doi.org/10.1001/jamapediatrics.2013.2376

Gupta, R. S., Warren, C. M., Smith, B. M., Blumenstock, J. A., Jiang, J., Davis, M. M., & Nadeau, K. C. (2018). The Public Health Impact of Parent-Reported Childhood Food Allergies in the United States. Pediatrics, 142(6), e20181235. https://doi.org/10.1542/peds.2018-1235

Gupta, R. S., Warren, C. M., Smith, B. M., Jiang, J., Blumenstock, J. A., Davis, M. M., Schleimer, R. P., & Nadeau, K. C. (2019). Prevalence and Severity of Food Allergies Among US Adults. JAMA Network Open, 2(1), e185630. https://doi.org/10.1001/jamanetworkopen.2018.5630

Hefle, S. (1999). Impact of processing on food allergens. Advances in Experimental Medicine and Biology, 107-119. https://doi.org/10.1007/978-1-4615-4853-9_8

Hoffman, D. R., & Collins-Williams, C. (1994). Cold-pressed peanut oils may contain peanut allergen. Journal of Allergy and Clinical Immunology, 93(4), 801-802.

Jackson, K. D., Howie, L. J. D., & Akinbami, L. J. (2013). Trends in allergic conditions among children: United States, 1997-2011. NCHS Data Brief, (121), 1–8.

Medicine, I. of. (2006). Table A7-1. In Dietary Reference Intakes: The essential guide to nutrient requirements. Washington D.C.: The National Academies Press.

Mehta, H., Groetch, M., & Wang, J. (2013). Growth and nutritional concerns in children with food allergy. Current Opinion in Allergy and Clinical Immunology, 13(3), 275–279. https://doi.org/10.1097/ACI.0b013e328360949d

Messina, M., & Venter, C. (2020). Recent Surveys on Food Allergy Prevalence. Nutrition Today, 55(1), 22–29. https://doi.org/10.1097/NT.0000000000000389

Metzler, M. W., McKenzie, T. L., van der Mars, H., Williams, L. H., & Ellis, S. R. (2013). Health optimizing physical education (HOPE): A new curriculum model for school programs-part 1: Establishing the need and describing the curriculum model. Journal of Physical Education, Recreation, and Dance, 84(4), 41–47. https://doi.org/10.1080/07303084.2013.773826

Metzler, M. W., McKenzie, T. L., van der Mars, H., Barrett-Williams, S. L., & Ellis, R. (2013). Health optimizing physical education (HOPE): A new curriculum for school programs-Part 2: Teacher knowledge and collaboration. Journal of Physical Education, Recreation & Dance, 84(5), 25–34. https://doi.org/10.1080/07303084.2013.779531

Niggemann, B., & Beyer, K. (2007). Pitfalls in double-blind, placebo-controlled oral food challenges. Allergy: European Journal of Allergy and Clinical Immunology, 62(7), 729–732. https://doi.org/10.1111/j.1398-9995.2007.01396.x

Nowak-Wegrzyn, A., Conover-Walker, M. K., & Wood, R. A. (2001). Food-Allergic Reactions in Schools and Preschools. Archives of Pediatrics & Adolescent Medicine, 155(7), 790. https://doi.org/10.1001/archpedi.155.7.790

Ortolani, C., & Pastorello, E.A. (2006). Food allergies and food intolerances. Best Practice and Research Clinical Gastroenterology, 20(3), 467-483. https://doi.org/10.1016/j.bpg.2005.11.010.

Perry, T. T., Conover-Walker, M. K., Pomés, A., Chapman, M. D., & Wood, R. A. (2004). Distribution of peanut allergen in the environment. Journal of Allergy and Clinical Immunology, 113(5), 973–976. https://doi.org/10.1016/j.jaci.2004.02.035

Rajan, J., & Laubach, S. (2013). Child and parental reports of bullying in a consecutive sample of children with food allergy. Pediatrics, 132(SUPPL.1). https://doi.org/10.1542/peds.2013-2294KK

Roncada, P., Gaviraghi, A., Liberatori, S., Canas, B., & Bini, L.G.G. (2002). Identification of Caseins in Goat Milk. Proteomics, 2(6), 723–726. https://doi.org/10.1002/1615-9861(200206)2:6<723::AID-PROT723>3.0.CO;2-I

Schaub, J., & Marian, M. (2011). Reading, writing, and obesity: America's failing grade in school nutrition and physical education. Nutrition in clinical practice: official publication of the American Society for Parenteral and Enteral Nutrition, 26(5), 553–564. doi: 10.1177/0884533611416820

Shils, M.E., & Shike, M. (2006). Modern Nutrition in Health and Disease (10th ed.). Lippincott, Willams, & Wilkins.

Sicherer, S. H., & Mahr, T. (2010). Management of Food Allergy in the School Setting. PEDIATRICS, 126(6), 1232–1239. https://doi.org/10.1542/peds.2010-2575

Sicherer, S. H., Furlong, T. J., DeSimone, J., & Sampson, H. A. (2001). The US Peanut and Tree Nut Allergy Registry: Characteristics of reactions in schools and day care. The Journal of Pediatrics, 138(4), 560–565. https://doi.org/10.1067/mpd.2001.111821

Skopinceva, J. (2017). Assessing the Nutrition Related Knowledge, Attitudes, and Beliefs of Fitness Professionals. Advances in Obesity, Weight Management & Control, 6(3). https://doi.org/10.15406/aowmc.2017.06.00160

Taylor, S., Busse, W., Sachs, M., Parker, J., & Yunginger, J. (1981). Peanut oil is not allergenic to peanut-sensitive individuals. Journal of Allergy and Clinical Immunology, 68(5), 372–375. https://doi.org/10.1016/0091-6749(81)90135-4

Tezza, G., Mazzei, F., Boner, A. (2013). Epigenetics of Allergy. Early Human Development, 89(S1), S20–S21. https://doi.org/10.1016/S0378-3782(13)70007-0

Torres-McGehee, T. M., Pritchett, K. L., Zippel, D., Minton, D. M., Cellamare, A., & Sibilia, M. (2012). Sports nutrition knowledge among collegiate athletes, coaches, athletic trainers, and strength and conditioning specialists. Journal of Athletic Training, 47(2), 205–211. https://doi.org/10.4085/1062-6050-47.2.205

Warren, C. M., Chadha, A. S., Sicherer, S. H., Jiang, J., & Gupta, R. S. (2019). Prevalence and Severity of Sesame Allergy in the United States. JAMA Network Open, 2(8), e199144. https://doi.org/10.1001/jamanetworkopen.2019.9144

White, M. V., Hogue, S. L., Bennett, M. E., Goss, D., Millar, K., Hollis, K., Siegel, P. H., Wolf, R. A., Wooddell, M. J., & Silvia, S. (2015). EpiPen4Schools pilot survey: Occurrence of anaphylaxis, triggers, and epinephrine administration in a U.S. school setting. Allergy and Asthma Proceedings, 36(4), 306–312. https://doi.org/10.2500/aap.2015.36.3859