Sports, Cardiovascular, and Wellness Nutrition
a dietetic practice group of the Academy of Nutrition and Dietetics

SCAN'S Pulse

Spring 2020, Vol. 39, No. 2

CONTENTS

CPE article

Oral Health Disparities in Athletes

by Katelynn Sasaki, MS, RD

For this feature article plus the following one, the Academy of Nutrition and Dietetics, an accredited Provider with the Commission on Dietetic Registration (CDR), has approved a total of 1 continuing professional education unit (CPEU), level 1. To apply for ***free*** *CPE credit, go to* www.scandpg.org/nutrition-info/pulse-newsletters/) and click ***Take The Quiz Now.*** *Upon successful completion of the quiz, a Certificate of Completion will appear in your My Profile (under the heading, My History). The certificate may be downloaded or printed for your records.*

Learning Objectives

After you have read this article, you will be able to:

- Discuss the findings of current evidence regarding oral health behaviors among athletes, and identify areas for future research.
- Summarize the general oral health recommendations of the American Dental Association and their objectives.
- Explain ways in which sports dietitians can play a role in influencing the oral health of their clients.

Physical and mental health both have vital roles in athletic performance. However, oral health is an often-overlooked aspect of physical health. Research has demonstrated a disparity between oral health behaviors and oral health status in athletes and the recommendations from dentists and periodontists.[1,2] Dietitians can incorporate oral health considerations into nutrition recommendations to better support athletes.

Why Oral Health Matters for Athletes

The relationship between athletes and oral health has previously focused on the risk of trauma to oral health. However, chronic oral health neglect can negatively impact general health and other aspects of athletes' lives. As has been reviewed, athletes have reported experiencing high rates of dental caries, periodontal disease, and erosive tooth wear.[1] Poor dental and oral health also can have negative impacts on quality of life, systemic inflammation, and performance.[1,2,3] Much of the evidence on performance effects is based on self-reporting, but athletes also experience pain, time lost training, infection, impaired socialization, loss of sleep, trouble eating, and general discomfort.[3]

Dental Recommendations

Dental erosion, caries, and periodontal disease are related to plaque biofilm, salivary flow, and oral pH. Current dental recommendations from the American Dental Association (ADA)[4] include:

1. Brushing teeth twice a day with fluoride toothpaste for 2 minutes each
2. Daily interdental cleaning
3. Limiting sugary beverages and snacks
4. Regular dentist visits twice yearly

These recommendations are intended to reduce risk of erosion, caries, and periodontal disease, but should be accompanied by individual dental recommendations after seeing a professional.

Current Oral Health Behaviors

There have been consistent reports of poor oral health in athletes since the first reported data from the 1968 Olympic games athletes.[5] During the 2012 Olympic games, dental consultations were 30% of all reported medical visits, second only to musculoskeletal visits.[6] European and Asian researchers have since continued to investigate oral health behaviors and oral health status of athletes, and findings remain indicative of poor oral health.

More recently, Gallagher et al investigated reported oral health behaviors of elite athletes (n=352) in the United Kingdom (UK).[7] While the majority of athletes reported brushing their teeth at least twice a day, there was a discrepancy regarding the use of additional methods for oral hygiene. These neglected methods included use of an electric toothbrush, fluoride mouthwash, interdental cleaning, regular dentist visits, and sugar-free chewing gum. Incorporating the additional cares into daily practice was suggested to improve oral health. These data support previous studies showing discrepancies between recommended oral health behaviors and reported athlete behaviors. However, when asked to rate their willingness to change habits, the majority of athletes reported confidence in their ability to change if it improved oral health. Confidence and willingness to change indicate the possibility of improvement with oral care intervention.

The effects of unsupported oral health behaviors have also been investigated. Professional soccer players in Thailand (n=25) reported brushing their teeth twice daily, but two thirds had not had a dental examination or hygiene care in the past year.[8] Each athlete was evaluated by the same dentist and 84% were found to have dental caries, averaging 10 affected teeth per person. Unlike the study in the UK, this study found a lower proportion of athletes willing to change habits or ranking oral health as a priority.

While there is conflicting evidence surrounding exact etiology or methodology for intervention, there is a consensus of poor oral health in athletes.[1,7,8] Dental caries, periodontal disease, and erosive tooth wear are all considered to be preventable. Remaining questions are W*hy is athlete oral health still poor?* and H*ow can improvements be made?*

Impact of Health Care Infrastructure on Oral Health

A number of the studies recently published have been conducted in Europe and Asia, mainly the UK and Thailand. It is possible that the emphasis on oral health in these countries is related to health care infrastructure and availability. In addition, cultural perspectives and values of different health care modalities or aspects of health likely influence use of services.

The National Health Service of the UK provides health care coverage financed by taxes. This is beneficial when considering health care accessibility and socioeconomic class equality by dramatically reducing the out-of-pocket costs for medical intervention and prescription medications. Equal access to health care and increased promotion of public health have resulted in positive health outcomes for the UK such as increased

From The Editor

You're Never a Loser…

by Mark Kern, PhD, RD, Editor-in-Chief

Until you quit trying. The great football player and coach Mike Ditka is credited for that truism. It's one of the reasons I try to never completely finish anything, but another way to avoid being a loser is to successfully complete something…like this issue of *PULSE*.

On the cover you'll find an article by Katelynn Sasaki, MS, RD that will help you to brush up on your knowledge of oral health in athletes. That article is doing double duty in this issue, because we've obtained permission to use it along with the next article on the cardiovascular benefits of blueberries to serve as a free CPE unit. In the latter article, Emily Woolf, MS, NDTR and Sarah Johnson, PhD, RDN provide an excellent review of this seemingly potent functional food. Lastly, Natalie Allen, MEd, RDN, Shannon Hauschildt, MS, PA-C, Melissa Penkalski, DNP, APRN, and Kristin Paloncy, EdD, ATC describe their approach to using a case study for enhancing interprofessional education for dietetics students working with athletes.

And remember: You haven't really finished *PULSE* until you've had a chance to read what's new in SCAN, what has happened at a recent conference or two, what new books are out there (hint: there's a really good one to read about on page 18), and all the rest. So don't give up on this issue until you're done.

life expectancy, decreased length of hospital stay, and decreased smoking rates.[9] However, the system comes with a wait for elective procedures and specialized care appointments. This makes it more difficult for individuals to choose health care providers and advocate for their health. It is reportedly difficult to find a dentist in the UK's National Health Service, possibly explaining the low number of athletes reporting regular dental visits.[4,7]

Thailand has recently seen changes in its health care system in efforts to improve public health. Thailand began Universal Healthcare Coverage (UHC) in 2002 and has been making progress in improving health outcomes for all, including decline of infant deaths and increased life expectancy.[10] However, there is a continued need for improvement in quality of care, comprehensive care, and accessibility across different geographic regions.[11]

It is important to note that since less research on dental health of athletes in other countries is available, similar research is needed around the world to determine if dietetics professionals should prioritize the dental health of athletes in other locations. Until more is learned, it is important for dietetics professionals to consider dental health of their clients.

Factors Influenced by Dietitians

As sports dietitians advocate for athlete health, there is a responsibility to advocate for all aspects of health and well-being. This includes referring athletes to the appropriate health professionals and considering nutrition's role in overall health recommendations. In regard to oral health, dietitians have the potential to influence frequency of eating and hydration routines. Both factors can influence saliva production and carbohydrate contact with the enamel.[4,12,13] Incorporating oral health screening questions and an oral cavity examination may be important for recognizing oral health issues before they could become severe enough to negatively impact athletic performance and/or participation.

> "There have been consistent reports of poor oral health in athletes since the first reported data from the 1968 Olympic games athletes." [5]

Dietitians have the opportunity to work with athletes to develop a fueling plan that supports oral health while providing nutrition for performance and recovery. Some dentists recommend reducing snacks, especially carbohydrate-rich snacks, in order to reduce risk for enamel erosion. Reducing snacks between meals is a challenge for athletes due to pre- and post-training nutrition needs and

increased energy expenditure. In addition, carbohydrate gels, chews, and drinks for endurance athletes further increase enamel exposure. Evidence between these carbohydrate supplements and erosion are conflicting, but dietitians may encourage athletes to bring this concern to their regular dentist visits for individualized oral health practices.[4,12] The necessity of use for these supplements can also be evaluated. For example, higher acidity sports drinks could be replaced by milk and/or water with proper post-event fuel or less acidic electrolyte drinks could be substituted. Altering fueling routines may not be feasible to all athletes, but dentists may recommend specialized rinses, pastes, or other additional precautions at their discretion to mitigate any potential harm.[12,13] Dietitians could be involved in promoting a team culture shift to incorporate oral care following practice and events just as post-exercise showering is customary.

Dietitians should also add emphasis on hydration during and after training or competition in order to maintain saliva flow and pH of the oral cavity. Drinking or rinsing with water after consuming carbohydrate-rich snacks or beverages is also suggested to reduce contact time with tooth enamel.[12-14] Dietitians can work with athletes to develop a hydration routine and habituate water consumption after snacks or beverages.

Future Research

Given the current literature, dietitians should feel comfortable referring athletes to oral health professionals for individualized advice and encouraging athletes to follow general guidelines. The exact etiology of dental and oral diseases in athletes remains unclear, but adherence to general ADA guidelines is suggested to maintain proper oral health. Current research is conflicting regarding supplementation and electrolyte drink use, and narrowing down detrimental practices or specific foods and beverages would be beneficial to building nutrition recommendations without unnecessary restrictions. In addition, there is limited research investigating differences in oral health between elite athletes and general populations or differences between various sports and exercise. Although oral health and access data of athletes are lacking in the United States, sports dietitians are in a good position to lead athletic care teams in oral health screenings and behavior change to support overall health of their athletes.

"Altering fueling routines may not be feasible to all athletes, but dentists may recommend specialized rinses, pastes, or other additional precautions at their discretion to mitigate any potential harm."[12,13]

Katelynn Sasaki, MS, RD is a clinical dietitian in Orange County, California.

References

1. Needleman I, Ashley P, Fine P, et al. Oral health and elite sport performance. *Br J Sports Med.* 2014:49:3-6.
2. Yapıcı H, Ero lu O, Ayan S, et al. The relation between performance and oral health in male athletes. *EuRJ*. 2019:5:1007-1013.
3. Bryant S, McLaughlin K, Morgaine K, et al. Elite athletes and oral health. *Int J Sports Med*. 2012:*32*:720-724.
4. Home Oral Care. Available at: https://www.ada.org/en/member-center/oral-health-topics/home-care. Published August 29, 2019. Accessed October 29, 2019.
5. Ashley P, Di Iorio A, Cole E, et al. Oral health of elite athletes and association with performance: a systematic review. *Br J Sports Med*. 2014:49:14-19.
6. Vanhegan IS, Palmer-Green D, Soligard T, et al. The London 2012 Summer Olympic Games: an analysis of usage of the Olympic Village 'Polyclinic' by competing athletes. *Br J Sports Med*. 2013:47:415-419.
7. Gallagher J, Ashley P, Petrie A, et al. Oral health-related behaviours reported by elite and professional athletes. *Br Dent J*. 2019:227:276-280.
8. Chantaramanee A, Samnieng P. Oral health status and impact on performance of professional soccer players. *JDI.* 2016:23:1-4.
9. Cylus J, Richardson E, Findley L, et al. Health systems in transition. *Health*. 2015:17
10. Sumriddetchkajorn K, Shimazaki K, Ono T, et al. Universal health coverage and primary care, Thailand. *Bulletin of the World Health Organization*. 2019:*97*:615.
11. World Health Organization. The Liverpool Declaration. Promoting oral health in the 21st century. Available at: http://www.who.int/oral_health/events/liverpool_declaration/en/. Accessed October 31, 2019.
12. Antunes LS, Veiga L., Nery VS, et al. Sports drink consumption and dental erosion among amateur runners. *J Oral Sci*. 2017:59:639-643.
13. Needleman I, Ashley P, Fine P, et al. Consensus statement: Oral health and elite sport performance. *Br Dent J*. 2014:217:587.
14. Broad EM, Rye LA. A. Do current sports nutrition guidelines conflict with good oral health? *Gen Dent*, 2015:63:18-23.

CPE article

Blueberries for Cardiovascular Health: An Update on Clinical Evidence and Possible Mechanisms

by Emily K. Woolf, MS, NDTR and Sarah A. Johnson, PhD, RDN

For this feature article and the preceding one, the Academy of Nutrition and Dietetics, an accredited Provider with the Commission on Dietetic Registration (CDR), has approved a total of 1 continuing professional education unit (CPEU), level 1. To apply for ***free*** *CPE credit, go to* www.scandpg.org/nutrition-info/pulse-newsletters/) and click ***Take The Quiz Now.*** *Upon successful completion of the quiz, a Certificate of Completion will appear in your My Profile (under the heading, My History). The certificate may be downloaded or printed for your records.*

Learning Objectives

After you have read this article, you will be able to:

- Summarize the research on the effects of blueberry consumption on blood pressure and vascular function.
- Describe the proposed mechanisms of action theorized to explain how blueberry consumption impacts cardiovascular health and function.
- Identify the nutrients in blueberries that may be responsible for exerting beneficial effects on cardiovascular health.

Cardiovascular disease (CVD) is the leading cause of death in the United States, and is defined as a group of conditions that include atherosclerosis, ischemic or hemorrhagic stroke, congestive heart failure, arrhythmias, chronic hypertension, and/or heart valve disease.[1] Advancing age is the primary risk factor for CVD, due in large part to development of age-related vascular dysfunction, including endothelial dysfunction and arterial stiffness.[2] Vascular dysfunction often leads to hypertension (HTN). Likewise, HTN can cause and accelerate vascular dysfunction. Therefore, attenuating these major risk factors may decrease CVD risk.[2] The American Heart Association projects that more than 130 million adults in the U.S. will have some form of CVD by 2035, increasing total CVD health care costs to $1.1 trillion.[1] With increasing health care costs and CVD-associated morbidity and mortality, effective preventive measures that also have high consumer acceptability are needed.

> "In particular, blueberries are one of the highest ranked fruits for (poly)phenolic compounds and are rich in anthocyanins, proanthocyanidins, flavan-3-ols, flavonols, phenolic acids, and stilbenes." [5-6]

Lifestyle modifications, such as diet and nutrition, have high potential for decreasing the risk of developing CVD.[3] A diet rich in plant foods, including fruits and vegetables, has been considered beneficial for cardiovascular health due to their phytochemical and nutrient contents and associated effects *in vivo* including antioxidant effects.[3,4] (Poly)phenolic compounds, e.g., flavonoids such as anthocyanins and non-flavonoid compounds such as stilbenes, have been studied for their positive effects on cardiovascular health.[4] In particular, blueberries are one of the highest ranked fruits for (poly)phenolic compounds and are rich in anthocyanins, proanthocyanidins, flavan-3-ols, flavonols, phenolic acids, and stilbenes.[5-6] Blueberries also contain various nutrients including dietary fiber, vitamins C and K, and manganese,[5] all of which are involved in the regulation of cardiovascular health.[7-9] Accumulating evidence continues to demonstrate the positive impact of blueberries on cardiovascular health in various populations.[10-19] This article provides an overview of the impact of chronic blueberry consumption on blood pressure and vascular function in humans, and summarizes the potential mechanisms through which blueberries exert their effects to reduce CVD risk.

Blueberries and Cardiovascular Disease Risk Factors

Hypertension

Blood pressure is the force of blood flowing through blood vessels. Chronic high blood pressure, also known as HTN, contributes to the risk of developing CVD due to the constant pressure and stress placed on

the heart and blood vessels.[1] Onset of HTN can be caused by a variety of events, such as malnutrition, family history and genetics, age, sex, ethnicity, diabetes, physical inactivity, obesity, and over consumption of alcohol and tobacco.[2] The increased CVD risk caused by HTN is mediated by arterial stiffening and endothelial dysfunction, among other factors such as placing stress on the heart and thus causing left ventricular hypertrophy.[21] Likewise, age-related vascular dysfunction can cause high blood pressure, particularly isolated systolic HTN.[2]

Clinical trials have shown that 6 to 8 weeks of 22-38 g freeze-dried blueberry powder significantly decreased brachial systolic and/or diastolic blood pressure by 3.0 to 7.8 mmHg and 2.0 to 5.5 mmHg, respectively, in adult men and postmenopausal women,[3,10] while one study showed aortic systolic pressure was lowered by 12 mmHg in sedentary men and women after 6 weeks consumption of 38 g freeze-dried blueberry powder.[22] Although blueberries are promising with respect to reducing blood pressure, the research is equivocal, with some studies demonstrating no reductions in blood pressure.[23,10,15,22] A possible reason for the discrepancy is that clinical trials not demonstrating a benefit included study populations that did not have high blood pressure to begin with, or high blood pressure was not consistent among all study participants (e.g., in those with metabolic syndrome [MetS]).[15,23] In addition, the duration of the intervention may be a contributing factor. Based on the current evidence, blueberry consumption for at least 6 weeks may be required to improve blood pressure in certain populations.[12,18] However, more research is needed to elucidate the antihypertensive effects of blueberries in humans.

Endothelial Dysfunction

The vascular endothelium is a thin layer of endothelial cells lining the inner wall of all blood vessels and is responsible for secreting vasoactive molecules controlling blood flow, thromboresistence, vascular smooth muscle cell proliferation, cellular adhesion, inflammation, and vascular tone (i.e., the degree of vasoconstriction to vasodilation).[2,24] A major contributing factor of the endothelium to the maintenance of cardiovascular health is the ability to produce nitric oxide (NO), a potent vasodilator. Endothelial dysfunction is characterized by increased vasoconstriction relative to vasodilation, as well as a procoagulative, prothrombotic, and pro-inflammatory state. Reduced bioavailability of NO appears to underlie endothelial dysfunction and is driven by excessive vascular oxidative stress.[2,25]

> "Reduced bioavailability of NO appears to underlie endothelial dysfunction and is driven by excessive vascular oxidative stress."[2,25]

Two commonly used methods to assess endothelial function include ultrasound-assessed flow-mediated dilation (FMD) of the brachial artery, and peripheral arterial tonometry-assessed reactive hyperemia index (RHI), both measuring the ability for blood vessels to expand in response to a hyperemia episode mediated through blood-pressure cuff occlusion of the arm.[2] Recently, Curtis et al found that consuming 25 g freeze-dried blueberry powder (equivalent to ~ 1 c fresh blueberries) daily for 6 months significantly improved FMD by 1.45% in individuals with MetS.[10] Similarly, Stull et al showed daily consumption of 45 g freeze-dried blueberry powder (~ 2 c fresh blueberries) for 6 weeks significantly increased RHI scores by 0.32 in adults with MetS.[23] Lastly, 22 g freeze-dried blueberry powder taken daily for 8 weeks increased blood NO metabolite levels in postmenopausal women with pre- or stage 1-HTN, suggesting improved NO bioavailability.[12] Collectively, these results suggest that chronic blueberry consumption may decrease CVD risk by improving endothelial function.

Arterial Stiffness

Arterial stiffness is characterized by stiffening or hardening of the arteries, which reduces ability of the arteries to expand and recoil to buffer the energy of the pulse wave.[2] Even though physical inactivity, malnutrition, and obesity contribute to and can accelerate arterial stiffening, aging is the primary risk factor due to thickening of the walls and reduced elastic properties over time.[26-27] This causes the heart to work harder and can lead to increased systolic blood pressure and left ventricular hypertrophy, and can cause damage to the vasculature of the brain, kidneys, and other tissues.[2]

One way to clinically measure arterial stiffness is through pulse wave velocity (PWV), which measures the rate of pulse wave between two arterial segments.[2,28] Johnson et al demonstrated that 8 weeks of 22 g freeze-dried blueberry powder (~1 cup fresh blueberries) decreased brachial-ankle PWV in postmenopausal women with pre- and stage 1-HTN.[2] Another measure of arterial stiffness is augmentation index (AIx), the proportion of central aortic pulse pressure that results from arterial wave reflection secondary to arterial stiffness.[2,29] McAnulty et al showed that daily consumption of 38 g freeze-dried blueberry powder for 6 weeks decreased AIx by 4.25% in sedentary men and women.[22] Also, Curtis et al found that higher consumption (26 g), but not lower consumption (13 g), of freeze-dried blueberry powder and consumption for a longer duration (6 months) sig-

nificantly decreased AIx by 2.24% in individuals with MetS.[10] Overall, blueberries may have the potential to reverse arterial stiffness to a degree in high-risk populations.

Mechanisms of Action of Blueberries on CVD

Studies examining health benefits of blueberry (poly)phenolic compounds have demonstrated their impacts on cardiovascular health and function, and have provided insight into potential mechanisms.[46] In particular, studies in cell and animal models, and in humans, have shown that blueberries, their bioactive compounds, and the resulting metabolites positively impact cardiovascular health[30-31] through modulation of vascular function,[11,32] oxidative stress,[33-36] lipid metabolism,[37-39] and inflammation.[40-43] Following is a discussion of the potential mechanisms of action:

Oxidative Stress

Oxidative stress results from the overproduction or insufficient removal of reactive oxygen/nitrogen species (ROS/RNS).[44-45] Nicotinamide adenine dinucleotide phosphate (NADPH) oxidase (NOX) activation promotes excessive superoxide radical production within the vasculature, which can lead to endothelial NO synthase (eNOS; enzyme that catalyzes the production of NO from L-arginine) uncoupling. Uncoupling of eNOS causes the enzyme to produce superoxide radicals instead of NO, thereby exacerbating vascular oxidative stress, oxidative damage to vascular tissues, and reduced NO bioavailability.[46] NO is a potent vasodilatory molecule also important for other aspects of vascular health, and therefore reduced NO bioavailability can further provoke tissue injury, inflammation, disruption of blood flow, among other factors, within the vasculature.[44] It is postulated that the beneficial effects of blueberries on oxidative stress are due to downregulation of NOX, scavenging of free radicals, and/or upregulation of endogenous antioxidant enzyme system by its (poly)phenolic compounds and their metabolites.[46-48]

eNOS/NO/cGMP Pathway

Mechanistic studies suggest that blueberries, their (poly)phenolic compounds, and their metabolites positively affect vascular function through activation of the eNOS/NO/cGMP signaling pathway.[46] By way of catalyzing the production of NO, eNOS activation is important for activation of the cyclic guanosine monophosphate (cGMP) signaling-pathway.[46] After NO is produced in endothelial cells, it diffuses to vascular smooth muscle cells, where it activates soluble gyanylyl cyclase generating cGMP. This leads to activation of protein kinase G, resulting in smooth muscle relaxation and vasodilation.

Bharat et al found that the blueberry anthocyanin metabolites malvidin-3-glucoside and cyanidin-3-glucoside attenuated palmitate-induced NO bioavailability reduction in human aortic endothelial cells.[11] Similarly, Park et al found that pterostilbene, a stilbene in blueberries, was able to stimulate NO production via the eNOS pathway in human umbilical venous endothelial cells.[32] One rat study demonstrated that consumption of an 8% (wt/wt) freeze-dried blueberry diet for 7 weeks improved *ex vivo* NO-mediated relaxation of arteries isolated from rats using a method known to be eNOS-dependent.[49] With this, it can be suggested that blueberries exert positive effects on vascular function, in part, through activation of eNOS.

Inflammation

Inflammation is the body's immune response to injuries, pathogens, and/or irritants and is characterized by an increase in the levels of pro-inflammatory molecules such as C-reactive protein (CRP), tumor necrosis factor-alpha (TNF-), monocyte chemotactic protein-1 (MCP-1), intercellular adhesion molecule-1 (ICAM-1), vascular cell adhesion molecule-1 (VCAM-1), E-selectin, and interleukins (IL-1 , IL-1 , IL-6, IL-8, and IL-12).[11,46] Chronic inflammation, particularly vascular inflammation, is associated with the development of CVD, partly through its role in the development of vascular dysfunction, hypertension, and atherosclerosis.[2,50]

Cell and animal studies have demonstrated that blueberry metabolites decreased the production of some of these pro-inflammatory molecules.[11,30,40-42,51] In particular, human vascular endothelial cells treated with the blueberry anthocyanin metabolites malvidin-3-glucoside and cyanidin-3-glucoside, or blueberry extracts, decreased the production of IL-1 , TNF- , MCP-1, ICAM-1, E-selectin, and/or VCAM.[11,43] Furthermore, using rat animal models, treatment with 1% to 10% of freeze-dried blueberry powder for 5 to 8 weeks decreased the circulating levels of pro-inflammatory markers TNF- , IL-6, CRP, and/or T helper type 1 cells.[30,40-41,52] One way that production of TNF- and IL-6 is downregulated in cells by blueberry consumption may be due to down regulation of mitogen-activated protein kinase/c-Jun NH2-terminal kinase (MAPK/JNK) and MAPK p38 pathways.[41] Lastly, a clinical human trial has demonstrated that 22.5 g freeze-dried blueberry powder consumed twice daily decreased monocyte gene expression of TNF- and IL-6 in individuals with MetS.[56] Collectively, these studies suggest that blueberry consumption may de-

> "Overall, blueberries may have the potential to reverse arterial stiffness to a degree in high-risk populations."

crease chronic inflammation, thereby contributing to decreased CVD risk.

Lipid Metabolism

Hyperlipidemia occurs when there are increased levels of lipids in the circulatory system. Chronic high blood lipid profiles, particularly when coupled with oxidative stress, can promote low-density lipoprotein (LDL) oxidation and peroxidation, and adipogenesis (formation of fat cells) within the arteries, all of which are contribute to atherosclerosis.[38,46,53] (Poly)phenolic compounds in blueberries have been shown to fight against adipogenesis *in vitro* by suppressing adipocyte differentiation.[53] Furthermore, Vendrame et al found that feeding obese Zucker rats a 10% freeze-dried wild blueberry diet for 8 weeks decreased total plasma cholesterol and triglyceride concentrations.[38] This could possibly be, in part, due to blueberry (poly)phenolic compounds and their metabolites being able to increase expression of transcription factor peroxisome proliferator-activated receptors, which has been identified to regulate lipid metabolism.[38,54] Wu et al found that 1% of freeze-dried whole blueberry for 20 weeks decreased LDL oxidation in rats, independent of serum lipid levels and TAC.[55] Lastly, daily consumption of 50 g freeze-dried blueberry powder for 8 weeks decreased plasma oxidized LDL in MetS participants.[57] Overall, blueberries may modulate lipid metabolism and/or reduce the oxidation of LDL, thus reducing the risk for atherosclerosis or other CVDs.

Conclusion

In conclusion, blueberries are a promising functional food and/or dietary component for reducing the risk of CVD (**Fig. 1**). The body of evidence continues to expand in a way that demonstrates the positive effects of blueberries on cardiovascular health, including endothelial function, arterial stiffness, blood pressure, oxidative stress, and inflammation in a number of cell, animal, and human studies. Nonetheless, there is variability in the findings across studies. The reasons remain unclear at this time but are likely due to differences in study designs and methodologies employed, treatment amount and duration of exposure, and inter-individual and inter-population or group variability in the health of study participants and their responses to the interventions.

Collectively, the findings of clinical human studies suggest that consumption of as low as 22 g freeze-dried blueberry powder (equivalent to ~ 1 c fresh blueberries) for at least 6 weeks has positive effects on cardiovascular health and function. It is postulated that these effects might be due to the (poly)phenolic compounds in blueberries. Considering there are known beneficial effects of the nutrients in blueberries on cardiovascular health, it is likely that there are synergistic and/or additive effects of the nutrients and (poly)phenolic compounds, supporting consumption of the whole fruit. Further research will help elucidate the clinical effects of blueberries for reducing CVD risk, and mechanistic studies can provide insight into potential ways to enhance their efficacy.

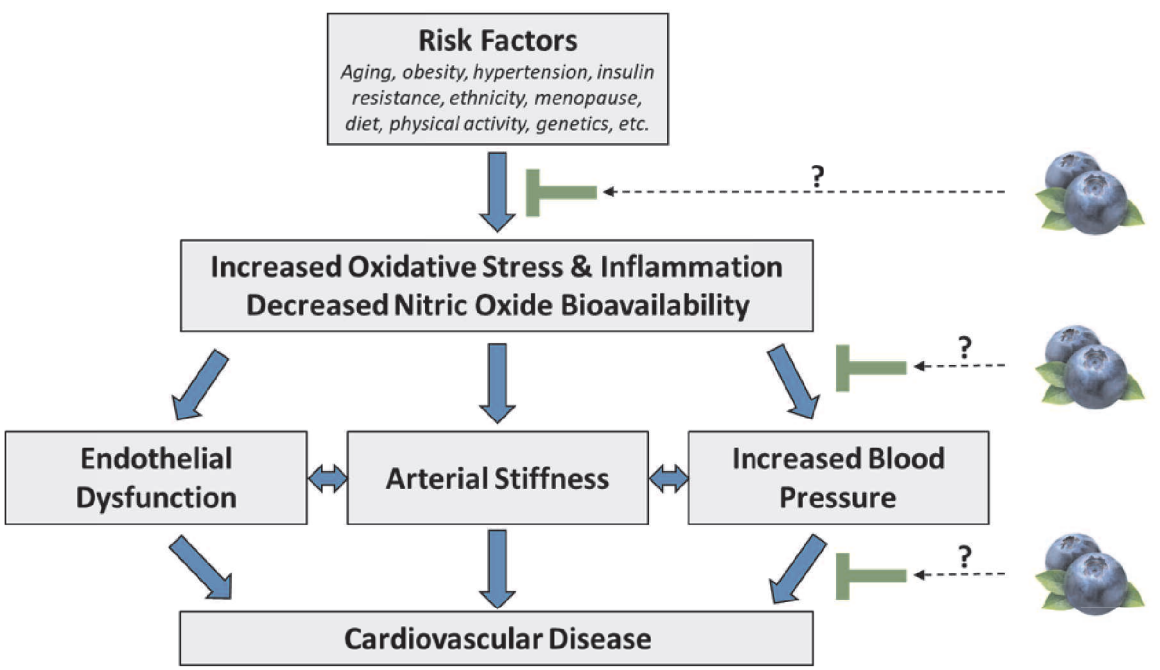


Figure 1. Overview of potential mechanisms by which blueberries may reduce the risk for cardiovascular disease development.

Emily K. Woolf, MS, NDTR is a doctoral student in the Department of Food Science and Human Nutrition at Colorado State University in Fort Collins, CO. Sarah A. Johnson, PhD, RDN is an assistant professor and director of the Functional Foods & Human Health Laboratory in the Department of Food Science and Human Nutrition at Colorado State University in Fort Collins, CO.

References

1. What is cardiovascular disease? Available at: https://www.heart.org/en/health-topics/consumer-healthcare/what-is-cardiovascular-disease . November 10, 2019.
2. Johnson SA, Litwin NS, Seals DR. Age-related vascular dysfunction: what registered dietitian nutritionists need to know. *J Acad Nutr Diet*. 2019;119:1785-1796.
3. Basu A, Rhone M, Lyons TJ. Berries: emerging impact on cardiovascular health. *Nut Rev*. 2010;68:168-177.
4. Reis JF, Monteiro VVS, de Souza Gomes R, et al. Action mechanism and cardiovascular effect of anthocyanins: a systematic review of animal and human studies. *J Transl Med*. 2016;14:315.
5. Wu X, Wang TT, Prior RL, et al. Prevention of atherosclerosis by berries: the case of blueberries. *J Agr Food Chem*. 2018;66:9172-9188.
6. Hosseinian FS, Beta T. Saskatoon and wild blueberries have higher anthocyanin contents than other Manitoba berries. *J Agr Food Chem*. 2007;55:10832-10838.
7. Ellulu MS. Obesity, cardiovascular disease, and role of vitamin C on inflammation: a review of facts and underlying mechanisms. Inflammopharmacology. 2017;25:313-328.
8. Villa JKD, Diaz MAN, Pizziolo VR, et al. Effect of vitamin K in bone metabolism and vascular calcification: a review of mechanisms of action and evidences. *Crit Rev Food Sci*. 2017;57:3959-3970F.
9. Burlet E, Jain SK. Manganese supplementation increases adiponectin and lowers ICAM-1 and creatinine blood levels in Zucker type 2 diabetic rats, and downregulates ICAM-1 by upregulating adiponectin multimerization protein (DsbA-L) in endothelial cells. *Mol Cell Biochem*. 2017;429:1-10.
10. Curtis PJ, van der Velpen V, Berends L, et al. Blueberries improve biomarkers of cardiometabolic function in participants with metabolic syndrome—results from a 6-month, double-blind, randomized controlled trial. *Am J Clin Nutr*. 2019;109:1535-1545.
11. Bharat D, Cavalcanti RRM, Petersen C, et al. Blueberry metabolites attenuate lipotoxicity–induced endothelial dysfunction. *Mol Nutr Food Res*. 2018;62:1700601.
12. Johnson SA, Figueroa A, Navaei N, et al. Daily blueberry consumption improves blood pressure and arterial stiffness in postmenopausal women with pre-and stage 1-hypertension: a randomized, double-blind, placebo-controlled clinical trial. J Acad Nutr Diet. 2015;115:369-377.
13. Del Bo C, Porrini M, Fracassetti D, et al. A single serving of blueberry (V. corymbosum) modulates peripheral arterial dysfunction induced by acute cigarette smoking in young volunteers: a randomized-controlled trial. Food & Function. 2014;5:3107-3116.
14. Del Bo C, Deon V, Campolo J, et al. A serving of blueberry (V. corymbosum) acutely improves peripheral arterial dysfunction in young smokers and non-smokers: two randomized, controlled, crossover pilot studies. *Food & Function*. 2017;8:4108-4117.
15. Cheatham C, Vazquez-Vidal I, Medlin A, et al. Blueberry consumption affects serum uric acid concentrations in older adults in a sex-specific manner. *Antioxidants*. 2016;5:43.
16. Kay CD, Holub BJ. The effect of wild blueberry (Vaccinium angustifolium) consumption on postprandial serum antioxidant status in human subjects. *Bri J Nutr*. 2002;88:389-397.
17. Mazza G, Kay CD, Cottrell T, et al. Absorption of anthocyanins from blueberries and serum antioxidant status in human subjects. *J Agr Food Chem*. 2002;50:7731-7737.
18. Basu A, Du M, Leyva MJ, et al. Blueberries decrease cardiovascular risk factors in obese men and women with metabolic syndrome. *J Nutr*. 2010;140:1582-1587.
19. Stote KS, Sweeney MI, Kean T, et al. The effects of 100% wild blueberry (Vaccinium angustifolium) juice consumption on cardiometabolic biomarkers: a randomized, placebo-controlled, crossover trial in adults with increased risk for type 2 diabetes. *BMC Nutr*. 2017;3:45.
20. Behaviors that increase risk for high blood pressure. Available at: https://www.cdc.gov/bloodpressure/behavior.htm . November 10, 2019.
21. Petrie JR, Guzik TJ, & Touyz RM. Diabetes, hypertension, and cardiovascular disease: clinical insights and vascular mechanisms. *Can J Cardiol*. 2018;34:575-584.
22. McAnulty LS, Collier SR, Landram MJ, et al. Six weeks daily ingestion of whole blueberry powder increases natural killer cell counts and reduces arterial stiffness in sedentary males and females. *Nutr Res*. 2014;34:577-584.
23. Stull A, Cash K, Champagne C, et al. Blueberries improve endothelial function, but not blood pressure, in adults with metabolic syndrome: a randomized, double-blind, placebo-controlled clinical trial. *Nutrients*. 2015;7:4107-4123.
24. Lodish H, Berk A, Zipursky SL, et al. Molecular cell biology 4th edition. New York, NY: WH Freenman; 2000.
25. Thijssen DH, Bruno RM, van Mil AC, et al. Expert consensus and evidence-based recommendations for the assessment of flow-mediated dilation in humans. *Eur Heart J*. 2019;40:2534-2547.
26. Duprez D, DeBuyzere ML, Rietzschel ER. Arterial stiffness and cardiovascular disease. *E J Cardiol Pract*. 2000;1.
27. Lee HY, Oh BH. Aging and arterial stiffness. *Circulation*. 2010;1010120923-1010120923.
28. Butlin M, Qasem A. Large artery stiffness assessment using SphygmoCor technology. Pulse. 2016;4:180-192.
29. Wong L, Shanehsaz E, Hong T, et al. Augmentation index (AiX) and augmentation pressure (AP) in a cardiac population. *Heart Lung Circ*. 2011;20:S11-S12.

30. Klimis-Zacas D, Vendrame S, Kristo AS. Wild blueberries attenuate risk factors of the metabolic syndrome. *J Berry Res.* 2016;6:225-236.
31. Ahmet I, Spangler E, Shukitt-Hale B, Juhaszova, et al. Blueberry-enriched diet protects rat heart from ischemic damage. *PLoS One.* 2009;4:e5954.
32. Vendrame S, Kristo AS, Schuschke DA, et al. Wild blueberry consumption affects aortic vascular function in the obese Zucker rat. *Appl Physiol Nutr Metab.* 2013;39:255-261.
33. Flores FP, Singh RK, Kerr WL, et al. (2014). Total phenolics content and antioxidant capacities of microencapsulated blueberry anthocyanins during in vitro digestion. *Food Chem.* 2014;153:272-278.
34. Hurst RD, Wells RW, Hurst SM, et al. Blueberry fruit polyphenolics suppress oxidative stress–induced skeletal muscle cell damage in vitro. *Mol Nutr Food Res.* 2010;54:353-363.
35. Duffy KB, Spangler EL, Devan BD, et al. A blueberry-enriched diet provides cellular protection against oxidative stress and reduces a kainate-induced learning impairment in rats. *Neurobiol Aging.* 2008;29:1680-1689.
36. Louis XL, Thandapilly SJ, Kalt W, et al. Blueberry polyphenols prevent cardiomyocyte death by preventing calpain activation and oxidative stress. *Food & Function.* 2014;5:1785-1794.
37. Xie C, Kang J, Chen JR, et al. Phenolic acids are in vivo atheroprotective compounds appearing in the serum of rats after blueberry consumption. *J Agr Food Chem.* 2011;59:10381-10387.
38. Vendrame S, Daugherty A, Kristo AS, et al. Wild blueberry (Vaccinium angustifolium)-enriched diet improves dyslipidaemia and modulates the expression of genes related to lipid metabolism in obese Zucker rats. *Bri J Nutr.* 2014;111:194-200.
39. Wu X, Kang J, Xie C, et al. Dietary blueberries attenuate atherosclerosis in apolipoprotein E-deficient mice by upregulating antioxidant enzyme expression. *Journal Nutr.* 2010;140:1628-1632.
40. Mykkänen OT, Huotari A, Herzig KH, et al. Wild blueberries (Vaccinium myrtillus) alleviate inflammation and hypertension associated with developing obesity in mice fed with a high-fat diet. *PLoS One,* 2014;9:e114790.
41. Xie C, Kang J, Ferguson ME, et al. Blueberries reduce pro-inflammatory cytokine TNF-α and IL-6 production in mouse macrophages by inhibiting NF-κB activation and the MAPK pathway. *Mol Nutr Food Res.* 2011;55:1587-1591.
42. Lau FC, Bielinski DF, Joseph JA. Inhibitory effects of blueberry extract on the production of inflammatory mediators in lipopolysaccharide-activated BV2 microglia. *J Neurosci Res.* 2007;85:1010-1017.
43. Huang WY, Liu YM, Wang J, et al. Anti-inflammatory effect of the blueberry anthocyanins malvidin-3-glucoside and malvidin-3-galactoside in endothelial cells. *Molecules.* 2014;19:12827-12841.
44. Panth N, Paudel KR, Parajuli K. Reactive oxygen species: a key hallmark of cardiovascular disease. Advances in Medicine; 2016.
45. Pizzino G, Irrera N, Cucinotta M. Oxidative stress: harms and benefits for human health. *Oxid Med Cell Longev.* 2017;2017:1-13.
46. Cutler BR, Petersen C, Anandh Babu PV. Mechanistic insights into the vascular effects of blueberries: Evidence from recent studies. *Mol Nutr Food Res.* 2017;61:1600271.
47. Lazzè MC, Pizzala R, Perucca P, et al. Anthocyanidins decrease endothelin-1 production and increase endothelial nitric oxide synthase in human endothelial cells. *Mol Nutr Food Res.* 2006;50:44-51.
48. Nedeljkovic ZS, Gokce N, Loscalzo J. Mechanisms of oxidative stress and vascular dysfunction. *Postgrad Med J.* 2003;79:195-200.
49.Kalea AZ, Clark K, Schuschke DA, Klimis-Zacas DJ. Vascular reactivity is affected by dietary consumption of wild blueberries in the Sprague-Dawley rat. *J Med Food.* 2009;12:21-28
50. Pahwa R, Jialal I. Chronic inflammation. In StatPearls [Internet]. StatPearls Publishing. 2018.
51. Kang J, Thakal KM, Jensen GS, et al. Phenolic acids of the two major blueberry species in the US Market and their antioxidant and anti-inflammatory activities. *Plant Food Hum Nutr.* 2015;70:56-62.
52. Vendrame S, Daugherty A, Kristo AS, et al. Wild blueberry (Vaccinium angustifolium) consumption improves inflammatory status in the obese Zucker rat model of the metabolic syndrome. *J Nutr Biochem.* 2013;24:1508-1512.
53. Moghe SS, Juma S, Imrhan V, et al. Effect of blueberry polyphenols on 3T3-F442A preadipocyte differentiation. *J Med Food.* 2012;15:448-452.
54. Silva S, Costa EM, Veiga M, et al. Health promoting properties of blueberries: a review. *Crit Rev Food Sci Nutr.* 2018;1-20.
55. Wu X, Kang J, Xie C, et al. Dietary blueberries attenuate atherosclerosis in apolipoprotein E-deficient mice by upregulating antioxidant enzyme expression. *J Nutr.* 2010;140:1628-1632
56. Nair AR, Mariappan N, Stull AJ, et al (2017). Blueberry supplementation attenuates oxidative stress within monocytes and modulates immune cell levels in adults with metabolic syndrome: a randomized, double-blind, placebo-controlled trial. *Food & Function.* 2017;8:4118-4128.
57. Basu A, Du M, Leyva MJ, et al (2010). Blueberries decrease cardiovascular risk factors in obese men and women with metabolic syndrome. *J Nutr.* 2010;140:1582-1587.

"Overall, blueberries may modulate lipid metabolism and/or reduce the oxidation of LDL, thus reducing the risk for atherosclerosis or other CVDs."

Interprofessional Education in Clinical Sports Dietetics: A Case Study Approach

by Natalie Allen, MEd, RDN, Shannon Hauschildt, MS, PA-C, Melissa Penkalski, DNP, APRN, CPNP-PC, AE-C, and Kristin Paloncy, EdD, ATC

The interprofessional education (IPE) case study (CS) project described here was developed to train future practitioners, with the aim of helping college students understand the value of working as part of a health care team. Rarely do health care providers (HCPs) work in an isolated setting; therefore, it is critical for students to understand their role(s) and responsibilities within a multidisciplinary setting. Today there is increased interest in the ability of medical providers to work together and understand how collaboration benefits the overall health of the patient. The Academy of Nutrition and Dietetics position paper on this subject encourages IPE between medical students, students of other health professions, and registered dietitian nutritionists (RDNs).[1] This collaboration can serve to promote greater understanding among HCPs regarding the value that RDNs bring in improving the quality of care that patients receive.[1] The training and experience of RDNs make them uniquely qualified for the role of educating others on nutritional components of health care.[1]

The use of IPE has grown dramatically at the collegiate level as educators look for ways to prepare students for a wide range of health care professions. The case study (CS) approach described in this article aligns with the Accreditation Council for Education in Nutrition and Dietetics (ACEND) education standard KRDN 2.2, which states that graduates of a Didactic Program in Dietetics (DPD) should be able to describe interprofessional relationships in various practice settings.[2] Interprofessional collaboration is based on the premise that when providers and patients communicate and consider each other's unique perspective, they can better address the multiple factors that influence the health of individuals, families, and communities.[3] No one provider can do all of this alone.[3]

Overview of the IPE Case Study Approach

At Missouri State University, an IPE CS was developed with faculty from the following departments: Biomedical Sciences/Dietetics, Athletic Training, Nursing, and Physician Assistant. Focusing on the topic of the female athlete triad (triad), students in an undergraduate dietetics sports nutrition class were led through a fictional athlete's course of treatment. A review of the literature found that the dissemination of knowledge regarding the screening and treatment of the triad is lacking. Only 12% of athletic trainers correctly identified all three components of the triad.[4] Research also shows that only 8% of collegiate female athletes were "always screened" for disordered eating.[4] In 2014, the "Female Athlete Triad Coalition Consensus Statement on Treatment and Return to Play of the Female Athlete Triad" was published, focusing on the clinical management of athletes affected by the triad.[5] The consensus statement includes "The Female Athlete Triad: Cumulative Risk Assessment," a screening tool to identify and assess at-risk athletes.[5] The guidelines in the consensus statement are unique in that they are specific to the triad rather than other screening instruments. Both the consensus statement and screening tool were used in development of this CS.[5]

The reasoning for our educational emphasis on understanding the triad and a focus on team approach was based on concerns expressed by the university's medical rehabilitation staff and team physicians for collegiate athletes. A general concern regarding the prevalence of bone stress injuries among female athletes was consistent with indicators of low energy availability (EA) and the need for a standardized approach to screening and treatment in collegiate athletic settings. At this time, the researchers questioned whether there may be an improved process to help future practitioners improve knowledge specific to the triad and increase confidence in recognition of symptoms, which should result in improved practice standards. Therefore, an IPE CS (described below) was developed to help undergraduate students learn about the topic of the triad in the context of a simulated clinical setting.

As part of a sports nutrition course, students were divided into small groups, with student representatives from both Dietetics and Athletic Training majors in each group. Information on the fictional athlete was released to students in subsections, to mimic the timeline of events in real life. Students devised a detailed care plan for the athlete based on their knowledge of the triad. Students worked together to define roles for each discipline, understand laboratory data, calculate anthropometrics, evaluate calorie/protein/fat/fluid intake, and develop goals for the athlete.

Goals of the IPE Case Study Approach

The two goals of the IPE CS approach are as follows:

1. To increase student knowledge of the roles and responsibilities of an athletic trainer (AT) and sports dietitian (RDN) when serving on a health care team in a sports dietetics setting, emphasizing collaboration and role clarification.

2. To increase knowledge of the female athlete triad, including early

identification, interventions, and evidence-based guidelines.

Developed as a class project over the span of 3 years, the IPE CS approach appears to be sustainable, despite minimal resource allocation. All (100%) of athletic training and dietetics students in the respective cohorts were surveyed (see **Fig. 1**) to determine if they tended to agree that the IPE CS had improved understanding and/or comfort in work related to IPE and the triad. Data collected anonymously from 122 college students over a 3-year period indicated that 100% of the student respondents either strongly agreed (a rating of 5) or agreed (a rating of 4) that the case study method of teaching increased understanding of "interprofessionalism" among health care providers. Average scores for each of the three student surveys (years 2017, 2018, and 2019) are summarized in **Figure 2**. Sample written student responses are shown in **Figure 3**.

Figure 1. IPE Case Study Student Survey

Students were asked to rate their agreement with the following five statements using a 5-point Likert scale (1=Do not Agree to 5=Strongly Agree).

1. Overall, the IPE CS project helped me better understand the role of the different health care disciplines involved.

2. I will be more comfortable in a work setting interacting with health care professions from various disciplines.

3. I have a better understanding of the female athlete triad.

4. I feel more comfortable assessing a patient and formulating a plan of care.

5. I better understand "interprofessionalism" and feel like this project was beneficial in promoting interprofessionalism among the students.

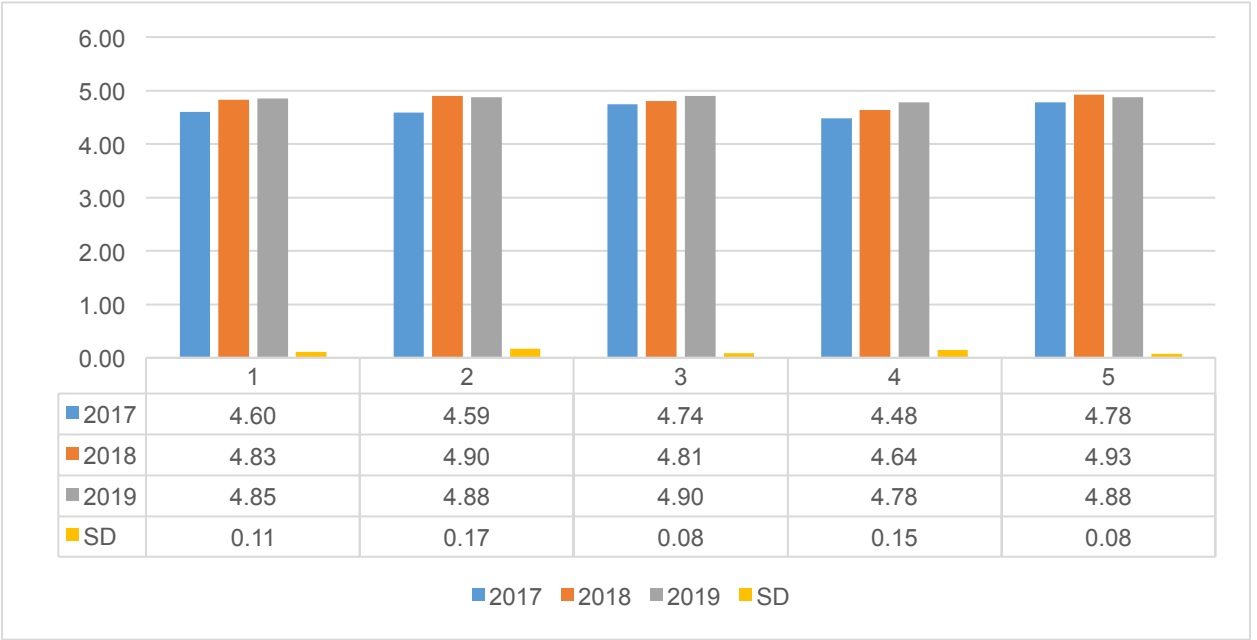
The IPE Case Study

NOTE: This IPE Case Study was written for college students who would be considered entry level upon earning credentials. The goal is to have students develop a care plan for an athlete and understand various HCP roles. This is a fictitious case and does not represent data from any individual.

Initial Visit

Katie is an 18-year-old female cross-country runner at the collegiate level who presented to the team physician with numerous injuries. She is 5'3" tall and weighs 102 lbs. During the spring semester of her senior year of high school, she had a tibial stress reaction. Menarche occurred at age 17. In the past year, she has had three menstrual cycles. She is currently in cross country season. Her workouts consist of running 40 to 50 miles a week along with working out with weights three times a week. Katie is a vegetarian and thinks she may be lactose intolerant. She is provided milk after workouts by her college athletic trainer, but she does not drink it. She also does not like electrolyte sports

Figure 2. IPE Case Study Student Survey over 3 Years: Average Scores



	1	2	3	4	5
2017	4.60	4.59	4.74	4.48	4.78
2018	4.83	4.90	4.81	4.64	4.93
2019	4.85	4.88	4.90	4.78	4.88
SD	0.11	0.17	0.08	0.15	0.08

drinks. Katie is detailed and specific on when she thinks she needs to eat meals and is regimented in eating at the same time each day. Also, if she feels like she has a "poor practice," she will run stairs or exercise at the campus fitness center for an additional hour each day.

6-Week Follow-Up

Katie had a 6-week follow-up appointment with the team physician and of note, her serum ferritin concentration was 10 ng/mL. Over the course of the past 6 weeks, she has lost 2 lbs and now weighs 100 lbs. Prior to being weighed at the doctor's office, she drank a liter of water and a liter of black coffee. Katie mentioned to the trainer that she feels like she keeps hitting the wall every time she runs. She also told the trainer that she is feeling dizzy and light-headed and has been fighting muscles cramps for the past few weeks. Katie also is complaining of shin splints and her trainer noticed that she was limping.

A few days ago, Katie's mother contacted the team dietitian after seeing a photo on social media. Mom is concerned that Katie looks thinner. Her mother attempted to speak with the medical team at the college, but her request was denied due to the Family Educational Rights and Privacy Act (FERPA) and Katie's desire to keep her medical information confidential.

8-Week Follow-Up

Katie's weight has decreased to 98 lbs. Of note, she now has intense hip pain. Her physician ordered magnetic resonance imaging (MRI), which confirmed a femoral neck stress fracture. She is on crutches for a minimum of 6 weeks, restricted to non-weightbearing on the involved leg, and restricted fully from participation in running and weightbearing activities. If Katie is pain-free in a non-weightbearing status, she may participate in non-weightbearing activities to maintain cardiovascular activity. Modalities may be used as needed for pain.

Because of activity limitations, Katie feels she needs to reduce her calorie intake. She has decided to limit her food intake, add protein supplements, and consume more caffeine. A few weeks after being diagnosed with her femoral stress fracture, she began complaining of pain in her lower back, nausea, and vomiting. Her pain intensified and she became bedridden. She was taken to the hospital, where the following laboratory results were noted: BUNv= 75 mg/dl; creatinine = 3.0 mg/dl; potassium = 5.9 mmol/L.

Katie is hospitalized for 7 days. The athletic medical team meets to discuss Katie's treatment plan, interventions, and status as a collegiate athlete.

12-Week Follow-Up

Katie is discharged from the hospital. She remains on crutches. The medical team requests a DEXA scan. The scan reveals a Z-score of -2.0. Katie still has not had a menstrual cycle and her current weight is 95 lbs. Her score on the "Female Athlete Triad: Cumulative Risk Assessment" tool is "high risk."

20-Week Follow-Up

Over the past 8 weeks, Katie has implemented medical team suggestions and is checking in regularly with the trainer and dietitian. Katie reports to the physician for a follow-up appointment regarding her fracture. Her ferritin level is 25 ng/mL and her weight has increased to 105 lbs. Katie had a menstrual cycle last week for the first time in 6 months.

Katie has consistently gone to counseling and her psychologist reports that she is doing well and making progress.

AUTHORS' NOTE: This Interprofessional Case Study may be photocopied and utilized in a collegial setting, with permission. Email nataliellen@missouristate.edu for full digital copy and permission.

Figure 3. Selected Student Comments from the Post-Study Survey

We learn about athletes like the one in the case study in class, but many of us do not have the opportunity to work with someone like her in real life. This case study allowed us to delve into the life of an athlete and follow her journey, all while keeping in mind the knowledge of our respective fields and opening a dialogue with other disciplines.
We all have something to bring to the table. Working together is the best way to benefit a patient.
Treating eating disorders must be a multi-professional approach because it is more than just as issue with food.
The overall health and wellness of an athlete is truly impossible to be achieved by one individual, so it is dire that we celebrate and utilize knowledge and skills of all health care professions, as a combined effort to provide the best care possible.
It was rewarding to see two different disciplines create one care plan together to better the patient.
Learning interprofessionalism in an undergraduate program is beneficial and puts our program ahead of others without it.

Natalie Allen, MEd, RDN, athletic team dietitian, Shannon Hauschildt, MS, PA-C, and Melissa Penkalski, DNP, APRN, CPNP-PC, AE-C are faculty in the McQueary College of Health and Human Services at Missouri State University in Springfield, MO. Kristin Paloncy, EdD, ATC is faculty at North Central College in Naperville, IL.

Special acknowledgments go to Melanie Morgan, RDN, who worked on the case study as a dietetic intern.

References
1. Denny S, Henry B, Kavanagh MB, et al. Position of the Academy of Nutrition and Dietetics: interprofessional education in nutrition as an essential component of medical education. *J Acad Nutr Diet*. 2017;117:1104-1113.
2. Accreditation Council for Education in Nutrition and Dietetics of the Academy of Nutrition and Dietetics. ACEND Accreditation Stands for Nutrition and Dietetics Didactic Programs. Available at: https://www.eatrightpro.org/acend/accreditation-standards-fees-and-policies/2017-standards. Accessed November 6, 2019.
3. Sullivan M, Kiovsky R, Mason D, et al. Interprofessional Collaboration and Education. *Am J Nurs*. 2015;115: 47-54.
4. Kroshus, E, DeFreese, D, Kerr, Z. Collegiate athletic trainers' knowledge of the female athlete triad and relative energy deficiency in sport. *J Athl Train*. 2018;53:51–59
5. De Souza MJ, Nattiv A, Joy E, et al. 2014 Female Athlete Triad Coalition Consensus Statement on treatment and return to play of the female athlete triad: 1st International Conference held in San Francisco, California, May 2012 and 2nd International Conference held in Indianapolis, Indiana, May 2013. *Br J Sports Med*. 2014;48(4):289.
6. Thomas DT, Erdman KA, Burke LM, et al. Position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine: nutrition and athletic performance. *J Am Nutr Diet*. 2016;116:501-527.

Conference Highlights

Food & Nutrition Conference & Expo™ (FNCE®)

October 26-29, 2019
Philadelphia, PA

Sports nutrition was a hot topic at this year's annual Food & Nutrition Conference & Exposition (FNCE). Sports nutritionists were even highlighted at the Opening Session. That's a first! The sports nutrition tract offered excellent sessions for SCAN members, as did the SCAN preconference session sponsored by Gatorade. Here are a few highlights, to keep you up to date with the current sports nutrition news:

Pre-Conference: Sport Supplements

Presented by Louise Burke, PhD, Australian Institute of Sport

■ Sport supplements that promise improved performance are always tantalizing. If they produce as little as 0.5% to 1% improvement, the supplement is deemed to *"work."* While scientists want well-controlled research studies to prove effectiveness, athletes respond very quickly to anecdotes—and often spend lots of money on what might be just a glimmer of hope. (In the 4 months leading up to the Olympics in 2000, one athlete spent $3,480 on supplements!)

■ The Australian Institute of Sport is creating a website for grouping supplements according to effectiveness: Group A (proven to enhance performance), Group B (deserves more research), Group C (little proof of meaningful benefits) and Group D (banned). Check it out at www.ais.gov.au/nutrition/supplements. The information can help guide athletes' supplement choices.

Pre-Conference: Sleep and Athletes

Presented by Amy Bender, PhD, University of Calgary

■ One of the best performance enhancers is "vitamin Zzz," also known as *sleep*! Lack of sleep has detrimental effects on performance. Athletes with good sleep quality are able to train harder, recover faster, and perform better. And take note: Athletes who think they can drink coffee at night and still sleep fine should think again. Brain wave studies suggest otherwise.

■ How much sleep is enough? More than 6 hours a night is needed; very few athletes can perform well with less than that. Top athletes commonly strive to get 8 to 10 hours of sleep each day, including a nap between 1:00 and 4:00 pm. (A later nap results in poorer sleep that night). Teens should target 8 to 10 hours and adults 7 to 9 hours.

■ Lack of sleep can significantly impact food intake. After two nights with only 4 to 5 hours of sleep, the appetite can increase about 20% over baseline. Sleep-deprived people commonly snack more than usual (on fatty foods), eat fewer fruits and vegetables, and consume about 385 additional calories.

■ When taught about the benefits of sleep, most people tend to sleep about 20 minutes more. For helpful information on sleep, athletes can visit centreforsleep.com and take the Athletes Sleep Screening Questionnaire.

Pre-Conference: Practical Tips from a Team RD

Presented by Kevin Luhrs, MS, RD, CSCS, Gatorade Sports Science Institute; formerly with the Tampa Bay Buccaneers

■ If you are the dietitian for a team that includes athletes who are not interested in nutrition, do not waste your time trying to convince skeptical or non-compliant athletes that nutrition will benefit their performance, recovery, and overall health. Instead devote your energy and time to those who are showing some interest or are fully interested in learn-

ing more about nutrition. This devotion to the believers will capture the attention of the non-believers.

■ Using a grocery store delivery app can be easier than taking athletes on a grocery store tour. The app is not only more time-efficient for both the RD and athletes, but also sets up the athletes for future success if/when their schedule makes it less likely that they will take the time to go to the grocery store. The app will familiarize the athlete on how to grocery shop online and what to look for, thereby making it more of a realistic resource.

■ As RDs, we often have such a food-first approach that we forget to teach athletes about the supplements that actually can have a positive impact on performance, recovery, and health. Athletes want supplements, so RDs need to teach them about safe supplementation—and credible supplements. A food-first message will not steer athletes away from buying supplements nor shift their focus from supplementation. Hence, RDs should inform athletes on which supplements have been backed by science.

Protein Timing: Is There an Anabolic Window of Opportunity?

Presented by Brad Schoenfeld, PhD, CUNY Lehman College

■ When it comes to building muscle, athletes should surround their workout with food to get the most benefits from their efforts. Intermittent fasters need to take note that if they lift weights in a fasted state (without having eaten any pre-exercise fuel), the muscle-building effect of exercise is not enough to out-weigh the muscle breakdown that happens in a fasted state. They should eat before they train!

■ Many athletes assume that if they fail to eat within 45 minutes of lifting weights, the anabolic (muscle-building) window slams shut—but that's not correct. Refueling either 1 hour or 3 hours post-exercise generates a similar gain in muscle protein synthesis. For the average exerciser, the effect of post-exercise protein timing on muscle growth is relatively small. For competitive body builders, the gain is also small but perhaps meaningful, so most prefer to err on the side of caution.

■ Consuming post-exercise protein stimulates insulin secretion, as does carbohydrate. (Did you know that whey protein stimulates more insulin than white bread?) Insulin reduces muscle breakdown and enhances glycogen replacement. To optimize glycogen replacement, refueling with a combination of protein and carbohydrate is best for athletes who do two-a-day workouts. The average athlete who does only one workout and refuels with a sports diet based on grains, starchy vegetables, and fruits can replenish depleted glycogen stores over the course of 24 hours.

> "While all protein gets absorbed from a meal, only a limited amount gets incorporated into muscle."

■ Does eating more protein build more muscle? While all protein gets absorbed from a meal, only a limited amount gets incorporated into muscle. Consuming a 20-g dose of protein every 3 hours (four times a day) is preferable to consuming one 80-g dose. Eating more than 20 g of protein per meal may—or may not—contribute to more muscle mass, depending on many variables. For example, a novice weightlifter will build more muscle than someone who has been lifting weights for 6 months. Vegans may need to consume a higher amount of protein to get an adequate amount of leucine, an amino acid that triggers muscle growth. Protein needs are best based on body weight. A reasonable target is for athletes to consume 0.2 to 0.25 g protein/lb body weight (0.4 to 0.55 g/kg) four times a day.

The Female and Male Athlete Triad: Implications for Recovery

Presented by Mary Jane De Souza, PhD, The Pennsylvania State University

■ Eating disorders (EDs) are not just a female problem. About 9% of male athletes—as compared with about 21% of female athletes—struggle with food issues and restrict their food intake to lose undesired body fat. The lack of fuel available to support normal bodily functions impacts bone health and reproductive function in men, just as it does in women. In men, low energy availability can lead to low testosterone, poor semen quality, and reduced sperm count and motility. In women, low energy availability shows up as loss of regular menses (amenorrhea), hence infertility.

■ Compared with female athletes, male athletes withstand more of a severe deficit before the appearance of symptoms such as low testosterone, bone stress injuries, and reduced bone density/poor bone health (osteoporosis).

■ To reverse the energy deficit, athletes need to boost their energy intake, which can be easier said than done for those struggling with eating issues and fears of "getting fat." One way to consume the recommended 350 additional calories per day is to break two energy bars into small bites, and nibble on them over the course of several hours. Men seem to be able to reverse the hormonal imbalance within days, while women can take months. Reversibility of bone density is not guaranteed.

Exercise in Eating Disorder Treatment: Misconceptions, Evidence, Future Directions

Presented by Tammy Beasley, RDN, CSSD, CEDRD, Alsana: An Eating Recovery Community

■ Should athletes with eating disorders be allowed to exercise during treatment? To date, the research suggests that exercise is safe for most athletes in recovery, as long as it is not associated with weight loss. Exercise improves psychological well-

being; it contributes to muscle gain, and having more muscle improves bone density (One 27-year-old with severe anorexia improved bone density by 8% in 6 months by lifting weights three times a week.)

■ The treatment team works with athletes with eating disorders to shift their focus from perfectionism to excellence—being the best they can be, but not necessarily striving to be *The Best* or *Number 1*. Perfectionism—and striving to be "the perfect athlete"— can get in the way of healing the exercise-eating disorder relationship.

Debate: Effects of a Keto Diet on Metabolism During Endurance Performance

Presented by Louise Burke, OAM, PhD, APD, Australian Institute of Sport, and Stephen Phinney, MD, PhD, Virta Health

■ A ketogenic sports diet (defined as 1.5 g protein/kg/day, <50 g carb/day, and dietary fat eaten to satiety) appeals to some athletes. While the diet had been around for years, we need more research to understand the fine details of keto-adaptation and keto supplements. (Supplement sales vastly exceed the science.)

■ A ketogenic sports diet may limit how intensely a highly competitive athlete can exercise. A study with world-class race walkers who had been on a keto-diet for 3 weeks indicated they were 1% slower in a 10K race, as opposed to the high-carbohydrate diet group that improved by 7%. Some studies suggest that the results have been different if these athletes had been keto-adapted for months, instead of just weeks.

■ Anecdotal reports from athletes who have followed a keto diet for months suggest that they are able to perform well, at least in ultra-endurance sports. For example, keto-ultra-runner Mike Morton set a record running the most miles (172.5) over the course of 24 hours. Trans-Pacific rowers Sami Inkine and Meredith Loring made history rowing from California to Hawaii in 45 days using a keto diet, taking 15 days off the prior record for a two-person boat.

■ Keto diets are known to curb appetite and assist with loss of undesired body fat. This might be helpful for athletes in weight-focused sports. For other athletes, keto could be a cover-up for an eating disorder—a band-aid that reduces carb-binges but fails to deal with any underlying emotional issues.

■ One diet does not fit everyone, and people vary in their responses to a ketogenic diet. We have much to learn. Keto diets come in both "good" and "bad" forms. (Some keto-athletes eat 4 to 5 servings of non-starchy vegetables a day, while others eat a lot of "fat bombs.") Research with non-athletes (obese people with type 2 diabetes) shows definite benefits for those who stay in ketosis. A key issue is sustainability of the keto lifestyle:

- How long is a person willing or able to maintain a very-low-carb, high-fat diet?
- What kind of support does the keto-dieter need to enhance compliance to this nontraditional eating plan?
- What happens when a keto-dieter ends ketosis and reintroduces carbohydrate? Will diet backlash result in carb binges, rapid weight regain, and dysregulated eating?
- For what percent of athletes do the benefits outweigh the costs?

> "A ketogenic sports diet may limit how intensely a highly competitive athlete can exercise."

Summarized by "Conference Highlights" editor Nancy Clark, MS, RD, who counsels both casual and competitive athletes at her office in the Boston area. She is author of the new 6th edition of her best-selling Nancy Clark's Sports Nutrition Guidebook. *Information about her books, teaching materials, and online works is available at www.NancyClarkRD.com.*

IDEA World Nutrition and Behavior Change Summit

June 28-29, 2019
Anaheim, CA

This specialty section of the IDEA® World Convention returned for its fourth year summit, targeting personal trainers, health coaches, and nutrition professionals working in fitness and wellness. Nutrition and behavioral science leaders shared current research and provided proven approaches to help guide clients toward successful permanent lifestyle change. Sessions over the two days offered 10 CPEUs approved by the Commission on Dietetic Registration. Here are highlights from the Nutrition and Behavior Change track:

Positioning Yourself as a Behavior Change Coach

The keynote address, "Sculpting the Ultimate Coach Within: How to Deliver Remarkable Client Results While Blazing an Epic Career Path," presented by John Berardi, PhD, focused on positioning and marketing oneself as a behavior change expert. Berardi encouraged the audience to complete the phrase, "I _____ so that you can _____" in communicating with potential clients. He emphasized the importance of knowing the features and benefits of your services (and products) and identifyingy your unique abilities. He urged prospective coaches to consider their breadth of knowledge versus their depth of mastery in a specific area. According to Berardi, your mission/purpose plus your competency and a strategic plan will lead you to personal and career success.

Parsing Today's Most Relevant Research

In "Dynamic Nutrition Science: Parsing Today's Most Relevant Research for Real Life," Jenna A. Bell, PhD, RD reminded us that misinformation fills the gap created by continuously changing nutrition science. Members of the health media usually have not been educated in nutrition, and writers can end up twisting the message looking for a better headline. On top of that, consumer demands are inconsistent. She advised professionals to turn to meta-analyses and systematic reviews to get a consensus on current diet trends. For example, low-carb diets may result in weight loss in the short-term but may increase low-density lipoprotein (LDL) cholesterol; reducing saturated fat is only beneficial if it is replaced with unsaturated fat, not carbohydrates; and when comparing animal versus plant protein, a whole foods plant-based diet, not processed diet, is beneficial.

The Current and Future State of Health Coaching

Presenting the session "The Current and Future State of Health Coaching," Jessica Matthews, DBH, NBC-HWC explained that health coaching may be the bridge between health care objectives and reality, as doctors have little time to spend on a patient. Matthews discussed how clients' involvement in their care changes the trajectory of their health and well-being. Health coaches can be a key part of the shift toward collaborative, integrative processes in lifestyle medicine. She provided evidence for their effectiveness in reducing negative health outcomes, and encouraged utilizing the National Board for Health & Wellness Coaching for certification.

Nutrition That Can Calm Inflammation

In "Skills Not Pills: Calming the Inflammation Superhighway with Focused Nutrition and Behavior Change," Marc Bubbs, ND, MSc, CISSN, CSCS explained the inflammatory response, its connection to the immune system, and why excessive inflammation is detrimental to human health. He discussed the potential for various dietary strategies to help cool inflammation. Anti-inflammatory foods must be considered in the midst of increased protein intake. He also shared how a client's capability (skills and knowledge), opportunity (social environment and culture) and motivation influence behavior.

Mobile Health and Behavior Change

Explaining how health care today is being commercialized with advanced technology/devices, Michelle Alencar, PhD presented the session "The Mobile Health Map: Inspiring Your Clients and Your Business." Alencar shared compelling research on mobile health as an effective and efficient model for wellness delivery, promoting sustainable behavior change. Making a virtual office an extension of nutrition your services could include wearable technology, remote monitoring, and/or telehealth. She suggested that RDs work as part of a multidisciplinary team with trainers, health coaches, disease management specialists, and physicians. As a service extender, an RD can better bill for services—and get paid.

Dairy Products Vs Plant-Based Alternatives

In "To Dairy or Not to Dairy? Translating the Science for Your Clients," Jim White, RDN, ACSM EX-P presented the pros and cons of dairy products and plant-based alternatives, discussing nutrient composition, health benefits, processing, and cost of each. Milk products have nine essential nutrients, fewer ingredients, and are less expensive. Nondairy products are cholesterol-free, lower in fat, and lactose-free but contain added sugars and are more expensive. He encouraged attendees to tailor their message to the client and discuss trade-offs between dairy and alternatives.

The Neuroscience of Behavior Change

Julia DiGangi, PhD presented "The Neuroscience of Behavior Change: How to Train the Brain to Create Healthier Habits," discussing patterned responses, habits, and brain predictions. She explained that clients need new evidence to change old behaviors. Sometimes what feels wrong often produces the most sustainable progress, known as the "paradox of progress." Behavior change is about focused intense attention. She described how improved sustained attention can be used toward developing new habits; practitioners can facilitate this by providing guidance that aims clients' efforts toward getting free from where they are stuck.

> "Sometimes what feels wrong often produces the most sustainable progress, known as the 'paradox of progress.'"

Applying the Health Action Process Approach

Mindset and a positive self-worth (along with habit formation and monitoring) are the predictors of long-term weight management success. In "Bridging the Gap Between Good Intentions and Meaningful Nutrition Change," Monica Reinagel, MS described the three parts of the health action process approach: self-efficacy, self-regulation, and planning. She shared how RDs can translate the theory into practical application by instilling confidence, planning with

flexibility for anticipated barriers, simplifying nutrition information, providing clear standards for comparison, and having both qualitative and quantitative outcome measures. She developed the simple Nutrition GPA® concept (and free tool) with these in mind.

Coaching Clients with Prediabetes

In "Reversing the Invisible Epidemic: Coaching People Who Have Prediabetes," Natalie Digate Muth, MD, MPH, RDN, FAAP outlined how health coaches and health professionals are uniquely positioned to fill a critical need in delivering group and individual diabetes prevention programs. Muth noted that lifestyle change leaders are in demand for diabetes prevention, so health coaches may find opportunities in make connections with health care settings and workplaces. She shared research supporting that lifestyle intervention to improve physical activity (150 minutes moderate/week), weight (5%-7% loss), and healthy eating is more effective than medication. Developing SMART (smart, measurable, achievable, relevant, and time-bound) goals and appropriate action plans are key to successs.

Living a Purpose-Powered Life

In the summit's final session, "The HOPE Solution: How Our Purpose Empowers!" Lee Jordan, MS shared inspirational case studies of client transformation. The HOPE Solution offers research-based practices for building well-being through living a purpose-powered life. The basics are to define and discover your purpose, focus on yourself, become self-aware without comparison, and take action steps to discovery. He encouraged health coaches, trainers, and nutrition professionals to elevate their approach to serving others, utilizing positive tools that cultivate strength.

Summarized by Debbie James, MS, RDN who is a freelance writer, the nutrition consultant for LA Fitness, and member of the Dietitians in Business and Communications dietetic practice group.

Reviews

Nancy Clark's Sports Nutrition Guidebook, 6th ed.

Nancy Clark, MS, RD, CSSD
Human Kinetics, PO Box 5076, Champaign IL
800-747-4457; info@hkusa.com
2020, softcover, 525 pp, ISBN 978-1-4925-9157-3

It's hard to believe that *Nancy Clark's Sports Nutrition Guidebook* is now in its 6th edition on or around the 30th anniversary of its original publication in 1990. Clark doesn't disappoint with this newest version, providing up-to-date and useful information just as in editions of the past.

The book is organized into four parts that discuss "everyday eating for active people," "the science of eating and exercise," "balancing weight and activity," and "winning recipes for peak performance." Clark skillfully blends the sciences of nutrition and exercise physiology with practical dietary advice geared toward healthful eating that can fuel athletes who range from weekend warriors to elite performers. The book helps athletes make sense of key components of the diet and how they influence exercise and recovery. It dispels common myths and provides insights into the pros and cons of popular diets. This is not a book about which and how much dietary supplements athletes should buy, but rather it's a book about how to choose a solid diet that meets dietary needs in a healthful and fun way. As I read through the book, I was impressed with the author's ability to clearly and accurately convey concepts that I often think of in academic terms in concise, practical applications. Clark is particularly adept at integrating the latest science along with her experiences of working with specialized clients ranging from elite athletes to those suffering from disordered eating and eating disorders, and incorporating them into recommendations that never fail to take into account the importance of enjoying the "yummy journey" along the way.

As in previous editions, Clark provides recipes that come with nutrition information, brief descriptions of what they are like and how they can fit into healthful diets, and a little personal information in some cases. Athletes (or practitioners) can use these recipes as hands-on tools to incorporate the recommendations provided throughout the book. The recipes appear to be mostly simple to prepare, which can be particularly useful for the athlete who hasn't spent much time in the kitchen. I put one of the recipes ("Fluffy Oatmeal Pancakes") to the test, and my kids and I were treated to a delicious breakfast. Next on my list of recipes to try from the book is "Chocolate Lush."

There are other features of the book that might be easy to overlook at first glance. For example in Appendix 1, Clark includes numerous resources to direct readers to additional information, indicating that she recognizes that one source can't meet every need. As a pioneer in the field, she also very briefly, but effectively, gives her insights for readers who are interested in becoming a sports nutritionist. Importantly, the book is well-referenced with 17 pages of sci-

entific sources that she has cited throughout.

Overall, I find myself hard-pressed to come up with a criticism of the book, since it so successfully meets its goals of guiding athletes toward effective and healthful diets that will help them meet the demands of sport performance, weight control, and lifelong health while also providing them with scientifically-based recommendations along the way.

Nancy Clark is a dietitian/sports nutritionist in private practice in the Boston, MA area, where she has practiced for more than 40 years. She travels the United States teaching others about sports nutrition and her experiences in the field. Her excellence in nutrition journalism has earned her recognition from the American Society of Nutrition, and she is a fellow of the Academy of Nutrition and Dietetics as well as the American College of Sports Medicine.

Reviewed by Mark Kern, PhD, RD, professor of Exercise and Nutritional Sciences at San Diego State University.

Research Digest

Refeeding Protocol and Eating Disorders

Chang Y, Thew M, Hettich K, et al. Adolescent inpatients with eating disorders: comparison between acute and chronic malnutrition states on a refeeding protocol. *Glob Pediatr Health*. 2019;6:1-6.

Refeeding syndrome is a concern during the first weeks of nutrition rehabilitation when working with patients with eating disorders (EDs). Symptoms include metabolic disturbances that can occur upon reinstitution of nutrition in malnourished patients, and the outcome can be fatal. This clinical trial focused on whether the duration of weight loss in patients with an ED affected refeeding parameters. Forty-six male and female participants were divided into two groups: acute malnutrition (duration 3 months or less; n=25) and chronic malnutrition (duration longer than 3 months; n=21). Participants met the following criteria: ages 10 to 19 years; diagnosed with an ED; diagnosed with severe malnutrition, acute weight loss/food refusal, cardiac abnormalities, electrolyte imbalance, acute medical complications related to malnutrition; and failure of outpatient treatment. Upon admission, energy needs were determined and patients were assigned a nutrition plan. Meal plans were prescribed that included an increase of approximately 250 kcal every 24 hours, and goal calories were to be met on day 4 of hospitalization. Vital signs were measured every 4 hours (supine heart rate, blood pressure, body temperature) and laboratory collection was taken every 12 hours (potassium, phosphate, and magnesium levels). Those with acute malnutrition had a higher monthly weight loss than those with chronic malnutrition (P=.001). After initiation of nutrition rehabilitation, there were no statistically significant differences between the two groups. These findings suggest that nutrition rehabilitation may not be affected by the length of malnutrition, and may not need to be considered when determining the patient's nutrition prescription.

Summarized by Taylor Dunn, graduate student, Department of Nutrition and Integrative Physiology, Coordinated Master's Program, Nutrition, Education and Research Concentration, University of Utah, Salt Lake City, UT.

Perfectionism and Dieting in College Athletes

Prnjak K, Jukic I, Tufano JJ. Perfectionism, body satisfaction and dieting in athletes: the role of gender and sport type. *Sports (Basel)*. 2019;7(8):181

Athletes presenting with perfectionist-like qualities may experience body dissatisfaction and disordered eating tendencies. There is an increasing interest in how these conditions present in athletes, especially related to sports that emphasize weight controlling behaviors. This randomized, cross-sectional study examined whether adaptive and maladaptive perfectionism resulted in disordered eating signs and symptoms in both female and male athletes of team and individual sport. In addition, the investigators observed whether body satisfaction can mediate the relationship between perfectionism and disordered eating. A total of 280 (192 male, 88 female) college athletes (mean age 21 years; Caucasian) completed a sociodemographic questionnaire, the Positive and Negative Perfectionism Scale (a 40-item measure of both adaptive and maladaptive perfectionism), the Body Image Satisfaction Scale, and the Eating Attitudes Test-26 (EAT-26) to measure disordered eating behaviors and attitudes. Results indicated that there were no significant differences between female and male athletes based on dieting behavior outcomes. Among female athletes, body satisfaction correlated with perfectionism and dieting (P<.05), while in male athletes, body satisfaction and maladaptive perfectionism were correlated (P<.05). The two facets of perfectionism (adaptive and maladaptive) were not significantly correlated in females or males; however, the body satisfaction variable independently contributed to the explanation of dieting (P<.05). These results suggest that the relationship between body satisfaction and disordered eating is not forthright; therefore, it would be essential to establish varied dimensions of perfectionism in the study of disordered eating as well as in the context in which ath-

letes perceive their body. This research received no external funding.

Summarized by Danielle Perez, graduate student, Department of Nutrition and Integrative Physiology, Coordinated Master's Program, Nutrition, Education and Research Concentration, University of Utah, Salt Lake City, UT.

Carbohydrate Periodization: Iron Regulation and Immune Function

Mckay A, Heikura I, Burke L, et al. Influence of periodizing dietary carbohydrate on iron regulation and immune function in elite triathletes. *Int J Sport Nutr Exerc Metab*. 2019;17:1-8.

Sleep-low training, or short-term restriction of carbohydrate (CHO) intake throughout the night and during early morning training, may provide adaptations of increased lipid oxidation in endurance athletes. This study's main purpose was to quantify the acute impact on health that sleep-low training may have, specifically regarding inflammation, iron regulation, and markers of immune function. Eleven elite triathletes were divided into two groups: sleep-low and high CHO. Both groups completed a 4-day training regime that included two evening sessions of high intensity training (HIT) with a low intensity training (LIT) session the following morning. High CHO participants consumed 6 to 8g/kg/day, while the sleep-low group restricted CHO intake (0g/kg) upon finishing the HIT session. CHO restriction continued until the next morning's LIT session was finished. Venous blood and saliva samples were taken pre- and post-LIT to measure immune and iron markers. Mucosal immunity increased significantly post-exercise, but there were no differences between dietary interventions. Hepcidin-25, an iron regulatory hormone, also increased significantly with exercise, with the greatest increase in the low CHO group (P=.026). In summary, the differences in immune and iron regulation were minimal between dietary groups and unlikely to negatively affect health. These findings suggest that short-term sleep-low training strategies may be beneficial for aerobic athletic performance without negative effects on health. Long-term effects of sleep-low training are unknown and require further investigation. This study was funded by grants from the Australian Catholic University Research Fund, the Australian Institute of Sport's High Performance Sport Research Fund, and Triathlon Australia.

Summarized by Damon Joyner, PhD, CSCS, assistant professor of Nutrition, Department of Nutrition and Exercise Sciences, Weber State University, Ogden, UT.

Post-Exercise Carbohydrate Effects on Skeletal Muscle and Bone Turnover Training Adaptations

Hammond K, Sale C, Fraser W, et al. Post-exercise carbohydrate and energy availability induce independent effects on skeletal muscle cell signaling and bone turnover: implications for training adaptation. *J Physiol*. 2019;597.18:4779-4796.

Recent evidence suggests reduced carbohydrate availability (i.e., the train low approach) may enhance endurance training adaptations. However, it is unclear whether adaptations are augmented by carbohydrate (CHO) restriction, energy restriction, or a combination of both. Therefore, the purpose of this study was to examine the effects of post-exercise CHO and calorie (CAL) restriction on bone metabolism, skeletal muscle lipid metabolism, and mitochondrial training adaptations. In this randomized crossover study, nine male runners completed a high intensity interval training (HIIT) running protocol (8×5 min at 85% VO2peak) twice per day (AM and PM) separated by 3.5 hours under three randomized post-exercise dietary conditions: 1) high carbohydrate [HCHO; CHO:12 g/kg, CAL:60 kcal/kg fat free mass (FFM)], 2) low carbohydrate/high fat availability [LCHO; CHO:3g/kg, CAL:60 kcal/kg FFM)], or 3) low carbohydrate/low calorie [LCAL; CHO:3 g/kg, CAL:20 kcal/kg FFM)]. Muscle glycogen significantly decreased (P<.01) in all groups immediately post-PM HIIT to approximately 200 mmol kg^{-1}. However, post-exercise muscle glycogen re-synthesis was highest in the HCHO group compared with the LCHF (P=.028) or LCAL (P=.002) groups. There were no group differences in markers of bone resorption following AM HIIT, although bone reabsorption was significantly lower in the HCHO group compared with to the LCHF (P=.032) or LCAL (P=.035) groups following PM HIIT. Lipid oxidation increased in all groups during both AM and PM HIITT sessions (P<.001), with LCHF (P=.014) and LCAL (P=.011) lipid oxidation significantly greater than HCHO. Mitochondrial biogenesis was not significantly affected by exercise (P=.17) or dietary condition (P=.38). In summary, these data suggest that when glycogen is at least 200 mmol kg^{-1}, low CHO and CAL restriction do not enhance skeletal, mitochondrial, and lipid adaptations. Furthermore, timing of high CHO availability may be more beneficial to bone metabolism regulation than CAL availability. Athletes may benefit from post-exercise CHO consumption to prevent detrimental effects on bone. This study was funded by a grant from the English Institute of Sport.

Summarized by Sara Saltzgiver, undergraduate student in sports nutrition, Department of Exercise and Nutrition Sciences, Weber State University, Ogden, UT.

Of Further Interest

News from Cardiovascular Health Subunit Director

Here are some announcements from the Cardiovascular Health (CV Health) subunit:

• **Update on CV Webinars.** Visit www.scandpg.org to view our newly released or soon-to-be released webinars: *2019 AHA/ACC Prevention Guidelines* (speaker: Penny Kris-Etherton); scheduled for March 13 at 1pm CST: *Unscrambling the Dietary Cholesterol Confusion: To Egg or Not to Egg* (speaker: Kevin Maki); and scheduled for June 22 at 12 noon CST*: Current Evidence and Clinical Recommendations on the Effects of Low-Carbohydrate and Very-Low-Carbohydrate (including Ketogenic) Diets for the Management of Body Weight and other Cardiometabolic Risk Factors* (speakers: Carol Kirkpatrick and Susan Vannucci. As with all full-hour webinars offered by SCAN, you have the opportunity to earn 1 CPEU.

• **Update on CV Webbies.** To enable members to increase their expertise one skill at a time,
SCAN recently launched Webbies—focused mini-webinars that run 3 to 5 minutes in length. Visit www.scandpg.org to view the following CV Health Webbies that are currently posted or soon-to-be posted: (1) *To Egg or Not To Egg: Eggs and CV Health*, by Geeta Sikand; (2) *Coconut Oil Controversy: Is the Jury Still Out?* by Sharon Smalling; (3) *So How DO Plant Sterols and Stanols Lower Cholesterol?* by Julie Bolick*;* (4) *How Does Viscous Fiber Lower Cholesterol?* by Karen Collins; (5) *Omega 6s and Heart Health—The Truth Revealed,* by Kevin Maki (to be posted in May); and *(6) Is Saturated Fat Associated with Clogging the Arteries?* by Nancy Smith (to be posted in July). Don't miss these new vehicles for gaining actionable skills and information in just a few minutes. If you have ideas for other Webbies for next year, please contact Geeta Sikand, director of the Cardiovascular Health subunit, at gsikand@gmail.com.

• **CV Reimbursement Trends/Efforts.** Carol Bradley is SCAN's reimbursement representative. If you're interested in becoming involved in our efforts to increase awareness of reimbursement issues/topics, contact Geeta Sikand, director of the CV Health Subunit, at gsikand@gmail.com.

• **We Need Volunteers for CV Health.** If you'd like to serve on the CV Health subunit Committee by sharing your expertise and updating CV Health Resources on the SCAN website and/or would like to serve on the CV Reimbursement Committee, contact Geeta Sikand, director of the CV Health subunit, at gsikand@gmail.com.

News from Wellness & Wellbeing Subunit

Here's an update from the newly renamed Wellness & Wellbeing subunit:

• **Volunteer Coordinator Needed.** The Wellness & Wellbeing subunit has a need for a volunteer coordinator. This person will work directly with the subunit director to identify and recruit volunteers for subunit project. Contact Mark Hoesten at mshcg@yahoo.com.

• **We Welcome Your Webinar Input!** Do you have an idea for, or are you interested in writing a webinar or a mini-webinar for the Wellness & Wellbeing subunit? Contact Mark Hoesten at mshcg@yahoo.com.

• **Food & Nutrition Conference and Expo.** We hope to see you in Indianapolis this year for FNCE 2020! Details can be found at https://eatrightfnce.org/.

News from the Sports Performance Subunit

Following are some highlights from the Sports Performance subunit (formerly called SD-USA):

• **See You Soon Boston!** The 2020 SCAN Symposium, March 21-23 in Boston, will be a sports-focused Symposium with opportunities to attend some exciting hands-on workshops and hear world-class speakers. If you haven't registered yet, do so today at https://web.cvent.com/event/e9c34e7a-b59e-47cb-935d-6c375b1259a3/summary

• **Symposium Pre-Conference: A Don't Miss Event.** Held at historic Fenway Park, the upcoming SCAN Symposium pre-conference event will be March 20, from 1 to 4 pm. Several well-known researchers and clinicians will be providing advanced learning, focusing on the unique characteristics of female athletes. Session speakers include: Adam Tenforde, MD, sports medicine specialist; Kate Ackerman, MD, MPH, director of the Harvard Medical School Female Athlete Program, and Lisa Lewis EdD, CADC-II, licensed psychologist. Register today at https://web.cvent.com/event/e9c34e7a-b59e-47cb-935d-6c375b1259a3/websitePage:8aea3b0f-8464-4f9b-8f13-92e4e1fae8d2

• **Join us at the Subunit Meeting at Symposium!** We've been hard at work developing new mentoring opportunities, and during our Subunit Meeting we'll be sharing all the exciting details! Big news is coming your way at the Sports Performance subunit meeting!

• **Updated Online Sports Nutrition Care Manual®.** Have you seen the updated version? A full webinar developed by Kate Davis will be available for you to learn about all of the numerous ways to utilize this newly updated tool. Check it out now at www.nutritioncaremanual.org/sports-nutrition-care.

• **SCAN Fact Sheets.** Check out the newest SCAN fact sheets at. www.scandpg.org/scan/educational-resources/fact-sheets/sn-fact-sheets Download them for free today!

• **Athletes and the Arts Partnership.** SCAN has an official partnership with Athletes and the Arts (an initiative of the American College of Sports Medicine). This ties in with our Expanding the Arena Initiative by promoting opportunities for sports dietitians to work with performing artists. We're looking for volunteers who are interested in developing this partnership. Visit the SCAN volunteer page at www.scandpg.org/scan/about-us/volunteer-opportunities today!

• **New! Changes to the CSSD Exam Window.** The CSSD exam is now administered year-round! Visit the Commission on Dietetic Registration (CDR) website at www.cdrnet.org/certifications/board-certification-as-a-specialist-in-sports-dietetics for more information.

Looking for Past *PULSE* Articles?

If you're doing research or simply want to locate content that appeared in an archived issue of *SCAN'S PULSE*, check out the annual "Index of Topics" posted for each year on SCAN's website. You'll find the issue and page number for each feature article (conveniently listed by practice are), and each item in the "Conference Highlights," "Reviews," and "Research Digest" departments. You can then instantly access the archived issue online. As a member benefit, all *PULSE* issues and annual indexes are available you for free at www.scandpg.org/nutrition-info/pulse-newsletters.

Call for Abstractors for "Research Digest"

The "Research Digest," which appears in each issue of *SCAN'S PULSE,* provides summaries of published papers relating to all of SCAN's practice areas: nutrition for sports and physical activity, cardiovascular health, and wellness.

You can contribute to the "Research Digest" by volunteering to abstract a recently published study on any of the above practice areas. For details on this opportunity, contact Kary Woodruff, MS, RD, CSSD, co-editor of "Research Digest," at kary.woodruff@health.utah.edu. Become a contributor to *PULSE*!

Manuscripts for *PULSE* Welcome

SCAN'S PULSE welcomes the submission of manuscript to be considered for publication. In particular, *PULSE* is interested in receiving original research reports and review articles. Manuscripts presenting practical guidelines, case studies, and other information relative to SCAN will also be considered.

Manuscripts must be prepared and submitted in accordance with *PULSE's* Guidelines for Authors; only manuscripts that follow these guidelines will be considered. The Guidelines for Authors can be accessed at www.scandpg.org/nutrition-info/pulse/.

Symposium 2020

Revolutionizing Performance Nutrition

March 21-23, 2020
Boston Park Plaza
Boston, MA

There's still time, so register today! The 36th Annual SCAN Symposium, ***Revolutionizing Performance Nutrition***, will explore, challenge, and discuss revolutionizing evidence-based nutrition research, science, practice, and policy.

The 2020 SCAN Symposium has been carefully planned to provide you with insights and information that can help individuals maximize their health and human performance. Attend this event to:

- Examine best nutrition practices for sport, physical activity, cardiovascular health, and well-being
- Gain new tools to support clients, patients, athletes, and first responders to perform to their peak potential
- Network with colleagues and advance your career development

For more information and updates, watch for eblasts and visit www.scandpg.org

Upcoming Events

March 21-23, 2020
Join your colleagues at the 36th SCAN Symposium, *Revolutionizing Performance Nutrition*, Boston, MA. For information: www.scandpg.org/scan-events/scan-symposia

May 26-30, 2020
ACSM Annual Meeting, World Congress on Exercise is Medicine®, and World Congress on the Basic Sciences of Exercise and the Brain, San Francisco, CA. For information: www.acsm.org

May 30-June 2, 2020
Nutrition 2020, Seattle, WA. For information: American Society for Nutrition, https://meeting.nutrition.org

June 4-7, 2020
National Lipid Association Scientific Sessions, Chicago, IL. For information: www.lipid.org/sessions

July 20-22, 2020
Annual National Wellness Conference, Orlando, FL. For information: www.nationalwellness.org/page/NWC

SCAN'S PULSE

Publication of the Sports,Cardiovascular, and Wellness Nutrition (SCAN) dietetic practice group of the Academy of Nutrition and Dietetics. ISSN: 1528-5707.

Editor-in-Chief
Mark Kern, PhD, RD
Exercise and Nutrition Sciences
San Diego State University
5500 Campanile Dr.
San Diego, CA 92182-7251
619/594-1834
619/594-6553 - fax
kern@mail.sdsu.edu

Sports Editors
Michelle Barrack, PhD, RDN, CSSD

Cardiovascular Editor
Zachary Clayton, PhD

Wellness Editors
Brooke Wickman, MS, RD

Conference Highlights Editor
Nancy Clark, MS, RD

Reviews Editor
To be appointed

Research Digest Editors
Stacie Wing-Gaia, PhD, RD, CSSD
Kary Woodruff, MS, RD, CSSD

SCAN Notables Editor
To be appointed

Managing Editor
Annette Lenzi Martin
708/715-9423
annettemartin100@outlook.com

The viewpoints and statements herein do not necessarily reflect policies and/or official positions of the Academy of Nutrition and Dietetics. Opinions expressed are those of the individual authors. Publication of an advertisement in *SCAN'S PULSE* should not be construed as an endorsement of the advertiser or the product by the Academy of Nutrition and Dieteics and/or Sports, Cardiovascular, and Wellness Nutrition.

Appropriate announcements are welcome. Deadline for the Fall 2020 issue: July 1, 2020. Deadline for the Winter 2021 issue: Sept. 1, 2020. Manuscripts (original research, review articles, etc.) willl be considered for publication. Guidelines for authors are available at www.scandpg.org/nutrition-info/pulse/ Email manuscript to the Editor-in-Chief; allow up to 6 weeks for a response.

Subscriptions: For individuals not eligible for Academy of Nutrition and Dietetic membership: $50. For institutions: $100. To subscribe: SCAN Office, 800/249-2875

To contact an editor listed above, visit: www.scandpg.org/scan/member-resources/scan-newsletters/pulse