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Dietary Flavonoids and Health: A Review

by Monica Bearden, RD, and Shara
Aaron, MS, RD

From the use of herbs and plants for medicinal purposes by ancient civilizations to today's emphasis on eating a variety of fruits and vegetables, we have long known that plant-based foods have the ability to prevent illness and heal. Although the precise mechanisms for these health promotion effects were unclear a few decades ago, researchers have shed more light on this topic by uncovering various phytochemicals that appear to be at least partially involved. It seems that phytochemicals, which serve to protect plants from environmental harm and extreme conditions, may also protect human health.

Unlike the well-known vitamins and minerals, phytochemicals are not defined by a classic deficiency disease. Nevertheless, it is likely that low intake of many phytochemicals may predispose individuals to risk for chronic diseases that impact many lives today—including heart disease, cancer, diabetes, and dementia. In fact, diets low in plant-based foods (and thus lacking in phytochemicals and other nutrients) have been linked to higher rates of chronic disease and even mortality.¹

New research findings on flavonoid-containing foods and their potential health benefits are reported

almost daily. These investigations range from epidemiologic studies such as the Iowa Women's Health Study,² which reveals an inverse relationship between coronary heart disease and flavonoid intake, to clinical trials demonstrating the impact of flavonoids on multiple vascular health biomarkers. Evidence is mounting that flavonoid-rich foods—such as onions, grapes, cranberries, tea, cocoa and chocolate, apples, peanuts, and blueberries— influence cell proliferation, inflammation, oxidation, blood flow, and insulin sensitivity, suggesting a potential role for flavonoids in the prevention of cancer, heart disease, and even diabetes.

Impact of Flavonoids on Cardiovascular Health

By far the most advanced flavonoid research lies in the cardiovascular field. Numerous studies demonstrate that flavonoids have effects on multiple mechanisms related to the cardiovascular system,³⁻⁶ such as reduction of platelet aggregation and low-density lipoprotein (LDL) oxidation.⁷⁻¹² In addition, through their actions on nitric oxide (NO), flavonoids also affect endothelium-dependant vasorelaxation, thus impacting the health of the vascular wall.¹³⁻¹⁹ Blood pressure may also improve with an increased intake of flavonoids.²⁰

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There is robust epidemiologic evidence supporting an association between plant-based foods rich in flavanols (a type of flavonoid) and decreased cardiovascular disease (CVD) risk and mortality. In 1993, Hertog and colleagues reported that individuals in the highest tertile of intake of tea, apples, and onions had a 68% reduction in CVD risk compared with those in the lowest tertile of intake.²¹ In 1999, Sesso and colleagues observed that drinking at least 1 cup of tea daily resulted in a 44% reduction in CVD risk compared with low tea intake.²² More recent data from the Zutphen Elderly Study showed that elderly men in the highest tertile of intake of cocoa-containing products had a 50% reduced risk of cardiovascular death and a 47% reduced risk of all-cause mortality.²³

Effects of Flavonoids on Skin

Although much of the flavonoid research has a cardiovascular focus, we are learning that these flavonoid-related vascular effects may also impact other organ systems (e.g., kidney, epidermis, brain) as well as insulin resistance.²⁴⁻³⁴ In one way or another, all functions of the body are dependant on the vascular system to receive needed nutrients and oxygen. As such, several vascular-related areas of research based on endothelial health and blood flow are emerging. For example, controlled wine consumption was found to enhance kidney antioxidant defenses and protect against renal ischemia/reperfusion injury in patients with chronic renal failure; this is believed to be due to wine's impact on oxidative stress and endothelial dysfunction.²⁴

A new area of study focuses on the impact of flavonoids on the

epidermis. The skin is a dynamic organ that relies on the vascular system to remain well hydrated, and studies show that the appearance of the skin may be improved by consuming foods rich in flavanols.^{26,27} In a novel study, two groups of women (n=24) consumed a high-flavanol (326 mg/day) or low-flavanol (26 mg/day) cocoa drink each day for 12 weeks.²⁶ Selected skin areas were exposed to solar-simulated radiation. Reddening of the skin after the ultraviolet (UV) exposure was measured, and peripheral blood flow and hydration in the skin were assessed. Results showed a 15% and 25% reduction in UV-induced

erythema at 6 and 12 weeks, respectively, for the high-flavanol group, while no change occurred in the low-flavanol group. In addition, blood flow to the skin and density and thickness of the skin were increased. A decrease in transepidermal water loss was also observed.

Another crossover study evaluated whether cocoa flavanols exerted acute effects on cutaneous microcirculation after a single dose of a high- versus low-flavanol cocoa beverage in 10 healthy women.²⁷ Dermal blood flow and oxygen saturation of hemoglobin were measured at 0, 1, 2, 4, and 6 hours post-consumption. Compared with baseline, peripheral blood flow was elevated 1.7-fold and oxygen saturation was increased 1.8-fold at 2 hours after consuming the high-flavanol cocoa beverage; no change after consumption occurred with the low-flavanol cocoa beverage. These results indicate that a high intake of flavanols may protect skin from UV damage, improve dermal blood circulation, maintain skin hydration,

“Several vascular-related areas of research based on endothelial health and blood flow are emerging.”

and ultimately improve overall appearance of the skin.

Flavonoids and Cognitive Function

An area of study appearing to gain momentum is cognitive function and the consumption of flavonoid-containing foods. Studies using grape juice and blueberry extracts have shown that rodents supplemented with these flavonoid-rich beverages performed better on water-maze tests and experienced increased neuronal communication in the brain compared with rodents receiving a typical diet.^{29,31} An observational study involving men and women aged 65 years or older revealed that moderate red wine drinkers (3-4 drinks/day) experienced significant reductions in risk for dementia.³⁰

In another investigation, 16 healthy women consumed a high-flavanol cocoa beverage (150 mg of cocoa flavanols) for 5 days ("treatment period") and then performed two reactionary tasks.³² Functional magnetic resonance imaging (fMRI) was used to measure blood oxygenation level-dependent (BOLD) responses in the brain. Reaction time and error rate also were measured. The experiment was repeated with a low-flavanol placebo drink. The BOLD response increased after the high-flavanol cocoa treatment period but not after the placebo treatment period. There was no effect after either treatment on reaction time or error rate during the tasks. Researchers state that BOLD results are a better indicator of neurocognitive function and cerebral blood flow compared with the behavioral effects of reaction time and error rate.

A pilot study (n=4) found that a single, high dose of flavanols (450 mg) in a cocoa beverage resulted in an increase in cerebral blood flow to the gray matter in the brain.³² The investigators stated that findings of this nature would suggest a potential use of flavanols in the treatment of dementia and stroke.



FROM THE EDITOR

It's All About Making Connections

We hear how important connections are all the time—getting the best job, getting elected to public office, and so on. Connections aren't always about beating the competition and getting ahead, though. In fact, this issue of *PULSE* connects several topics that you may not have realized were connected at all.

Our cover article by Monica Bearden, RD, and Shara Aaron, MS, RD explores the connection between the consumption of flavonoid-rich foods (including chocolate) and issues related to health and wellness. In our valuable continuing professional education (CPE) article, Ruth Taylor, MS, RD, illustrates the link between the metabolic syndrome and collegiate athletes, a population that many would not intuitively connect to that disease process.

In another article, Jessica Welch, MS, and I outline research describing connections between exercise participation, glutamine status, and function of our immune system. Finally, Chrissy Barth, RD, CFT, RYT, draws connections between the practice of yoga and the prevention and treatment of eating disorders.

You'll also want to peruse the rest of this issue to stay connected with SCAN and the latest outcomes of research on SCAN-related topics—because with SCAN, it's all about making connections.

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

Putting the Research into Perspective

Study findings thus far support eating plant-based foods, but more research is needed to support the isolation of flavonoids for therapeutic benefits. In addition, more research is needed because different types of flavonoid have produced different results in the investigations to date. Moreover, many of the in vitro and animal data have not yet been translated to human studies.

As another concern, some studies using purified forms of flavonoids have yielded results contrary to those observed in studies using the whole food.³⁵⁻³⁷ For example, anthocyanins extracted from black currants fed to Watanabe heritable hyperlipidemic rabbits for 16 weeks adversely affected plasma total and LDL

cholesterol concentrations. In contrast, these results were not found in rabbits fed black currant juice, suggesting that other components of the juice counteract the adverse effects of the purified anthocyanins. Although the black currant juice did not have the expected beneficial impact on total plasma cholesterol, very-low-density lipoprotein (VLDL) cholesterol was significantly lowered.³⁶

In addition, some studies have failed to confirm in vitro and animal findings. Duthie and colleagues fed anthocyanin-rich cranberry juice to 20 healthy women for 2 weeks. Results showed that blood cellular antioxidant status and biomarkers of lipid status related to heart disease were not altered, and there was no



effect on basal or induced oxidative damage.³⁷ These findings are contrary to the antioxidant potential and health benefits suggested by in vitro and animal data.³⁸

To date, the research supports a food-based approach for flavonoids in health promotion. While foods may be predominant in certain flavonoids (see figure), most contain a mix of types. Moreover, there are components of foods such as other phytochemicals, vitamins, minerals, and fiber that may work together with flavonoids to protect health and heal. Further research is needed to fully understand these synergies as well as the role of the individual flavonoids.

Making small changes in the diet to include more plant-based foods rich in flavonoids can beneficially impact the vascular system and, therefore, several organs and health concerns. The improvements in blood flow and endothelium integrity that are associated with flavonoids help explain why fruits and vegetables have long been promoted as important for the maintenance of good health.

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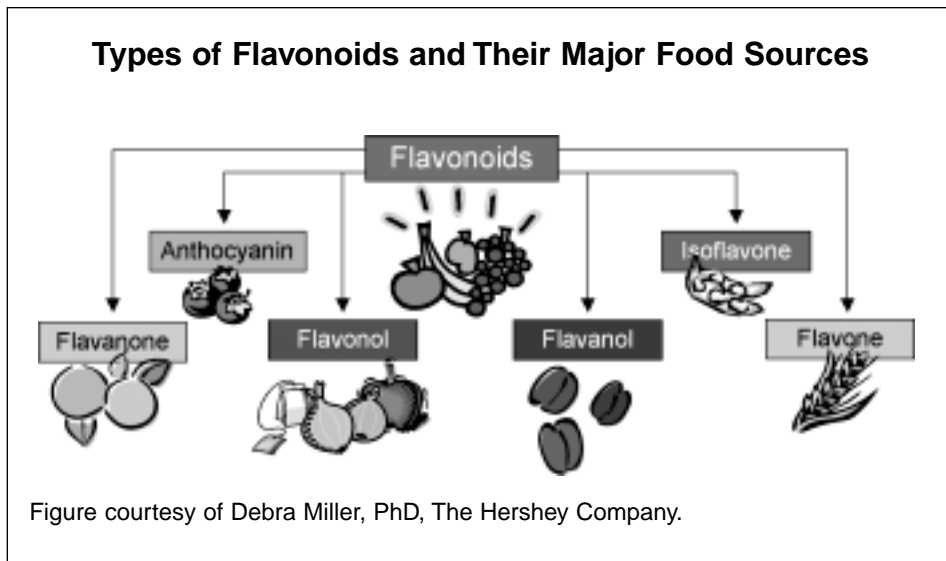


Figure courtesy of Debra Miller, PhD, The Hershey Company.

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“There are components of foods such as other phytochemicals, vitamins, minerals, and fiber that may work together with flavonoids to protect health and heal.”

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CPE article**The Metabolic Syndrome and Collegiate Athletes***by Ruth Taylor, MS, RD*

This article is approved by the Commission on Dietetic Registration (CDR) for 1 continuing professional education unit (CPEU), level 1. To apply for free CPE credit, obtain a question/answer sheet through one of the following methods: (a) download it from SCAN's Web site (www.scandpg.org), or (b) request it from the SCAN Office via phone: 800/249-2875, fax: 847/556-0352, or email: scanoffice@eatright.org.

Learning Objectives

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

- Describe supportive evidence of the prevalence of risk factors for the metabolic syndrome among football athletes.
- Explain the effects of the metabolic syndrome on sports performance.
- List the basic dietary intervention guidelines specific to the needs of collegiate athletes with MetS or risk factors of MetS.

The metabolic syndrome (MetS) has been defined by the American Heart Association and the National Heart, Lung and Blood Institute as a combination of at least three of the following conditions: elevated waist circumference, elevated triglyceride, reduced high-density lipoprotein (HDL)-cholesterol, hypertension, and elevated fasting blood glucose.¹ Obesity and insulin resistance are two significant risk factors of MetS; each is strongly associated with increased blood pressure and cardiovascular disease (CVD).

Health professionals may assume that collegiate athletes, who engage in moderate to extreme levels of physical activity, are not at risk for MetS or its risk factors because they are physically active. In reality, added

body bulk—seen particularly in sports that emphasize a large body size, such as football and field throwing events (e.g., shot put)—may have deleterious health consequences associated with MetS.

Prevalence of Metabolic Syndrome Risk Factors in Athletes

Although there are no published prevalence studies of MetS among collegiate athletes, there are reports of MetS risk factors at various levels of athletics, including high school, college, and professional.

Based on body mass index (BMI), a significant percentage of high school² and professional³ football players are



“Excess body fat, elevated blood pressure, and poor glucose control can impact the playing performance of athletes.”

obese. Among 215 high school linemen, 45% were found to be overweight (BMI \geq 25), with 9% classified with adult severe obesity (BMI \geq 35).² A study of 2,168 National Football League players determined that 3% of the players had class III obesity (BMI \geq 40), 26% had class II obesity (BMI \geq 35), 56% were classified as obese (BMI \geq 30), and 97% of the players were classified overweight.³ In addition, a recent study found that professional football players with higher BMIs had higher blood pressure levels compared with other players.⁴

The use of BMI to determine healthy weight status in athletes has been criticized, because it does not reflect an athlete's muscle mass. However, it seems unlikely that increased muscle mass alone explains higher BMIs for those in the class II or higher obesity range. In one investigation, Division I collegiate football offensive linemen, tight ends, and defensive linemen had body composition measured at near obese body fat levels with abdominal adiposity, thus increasing their risk for developing CVD and diabetes.⁵ Another study involving collegiate football players found that over-fat linemen had significantly higher mean values for systolic blood pressure and triglycerides compared with normal-fat players.⁶

Although research in this area is limited to male football athletes and there are no documented prevalence rates for other collegiate athletes, it appears that MetS risk factors affect a portion of the athletic population.

Impact on Athletic Performance

Excess body fat, elevated blood pressure, and poor glucose control can impact the playing performance of athletes. Miller et al⁷ found that among Division I football players, higher levels of body fat negatively correlated with performance in the power clean and vertical jump. The investigators also reported that among the linemen, increases in body fat were negatively associated with 40-yard and 20-yard dash performance.⁷

Cureton et al⁸ reported that increased body weight decreased maximal oxygen uptake (a common cardiorespiratory measure of performance potential). In addition, both higher body fatness and higher BMI have been associated with increased rates of lower extremity injury among high school football

players.⁹ These findings suggest that excess body weight may have a negative impact on athletic performance.

Sports participation and training may be restricted in athletes with hypertension. For athletes with uncontrolled hypertension (>140/90 mm Hg), recommended exercise restrictions include limited low-intensity dynamic exercise and avoidance of isometric sports. For athletes with controlled mild to moderate hypertension (>120/80 mm Hg to <140/90 mm Hg), only a possible limit on isometric training may be recommended.¹⁰ Generally, exercise in persons with essential hypertension induces an abnormal increase in blood pressure followed by a decrease in blood pressure nearing healthy ranges. This exercise-induced reduction in blood pressure towards normal values is often associated with reports of weakness and reduced exercise capacity.¹¹ Hence, athletes with hypertension may not be able to train to their maximum potential.

The effects of physical activity on metabolic responses in individuals who have insulin resistance are influenced by abnormal insulin secretion and peripheral insulin resistance.¹² Research shows the rate of oxygen consumption during acute bouts of graded exercise is significantly lower in persons with insulin resistance than in those with normal glucose control.¹³ According to the American College of Sports Medicine's position statement on exercise and diabetes, this indicates that oxygen delivery to peripheral tissues in individuals with insulin resistance may be impaired during exercise.¹² Therefore, functional exercise capacity is frequently lower in those with insulin resistance than those without diabetes. Regardless of whether an athlete has one MetS risk factor or more than one, athletic performance may be negatively affected by limited work capacity and training potential.

Metabolic Syndrome and Nutrition Intervention

A key component in the prevention of CVD is early intervention that emphasizes the essential role of diet in helping to prevent MetS. The sports dietitian's sphere of influence and responsibilities in addressing MetS and MetS risk factors in collegiate athletes are summarized in the table.

Annual physical examinations that include assessments of blood chemistry, lipid profiles, blood pressure, BMI, and body composition are essential in identifying at-risk athletes. Once an at-risk athlete is identified, medical nutrition therapy with individualized counseling is warranted to determine necessary food and physical activity modification for weight control, blood pressure control, and/or blood glucose control based on age, sex, and the physical energy demands of the specific sport.

The nutrition plan is not much different for at-risk athletes than non-athletes. Because college athletes follow a demanding schedule involving classes, practices, team meetings, study hall, and sport-related events, opportunities for food preparation and meals are often limited. The planning and implementation of realistic individualized meal plans—those that include reduced intakes of saturated fat, trans fat, cholesterol, sodium, and simple sugars and emphasize adequate intake of fruit, vegetables, whole grains, lean protein-rich foods, low-fat dairy foods, and appropriate portion sizes—must fit into the intense schedule of the athlete while providing optimal energy and timing of nutrients to maximize sports performance.¹

A recent study found that consumption of a diet consistent with the 2005 Dietary Guidelines for Americans is associated with a lower prevalence of MetS and lower levels of many of the risk factors of MetS.¹⁴ Because college athletes have limited nutrition knowledge,¹⁵ nutrition

education geared toward entire teams can play an important role in preventing athletes from developing MetS risk factors. Team education on weight management and an atherogenic diet¹ can take place in a

Table. Addressing MetS and Its Risk Factors in the Collegiate Athlete: The Sports Dietitian's Role

Identify At-Risk Athletes:

- Annual physical examination results
- Laboratory test findings: blood chemistry; lipid profile
- Blood pressure measurement
- BMI and body composition assessment

Consider These Factors:

- Age
- Sex
- Energy needs based on sport-specific and position-specific training
- Athlete's schedule and optimal timing of food
- Optimal composition of meals
- Athlete's access to food/supplements

Target Medical Nutrition Therapy:

- Weight management
- Dyslipidemia
- Hypertension
- Blood glucose control

Provide Education:

- Individual education
- Team education: lectures, seminars, written nutrition materials, interactive discussions
- Address necessary changes in energy intake to reflect changes in energy expenditure that may occur due to seasonal variation in training and competition, injury, eligibility, and post-sports career



variety of ways, including mini-lectures, interactive discussions, seminars, and comprehensive written handouts.¹⁵

Also important to prevention is consideration of the athlete's nutrition habits during the off-season, following an injury, or after his or her eligibility has ended. Unhealthy weight gain may be observed if food intake remains the same when sports participation ends and energy expenditure declines. Education on healthy nutritional practices for life that reflect expected changes in energy levels is essential in preventing unnecessary and often harmful weight gain.

Regulations Affecting Nutrition Intervention

A major regulation of the National Collegiate Athletic Association (NCAA) that impacts the nutrition plan for student athletes involves the use of nutritional supplements. According to Bylaw 16.5.2, Division I collegiate institutions can provide non-muscle-building nutritional supplements to student athletes with the intention of replacing calories and fluids lost through athletic participation.¹⁶ The nutritional supplement must be identified in one of four classes: carbohydrate/electrolyte drinks, energy bars, carbohydrate boosters, and vitamins and minerals.¹⁶

Confusion and controversy can sometimes result from differences in the interpretations of these supplement categories. For example, because "carbohydrate booster" and "energy bars" are not formally recognized or defined terms in the medical and dietetics professions, interpretation of the bylaw by collegiate sports dietitians may differ from that made by NCAA compliance officers. Although the provision of the supplemental calories and fluids for athletes is important to maintain weight, maintain blood glucose levels

during training, and maximize recovery after training, some supplements may lead to unnecessary weight gain if used in excess.

Another NCAA regulation that influences nutrition intervention in collegiate athletes is the provision of a one-meal-per day rule at athlete-exclusive training tables.¹⁵ Although not all schools implement an athlete-exclusive training table or dining facility, the training table can offer a unique opportunity for sports dietitians and sports medicine staff to



"A major regulation of the National Collegiate Athletic Association (NCAA) that impacts the nutrition plan for student athletes involves the use of nutritional supplements."

educate athletes about the optimal food choices to meet overall health, body composition, and performance goals.

Conclusion

Obesity is associated with numerous health risks, including those of the metabolic syndrome. Although prevalence rates of obesity, hypertension, dyslipidemia, and insulin resistance among collegiate athletes are not well documented, participation in sports that promote a larger body size may pose a health risk to the young-adult athletes competing in those sports. These risks should be considered by the athletes

and sports medicine staff.

Collegiate sports dietitians can work to identify athletes at risk for cardiovascular disease and diabetes, and can help prevent more serious medical problems by providing nutrition education. When working with the collegiate athlete population, consideration of NCAA regulations, performance nutrition, busy schedules, and optimal timing and composition of meals is critical to successful nutrition intervention.

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Glutamine Status, Exercise, and Immune Function

by Jessica Welch, MS, and Mark Kern, PhD, RD, CSSD

Glutamine is a conditionally essential amino acid that performs several roles in the human body. One role that has sparked recent attention involves immune function. Glutamine provides energy to immune cells through glutaminolysis, a process by which it becomes partially oxidized. Glutamine also has been linked to the regulation of T and B lymphocyte proliferation rates.¹

The role of glutamine in immune function has been examined by many researchers to determine if a relationship exists between exercise-induced immunosuppression and glutamine supplementation. To gain knowledge regarding this relationship, it is important to understand the metabolism of glutamine, the relationship between glutamine and exercise, and implications regarding current diagnostic criteria for the overtraining syndrome.

Glutamine Metabolism

The highest rate of glutamine production occurs in skeletal muscle. Glutamine is synthesized from ammonia and glutamic acid by the enzyme glutamine synthetase. The breakdown of glutamine to glutamic acid and ammonia is catalyzed by glutaminase.

Various tissues and organs utilize glutamine at different rates. The net direction of glutamine production and breakdown determines whether a specific tissue is a net consumer or producer of glutamine.² The organs primarily involved in glutamine synthesis include skeletal muscle,

lungs, liver, and brain. The body's primary consumers of glutamine include the kidneys, gut, and immune cells. The liver can also be classified as a glutamine consumer when carbohydrate availability is limited.

Glutamine catabolism occurs to a greater extent during a variety of conditions, including surgical trauma, infection, starvation, untreated diabetes mellitus, and prolonged exercise. These states are often accompanied by increases in cortisol and glucagon as well as increased demand for glutamine for

gluconeogenesis. In a fed state, the rate of glutamine synthesis in skeletal muscle, which is largely responsible for synthesizing, storing, and releasing glutamine into the plasma, is approximately 50 mmol/h.¹ The release of glutamine from muscle into the plasma is considered a rate-regulating step in glutamine metabolism by other tissues.

The availability and concentration of glucocorticoids, which are theorized to have a role in glutamine release from skeletal muscle during catabolic states, affect the rate of muscle glutamine synthetase activity.³ In addition, muscular activity has been shown to regulate the rate of glutamine release. Thus, physical activity may play an important role in immune function.¹

The Concept of Overtraining

To interpret research findings on the relationships linking glutamine, overtraining, and exercise-induced immunosuppression, a standard definition of overtraining along with specific diagnostic criteria are



“Physical activity may play an important role in immune function.”



essential. However, currently these are not universally used.

The most commonly identified factors that appear to contribute to overtraining include increased training volume, increased training intensity, and insufficient recovery between exercise sessions.¹ Parry-Billings et al⁴ asserted that when exercise bouts are frequent, intense, and prolonged, and recovery time is insufficient, performance will fail to improve optimally. Nieman⁵ further described overtraining as occurring most often when exercise bouts are prolonged (>1.5 to 2 h), moderate to high in intensity (at least 55% VO₂max), and performed without

food intake. His characterization of the type of exercise that can cause overtraining is consistent with studies suggesting that overtraining is most commonly associated with long-duration endurance training.^{4,6-8}

Some commonly used diagnostic criteria for the overtraining syndrome include chronic fatigue, otherwise unexplained decrements in performance, slowed or delayed wound healing, sore and painful muscles, and alterations in mood state (which can include sleep disturbances, depression, and chronic irritability).¹ An increase in urea excretion as well as a related negative nitrogen balance have been observed in overtrained athletes, and have been suggested markers of overtraining.^{4,9} Other research has demonstrated that overtrained athletes are at increased risk of illness, particularly upper-

respiratory tract infections, suggesting that the risk of infection is directly related to the volume and intensity of training; this may potentially be related to the glutamine response to exercise.¹⁰

The use of plasma glutamine concentration as a biochemical marker for overtraining has been debated, and agreement on a specific level has remained elusive. Relatively consistent findings indicate that resting plasma glutamine concentrations are lower in overtrained athletes compared with well-trained athletes and sedentary individuals.^{4,10-12} Therefore, the relationship between glutamine status

and exercise has been studied to determine the threshold at which rigorous exercise can depress glutamine concentrations and limit the potential for decreased immune function. While several factors (e.g., intensity and duration of exercise, nutritional status of the subjects, differences in measurement technique, timing

of blood sampling, and the collection and storage of the blood samples) should be considered when interpreting the results of various studies,¹ a comprehensive discussion of these issues is not within the scope of this review.

Glutamine and Exercise

As previously noted, several researchers have observed decreased plasma glutamine concentrations following long-duration exercise.^{1,13} This decline may be a result of an increased demand for glutamine by tissues that consume it, followed by increased glutamine uptake by these tissues. However, it has also been

suggested that this decrease in glutamine is the result of decreased production by skeletal muscle and a subsequent decrease in the amount and rate of glutamine release from the muscle. In addition, glutamine transport from muscle to the target tissues has been examined to determine if this process is responsible for the decrease in plasma glutamine after prolonged exercise.

Many studies have investigated the effect of exercise on plasma glutamine status. Change in plasma glutamine concentration can vary, based on the amount of time that has passed since the exercise session ended as well as the duration of the exercise bout. While it is common for exercisers to experience a decline in glutamine concentrations during prolonged exercise,^{14,16} shorter bouts can increase plasma glutamine concentrations.¹⁷⁻²⁰

The effect of exercise on plasma glutamine concentrations must be considered within the context of the type of exercise bout. Short, acute bouts refer to single exercise sessions that do not exceed 1.5 to 2 hours in duration. Research by Van Hall et al¹⁶ demonstrated post-exercise declines in plasma glutamine concentrations for up to 5 to 7 hours, with the lowest concentration observed 2 hours post-exercise. Other studies of relatively short exercise bouts have shown increased glutamine concentrations post-exercise.^{4,19,20} Katz et al¹⁹ measured plasma glutamine concentrations following 4 minutes of exercise at 100% VO₂max. Sewell et al²⁰ examined the glutamine response to treadmill running to exhaustion at a speed of 20 km/h. Parry-Billings and colleagues⁴ studied subjects completing high-intensity sprinting exercise.

The plasma glutamine response to acute, prolonged bouts of exercise (>2 h in duration) has also been examined. Parry-Billings et al⁴ detected significant decreases in plasma glutamine concentrations following completion of a marathon race. Rennie et al¹⁵ performed a study on cycling endurance exercise in which subjects exercised for 3.75



“...the risk of infection is directly related to the volume and intensity of training; this may potentially be related to the glutamine response to exercise.”¹⁰

hours at 50% VO_2 max. Immediately after exercise, glutamine levels were depressed; 2 hours post-exercise, they were even lower. Concentrations began returning to pre-exercise values by 4.5 hours post-exercise.

Walsh et al⁶ examined the glutamine response in subjects after 20 bouts of 1-minute cycling at 100% VO_2 max, with each bout separated by 2 minutes of recovery cycling at 30% VO_2 max. Immediately after exercise, no glutamine response was detected, but 5 hours post-exercise a decrease in plasma glutamine concentration was observed.

In another study, a significant decline in plasma glutamine concentration was observed 1 hour after subjects cycled for 3 hours at 55% VO_2 max.²¹ Subjects cycled to exhaustion within 1 hour at 80% VO_2 max with no detected change in post-exercise glutamine response. This study supports the notion that plasma glutamine concentrations decline with prolonged exercise bouts but not with relatively short bouts.

Responses of Glutamine to Chronic Training

Several investigators have examined post-exercise and resting glutamine responses to chronic exercise. For example, Keast et al²² reported a significant reduction in plasma glutamine concentration in subjects undergoing a period of intensified training designed to induce a state of overtraining. They also found an inverse relationship between plasma glutamine concentration and intensity of the training sessions. The researchers concluded that resting glutamine concentrations were significantly reduced below baseline when the exercise bouts were completed at an intensity of at least 90% VO_2 max.

When comparing well-trained versus overtrained athletes, Parry-Billings et al⁹ found significantly lower plasma glutamine concentrations in overtrained athletes, who also had prolonged depressions in plasma glutamine concentration. Subsequent findings⁴ also suggested

that not only were glutamine concentrations at rest lower in overtrained athletes compared with well-trained athletes, but that the overtrained subjects also presented with higher plasma glutamic acid concentrations. In that study, "overtrained" was defined as displaying the following criteria for at least 3 weeks: unexplained and consistent poor performance, chronic fatigue, irritability, sleep disturbance, and depression. Most of the overtrained subjects also presented with elevated resting heart rate, painful and sore muscles, slowed wound healing, and increased susceptibility to upper-

respiratory tract infections. Walsh et al⁶ also asserted that athletes suffering from the overtraining syndrome had lower resting plasma glutamine levels than well-trained individuals.

Linking Glutamine, Overtraining, and Immune Function

The relationship between plasma glutamine concentration and immune function has been researched in an attempt to explain the mechanism of exercise-induced immune system suppression. A common symptom of overtraining syndrome is an increased incidence of upper-respiratory tract infections. Since endurance exercise is associated with decreased plasma glutamine concentrations, it has been suggested that glutamine level may play a significant role in immune function. As mentioned previously, glutamine is required by lymphocytes to function optimally. When glutamine levels are compromised, lymphocyte function may be reduced.¹

To explain this relationship, Parry-Billings et al⁴ studied elite athletes diagnosed with the overtraining

syndrome. Overtrained subjects continued their training, but at a reduced intensity. Control subjects were matched to overtrained subjects based on sport, performance level, training volume, and training intensity. Resting plasma glutamine concentrations for overtrained athletes were lower than those for the control athletes. Other immune system parameters, such as T-lymphocyte proliferation rate and IL-1 and IL-6 plasma concentrations,

were also measured in the study; these were not affected by overtraining status. The researchers concluded that because glutamine is known to be vital to an optimally-performing immune system and because glutamine is decreased during

overtraining as well as after exhaustive exercise, altered glutamine status may be a cause of exercise-induced immunosuppression.⁴

Several studies also support a direct relationship between overtraining and increased risk of upper respiratory tract infection. Nieman et al²³ tracked marathon runners before and after a marathon race to determine the incidence of infection. They found that those who participated in the race reported a higher incidence of infection post-race compared with control runners who did not participate. In addition, participating runners who trained at a higher volume were at a higher risk of infection than those who trained at a lower volume.

In a similar study, Peters et al²⁴ tracked runners participating in a 56-km race and matched control subjects. Those who ran the race were at a significantly higher risk for upper respiratory tract infection in the 2 weeks post-race compared with the control subjects. In addition, infection



"When glutamine levels are compromised, lymphocyte function may be reduced."¹



rate was highest among those with faster race times.

Others have reported that well-trained swimmers had a higher incidence of upper respiratory tract infection when compared with overtrained swimmers.¹⁰ They also reported that plasma glutamine levels did not differ between those swimmers who developed infection and those who did not. The results of that study do not support a direct relationship between overtraining and immunosuppression.

Although many studies point toward a strong relationship concerning glutamine, overtraining, and immunosuppression, all studies are clearly not in agreement. Hiscock

Castell et al,²⁵ marathon and ultra-marathon race participants were given a placebo or a glutamine supplement immediately following and 2 hours after completion of the race. Both groups had elevated infection rates compared with the period prior to the race; however, those who consumed glutamine reported a lower rate of infection versus those who consumed a placebo beverage.

Kryzwkowski et al⁷ reported on a study in which subjects cycled for 2 hours at 75% VO₂max on three separate occasions. Subjects were given glutamine, protein, or placebo supplements during and up to 2 hours after exercise. The placebo

group experienced a 15% decrease in plasma glutamine concentration 2 hours post-exercise compared with baseline measurements. The groups supplemented with glutamine and protein did not experience this decline. Additionally, secretory immunoglobulin A (S-IgA) decreased in response to the exercise bouts, regardless of supplement ingested. These

results suggest that the post-exercise decline in S-IgA is not related to the plasma glutamine concentration, and that if glutamine status affects the immune system, it does not do so through a mechanism related to S-IgA.

Researchers have also assessed the potential for supplementation with other amino acids to alter glutamine status. Parry-Billings et al⁴ studied the glutamine response to a marathon run when subjects were supplemented with branched-chain amino acids (BCAAs). BCAA supplementation during prolonged exercise prevented the decline of plasma glutamine levels that was observed in subjects who consumed placebo beverages during the race. These results are supported and complemented by the research of


Bassit et al,²⁶ who studied the effect of BCAA supplementation for 15 days prior to a triathlon or 30-km run. The supplements prevented a 40% decrease in mitogen-stimulated lymphocyte proliferation that occurred in the placebo trial. This suggests that the BCAAs served to maintain—and prevent a reduction in—immune function. BCAAs also prevented the post-exercise plasma glutamine concentration reduction that occurs in the absence of supplementation.²⁶

Recent research also has suggested that alanine supplementation before and during exercise can boost glutamine concentration (unpublished data). In that research, subjects consumed 500 mL of a solution containing 6% alanine with or without carbohydrate 30 minutes prior to exercise. The beverages were also consumed during exercise at the rate of 250 mL every 15 minutes. After 45 minutes, glutamine concentration increased, while it was unchanged during trials of carbohydrate only or a placebo.

Conclusion

The potential role of altered glutamine status with regard to the phenomenon of exercise-induced immunosuppression that sometimes accompanies strenuous bouts of exercise training is still under investigation. Supplementation with glutamine and other amino acids offers promise for preventing exercise-induced plasma glutamine depression, and therefore may help in preventing immune system depression. Further research is needed before conclusive recommendations regarding these and other interventions can be made.

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 “Researchers have also assessed the potential for supplementation with other amino acids to alter glutamine status.”

and Pedersen¹³ reviewed the literature recently and asserted that reductions in plasma glutamine have not been established as the cause of increased post-exhaustive exercise susceptibility to upper respiratory tract infection. The authors suggested that despite reductions in plasma glutamine levels post-exercise, the intracellular concentrations may not be affected.

Nutritional Implications

Researchers have attempted to determine if nutritional interventions, particularly those involving glutamine and other amino acid supplementation, can attenuate the decrease in plasma glutamine concentrations and/or the incidence of exercise-induced immunosuppression. In a study by



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“Supplementation with glutamine and other amino acids offers promise for preventing exercise-induced plasma glutamine depression, and therefore may help in preventing immune system depression.”

Yoga in the Prevention and Treatment of Eating Disorders

by Chrissy Barth, RD, CFT, RYT

"As I was entering puberty, I started doubting myself and my self-esteem and battled with an eating disorder. It wasn't until I moved to NYC and discovered yoga that I was able to fully accept myself as I am and learn to love myself from the inside out. I have been teaching yoga for the past 12 years and brought yoga to the MTV generation as the star of MTV's Yoga and Pilates workouts. I most recently produced my own Bendigirl Yoga, which is specifically geared for young girls. I work with girls in their tweens and teens and have seen the profoundly positive effects yoga has on their self-esteem and body image. I want to continue to spread yoga to as many young girls as possible to help them develop an inner sense of beauty and hopefully fend off any type of eating disorder or self-esteem issues before they begin.

*There are seldom any mirrors in yoga class, as the focus is inward. Girls learn to get in touch with themselves and befriend their breath, calm their minds, and cherish their bodies. There is no competition in yoga and every girl learns to love the shape she has and to foster unique strengths. There is never any discussion about weight or external appearance in Kristin's yoga classes, only breath and movement and the feeling of being alive and aligned."*¹

—Kristin McGee

Over the past several years, yoga has received increased recognition and a surge in popularity. In addition to its benefits as an exercise, yoga has been found in preliminary research to be beneficial in augmenting mental and medical support in the prevention and treatment of eating disorders.² One of the most crucial aspects of the recovery process in disordered eating treatment is reintegration and reestablishment of

the mind-body connection. Disconnection between mind and body lies at the core of eating disorders; the detachment of the two is similar to a drug that numbs emotions. Yoga serves as a metaphor to living, enabling one to challenge a fear. With practice and persistence, yoga can help heal disordered eating.³

The prevalence of eating disorders ranges from 3% to 10% among at-risk females (i.e., those between 15 and 29 years of age).⁴ The occurrence of partial eating disorders is at least twice that of diagnosed eating disorders.⁴ In fact, weight-related behaviors have been reported to occur as early as fourth grade. Body dissatisfaction and excessive psychological investment in one's physical appearance, especially weight and shape, serve as precursors to eating disorders. For this reason, improvement of body image is an



"Yoga serves as a metaphor to living, enabling one to challenge a fear. With practice and persistence, yoga can help heal disordered eating."³

important component of the treatment as well as prevention of eating disorders, starting at the grade-school level.^{2,5}

Improving the Mind-Body Connection

Traditional disordered eating treatment programs have relied heavily on didactic presentations, which provide factual information

targeting the risk factors of eating disorders. These have shown little effect in decreasing disordered eating attitudes and behaviors; in fact, disordered eating behaviors may be unconsciously increased.⁴

More recent prevention programs have consisted of curricula blending information on healthy bodies, eating, and exercise. This model promotes healthy eating attitudes and behaviors, whereas the traditional model educates about the dangers of eating disorders. Because persons at risk for eating disorders are a vulnerable population, the traditional treatment model actually may have posed the risk of promoting eating disorders. The addition of the active and mentally uplifting practice of yoga to the curriculum improves physical self-esteem and healthy mind-body awareness.⁴

In a study reported in *Psychology of Women Quarterly*, Daubenmier affirmed the importance of the mind-body connection.⁶ The release of tension that yoga provides is a healthy way to dispel negative emotions and establish self-love. Daubenmier's research suggested that through yoga, participants may intuitively discover an ability to move beyond negative messages, such as the notion that thinness and beauty equate to success and happiness. Participants of yoga reported significantly higher body awareness, responsiveness, and satisfaction and less self-objection when compared with individuals participating in aerobic training or the control participants. In fact, those who participated in aerobic exercise (i.e., running and aerobics classes) were at greater risk for disordered eating behaviors.⁶ In particular, those with anorexia nervosa had strong feelings of self-loathing. Yoga enabled this population to become more aware of their bodies, improve flexibility (physically, mentally, and

emotionally), and maintain a calmer state of mind.

The Exercise Aspect of Yoga

The poses and style of yoga, especially initially, should be kept simple to prevent the compulsive patient from using yoga as an aid to purging. In comparison to relaxation exercises such as meditation, yoga also offers total body conditioning. In particular, hatha yoga focuses on the unification of mind-body-breath, strength, flexibility, and balance.⁷ This is helpful because many other physical activities are restricted for the patient with anorexia. Yoga requires movement, whereas relaxation is more passive.

Yoga is also beneficial in positively managing hyperactivity and reducing anxiety. In a study by Smith et al, yoga was proven to be as effective as relaxation techniques in reducing anxiety and stress and increasing physical and mental health and sleep ability.⁷

Patients with eating disorders who embark on yoga during therapy are less compelled to over-exercise in a private setting, such as in bed or in the shower, even when exercise is restricted, as in the case of severe underweight.^{8,9}

Yoga and Meal Times

Yoga is especially useful during meal times. For the person with anorexia nervosa, meal times often are filled with apprehension. During the refeeding stage, patients initially feel physical discomfort from the increased volume of food. In addition, this physical discomfort is often associated with feelings of guilt and failure. Scheduling yoga around meal times (i.e., before and after) has been shown to ease tension and aid positive transitions.⁹

Tuning Into Body Sensations, Not Appearance

Yoga introduces the patient to an experience of relaxation and a deep sense of peace of mind and body as well as a sense of freedom. Patients learn to tune into their body as it

moves through the poses, placing an emphasis on the body's abilities rather than physical appearance.⁶

Yoga enables the individual to look at his or her body in a different light. In the midst of a culture that promotes dissatisfaction with physical appearance, yoga helps



“Matching the patient with an appropriate yoga class is vital because some classes focus on a physical versus spiritual experience.”

people respect their body shape regardless of the size. At-risk individuals often have a disconnection not only with their body, but also with their feelings, appetite, and soul. Yoga helps recreate the individual's relationship with his/her body and inner self.³

It is during an authentic yoga class (one without mirrors) that participants are forced to tune into their internal sensations, becoming more aware of how the body feels rather than how it looks. In particular, females with eating disorders display negative emotional and cognitive reactions when looking at their reflection in the mirror. One patient participating in yoga stated that she began to see things more through a wide-angle lens; the “little things” no longer seemed so big and could more easily be put into perspective.^{3,10}

In the treatment of eating disorders, the incorporation of yoga into the recovery process takes direction from the practitioner. Matching the patient with an appropriate yoga class is vital because some classes focus on a physical versus spiritual experience. For example, a patient with a competitive

and perfectionist personality would thrive in a class with less emphasis placed on the physical and more on the meditative aspects of yoga. A patient with depression would benefit more from a class that includes movement and flow, with an emphasis on self-pacing and acceptance. The goal for both situations is to promote balance and disrupt destructive habits and behaviors.

A “Laboratory” for Examining Behavior

Yoga requires living in the moment, letting go of judgement, accepting personal limits, and knowing when to let up or challenge oneself more. Tolerating the discomfort of a yoga pose is metaphoric for the feelings of fullness during the refeeding process of disordered eating treatment. At the same time, refusing a posture that causes pain or emotional distress may help the patient become more assertive in the recovery process. Yoga becomes an “experimental laboratory” for examining behavior, and that can lead to positively changing patterns. All of what yoga offers—including stretching, strength-building, relaxation, meditation, and breathing techniques—provides opportunities for self-awareness and acceptance, which are vital in the recovery process.³

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FROM THE CHAIR

And the beat goes on . . .

This is the theme of the upcoming 2008 SCAN Symposium, to be held April 11-13 in Boston, Mass.—and it certainly describes the course our practice group has charted for the future. Over the past several months, we have made great strides in improving the visibility and marketability of our membership as well as strengthening the four practice areas of SCAN: sports, cardiovascular, and wellness nutrition, and the prevention and treatment of disordered eating. Some of the many highlights include:

- Formulation of a three-year strategic plan
- Development of a strategy for succession plan and leadership development
- In conjunction with the Commission on Dietetic Registration (CDR), completion of an internal marketing plan and a DVD for the Board Certified Specialist in Sports Dietetics (CSSD) credential from CDR
- Development of an external marketing strategy for the CSSD credential in conjunction with CDR
- Continued excellence in educational opportunities for our members at the ADA Food & Nutrition Conference & Expo (FNCE) and the SCAN Symposium. (Educational opportunities for those who cannot travel to such events are being explored.)
- Expansion of our partnerships, with record-setting fundraising
- Formation of a Standards of Practice (SOP) and Standards of Professional Performance (/SOPP) working group for sports dietetics
- Solicitation of members interested in expanding opportunities and education in the cardiovascular and wellness nutrition areas
- Record attendance at the SCAN educational program held during FNCE Provision of a leadership summit for sports dietitians practicing on the collegiate level

As we move forward, SCAN faces changes and challenges. ADA recently announced plans to implement a new Organizational Identity program for all entities of ADA, including dietetic practice groups (DPGs), affiliates, CDR, Commission on Accreditation for Dietetics Education (CADE), and the Foundation. This will mean a change in the visual identity of SCAN that will improve the recognition and visibility of our DPG.

In another arena, external relationships with other professional organizations remain crucial to the marketability of our membership and expanded job opportunities for our members. SCAN has a few key external relationships, and there are plans for strengthening these vital relationships. Given the new leadership team guided by Hope Barkoukis, PhD, RD, our chair-elect, SCAN stands ready and capable to face the challenges ahead.

As I finish out my year as SCAN chair, I would like to thank every SCAN member for your continued support of our practice group. You are the pulse of SCAN. I enjoyed your questions, suggestions, and enthusiasm. My deep appreciation also goes to SCAN's Executive Committee, executive director, Symposium Committee, and past leaders. Thank you for your countless hours of work, your unwavering devotion, and your "can do" attitude. I am honored to have served as your chair.

And the beat goes on . . .

Roberta Anding, MS, RD, CSSD, CDE
2007-2008 SCAN Chair





CONFERENCE HIGHLIGHTS

Health Issues for Physically Active Women: Scientific Update Conference

October 26, 2007

Toronto, Canada

by Suzanne Girard Eberle, MS, RD, CSSD

"Health Issues for Physically Active Women: A Scientific Update" was sponsored by the University of Toronto's Centre for Girls' and Women's Health and Physical Activity and the Canadian Academy of Sports Medicine. Approximately 75 healthcare professionals, researchers, and educators attended. The conference was preceded by the annual meeting of the Female Athlete Triad Coalition, of which SCAN is an active member. The Coalition, which represents key medical, nursing, athletic, and sports medicine groups, convenes to promote optimal health and well-being among female athletes and active women. It strives to prevent the Female Athlete Triad through advocacy, education, global leadership, public policy, and research.

The goal of the Scientific Update Conference was to review the new American College of Sports Medicine (ACSM) Position Stand on the Female Athlete Triad. Here are some key messages from the conference:

- Research from the past 10 years clearly shows that the components of the triad—low energy availability, amenorrhea, and osteoporosis—are not merely clinical observations that happen to coincide during the same period of time, but also are disease states that are closely linked by physiologic mechanisms.
- Components of the triad occur on a continuum from optimally healthy to pathologically unhealthy. Females need not exhibit all these clinical conditions simultaneously to be at risk.
- The triad is caused by low energy availability (LEA). Low energy availability is defined as the amount of dietary energy remaining for metabolic functions after the calories spent on exercise have been subtracted. Low energy availability occurs not only with eating disorders but also with dietary restraint, disordered eating behaviors, prolonged exercise, and participation in sports that emphasize leanness.
- Active females should ideally be screened for the triad as part of any pre-participation physical and annual health examination, as well as whenever an athlete presents with amenorrhea, stress fractures, or restrictive food intake. The primary treatment aim is to increase calorie intake and/or decrease exercise energy expenditure.
- Female athletes need to consume a threshold of 30 kcal/kg (13.5 kcal/lb) of fat-free mass (FFM) per day to supply adequate energy to allow normal pulsatility of luteinizing hormone and thereby prevent hypothalamic amenorrhea. Female athletes diagnosed with low bone mineral density (BMD) may require 45 kcal/kg (20.5 kcal/lb) FFM or more per day to achieve energy balance.
- New diagnostic criteria have been added for defining osteoporosis, including a T-score of less than 2.5 in postmenopausal women. T-scores compare individuals with average peak adult BMD, and BMD has a strong predictive value for osteoporotic fractures in postmenopausal women.
- In teens and premenopausal women, a low Z-score (below -2.0) plus two risk factors for bone fracture (hypogonadism, undernutrition, and previous fractures) are used to diagnose poor bone health. Z-scores compare individuals with age- and sex-matched controls. A Z-score of less than 2 standard deviations indicates that a young female has not actually lost bone (as happens with postmenopausal females), but has failed to gain bone in comparison to peers. A low Z-score is a warning sign that an individual has "low bone density below the expected range for age" (if a premenopausal woman) or "low bone density for chronological age" (if a child).
- Currently dual energy x-ray absorptiometry (DEXA) scans are the best method to measure bone density, although they do not provide information on bone quality. A DEXA retest should be performed yearly to monitor the effects of bone-building interventions.
- Trabecular bone, located mainly in the spine, is most susceptible to the effects of undernutrition. Women with anorexia nervosa commonly have low bone density in the spine.



"Components of the triad occur on a continuum from optimally healthy to pathologically unhealthy."



■ The primary cause for “bone loss” in the triad overwhelmingly is inadequate calories or “undernutrition,” which directly decreases bone formation. Estrogen deficiency plays a smaller role. The best predictor for an increase in bone density is an increase in body weight/weight restoration

■ Girls gain 50% of their adult bone mass during puberty (starting at age 10) and 98% within 2 to 3 years of the onset of menses. Girls who achieve menarche at 15 years of age or older are at 3-times greater risk of having low bone mass.

■ Restoration of menstrual cycles using oral contraceptives appears to delay and even reduce the likelihood of recovery, and is not recommended. Oral contraceptives also can contribute to potential undesirable changes in lipid profiles.

■ Amenorrhea in young athletes may contribute to the early development of an impaired cardiovascular status that is more typically seen in older, postmenopausal women. When compared with normally menstruating women who exercise, women with exercise-associated amenorrhea appear to have disordered regional blood flow that contributes to lower heart and blood pressure rates. Estrogen deficiency in these young women due to exercise-associated amenorrhea may counter the beneficial cardiovascular health effects of exercise and the known protective benefits of estrogen. Many questions remain unanswered as researchers in the cardiovascular field are just now turning their attention to this population.

Suzanne Girard Eberle, MS, RD, CSSD, is author of Endurance Sports Nutrition, 2nd edition (2007) and is in private practice in Portland, Ore.



Sports Nutrition for Endurance Athletes

Monique Ryan, MS, RD
Velo Press, 1830 North 55th St.,
Boulder, CO 80301-2700
303/440-0601, www.velopress.com
2007, softcover, 357 pp, \$21.95
ISBN-10: 1-931382-96-4

The second edition of *Sports Nutrition for Endurance Athletes* is a comprehensive resource for practitioners working with endurance athletes as well as for athletes who want information on how to improve their performance through nutrition. The text is divided into three main parts: Your Daily Performance Diet; Your Training Diet; and Sports-Specific Nutritional Guidelines.

Part I begins with a solid overview of the most important component of any nutrition program—hydration—and then proceeds to discussions on macronutrients and micronutrients. Throughout the first few chapters, there are excellent tables that provide vital information to help answer questions that commonly arise among clients. For example, the caffeine content of 20 foods and beverages fits well in the hydration chapter, and the list of whole grain alternatives (e.g., kasha, quinoa, teff) in the macronutrient chapter is useful for those who may be bored with the foods routinely recommended by lay publications and health professionals.

Part II focuses on nutrient timing, fluid intake and timing, body composition, and ergogenic aids. Demonstrating that rare ability to explain complex topics in simple terms, the author begins by discussing body's energy systems, heart rate, and fuel usage in language that laypersons can understand and apply. While many other books provide either a scientific or practical approach, this text does an impressive job translating scientific jargon into

applicable situations—particularly in the practical recommendations shown in tables throughout the book. The last chapter of Part II covers many popular ergogenic aids. As we know, athletes are faced with marketing messages and often misinformation hyping certain products. This book succeeds in providing science-based information relating to ergogenic aids in an easy-to-understand manner.

Part III discusses individual events: triathlons, different types of cycling (from road to cyclo-cross), distance running, swimming, rowing, and adventure racing. Provided are performance nutrition strategies for unique situations (e.g., 24-hour races, meal choices while traveling, eating on campus). These tips make the book particularly helpful for practitioners who deal with athletes participating in these sports, as well as for the athletes themselves.

Finally, the Appendix covers other important topics that didn't receive adequate space within the main body of the book. In addition to including a helpful list of the glycemic index of various foods and a comparison of vitamins and minerals, the author provides one of the most comprehensive listings of sports nutrition products to be found in any text. She also presents sample menus.

Practitioners who work with endurance athletes and the athletes themselves should absolutely make a place on their bookshelves for *Sports Nutrition for Endurance Athletes*. Nutrition is often the missing piece to the puzzle, and this text will help fill that gap that is so often lacking. Monique Ryan has a master of science degree in nutrition and is a certified health fitness instructor.

Reviewed by Christopher R. Mohr, PhD, RD, CSSD, owner of Mohr Results, Inc., a nutrition consulting company in Louisville, Ky.



Effects of Probiotics on Respiratory Infections and Gastrointestinal Symptoms in Marathon Runners

Kekkonen RA, Vasankari TJ, Vuorimaa T, et al. The effect of probiotics on respiratory infections and gastrointestinal symptoms during training in marathon runners. *Int J Sport Nutr Ex Metab.* 2007;17:352-363.

Research has shown that strenuous exercise training is associated with a greater risk for upper respiratory tract infections (URTIs) and gastrointestinal (GI) symptoms (e.g., diarrhea, heartburn). Probiotics are live microorganisms that may protect gut health and enhance immunity. The purpose of this study was to determine whether probiotics influence the number of healthy days, respiratory infections, and GI symptoms in marathon runners during 3 months of training and 2 weeks post-marathon. In this double-blind, placebo-controlled, parallel-group intervention study, experienced male and female long-distance runners (n=141) were randomized to receive either *Lactobacillus rhamnosus* GG (LGG) or placebo in the form of a milk-based drink or pill for 3 months prior to the Helsinki City marathon. Blood samples were taken at baseline, 1-week prior to the race, pre-race, and post-race. Study participants also recorded their health status (healthy or sick), URTIs, GI symptoms, and exercise in a daily journal. Hematologic measurements (e.g., hematocrit, thrombocytes) remained normal throughout the study. There were also no statistically significant differences between groups in the number of healthy days or URTIs and GI symptoms during training, pre-race, or post-race. However, the duration of GI symptoms was 57% shorter in the LGG group than in the placebo group post-race (1.0 vs. 2.3

days, $P<.05$). The results of this study suggest that probiotics have no protective effect on the incidence of URTIs or GI symptoms in experienced marathon runners, but they may shorten the duration of GI symptoms after an exhaustive effort such as the marathon. Whether such an intervention is warranted for experienced runners should be determined on an individual basis until more data are available.

Summarized by Elissa Kline, graduate student in the Division of Nutrition (Sports Dietetics Emphasis), University of Utah, Salt Lake City, Utah.



“... hypohydration may negatively impact the amount of work that can be completed during resistance exercise.”

Hydration in Resistance Exercise

Judelson DA, Maresh CM, Farrell MJ, et al. Effect of hydration state on strength, power, and resistance exercise performance. *Med Sci Sports Exerc.* 2007;39:1817-1824.

Although research supports the negative effect of hypohydration on endurance performance, studies examining the influence of hypohydration on resistance exercise performance have reported conflicting results. The purpose of this study was to determine the effect of three hydration states on strength, power, acute resistance exercise performance, and neuromuscular activation. Seven healthy resistance-trained males completed three

resistance exercise bouts separated by 1 week in a euhydrated (EU), 2.5% hypohydrated (HY25), and 5.0% hypohydrated (HY50) state in random order. Hypohydration was induced by decreased fluid intake and exercise-heat stress 1 day prior to each exercise bout, after which participants were rehydrated for their next trial (0, 2.5%, or 5% hypohydration). Body mass, urine specific gravity, urine osmolality, and rectal temperature were measured at baseline, pre-hypohydration, and pre-exercise to verify hydration states. Participants also completed the Profile of Moods States questionnaire prior to the experimental protocol to assess the effect of hydration state on psychological characteristics. Performance was quantified by vertical jump height, peak lower-body power (30% 1 RM squat jump), peak lower-body force (isometric back squat), a resistance exercise challenge (6 sets of 10 repetitions of parallel back squats at 80% 1 RM), and central activation ratio (CAR). There were no significant differences in psychological measures, vertical jump, peak power, or peak force among hydration states. Although CAR decreased with increasing hypohydration, these differences were not statistically significant ($P=.075$). Participants were able to complete significantly more work (e.g., repetitions) in the EU state compared with the HY25 state during sets 2 and 3 and the HY50 state during sets 2 through 5 ($P<.05$). However, the overall work completed was similar after the completion of six sets. The results of this study suggest that hypohydration may negatively impact the amount of work that can be completed during resistance exercise. Athletes of all sports should be encouraged to begin resistance



exercise euhydrated to optimize training.

Summarized by Stacie Wing-Gaia, PhD, RD, assistant professor, Division of Nutrition, University of Utah, Salt Lake City, Utah.

Effect of Carbohydrate on Perceived Exertion During Intermittent Exercise

Utter AC, Karry J, Nieman DC, et al. Carbohydrate attenuates perceived exertion during intermittent exercise and recovery. *Med Sci Sports Exerc.* 2007;39:880-885.

Interval training is thought to result in important physiologic adaptations for competitive athletes. Previous research has not yet examined the influence of carbohydrate (CHO) supplementation on the rating of perceived exertion (RPE) during this type of exercise. This randomized, placebo-controlled, counterbalanced study aimed to determine the effect of CHO availability on RPE during intermittent exercise and recovery periods. Twelve male endurance-trained cyclists completed two testing sessions that lasted a total of 2.6 hours (i.e., cycling for 2.0 h at 73% VO_2 peak and 64% W_{max} with 3-min rest periods every 10 min) with a 6% CHO solution versus placebo administered before ($12 \text{ mL}\cdot\text{kg}^{-1}$) and during ($4 \text{ mL}\cdot\text{kg}^{-1}\cdot 15\text{min}^{-1}$) the cycling protocol. Gas exchange variables, respiratory exchange ratio (RER), and heart rate were recorded every 30 minutes. Venous blood samples were taken before and after the 2-hour cycling protocol. Three RPE measures (overall, legs, and chest) were recorded during the ninth minute of each 10-minute interval and during the 3-minute rest bout at 30, 60, 90, and 110 minutes of the 2.6-hour testing session. Post-exercise, blood glucose was lower and cortisol was higher in the placebo versus the CHO condition ($P<.05$). At 120

minutes, RER was lower in the placebo (0.89 ± 0.1) versus the CHO condition (0.95 ± 0.1 , $P<.02$). Overall body RPE was significantly higher at 90 minutes ($P<.02$), with a trend at 110 minutes ($P=.04$) in the placebo versus the CHO condition. These findings suggest that CHO supplementation may be beneficial for athletes during prolonged intermittent exercise when endogenous glucose availability may become limited.

Summarized by Shaun K. Riebl, MS, dietetic intern, Virginia Commonwealth University Medical Center, Richmond, Va.



“...cyclists reported lower ratings of tiredness and leg soreness during the sprints.”

Effect of Protein on Recovery and Performance in Trained Cyclists

Rowlands DS, Thorp RM, Rossler K, et al. Effect of protein-rich feeding on recovery after intense exercise. *Int J Sports Nutr Exerc Metab.* 2007;17:521-543.

Carbohydrate and protein mixtures have become common feeding schemes after exercise to accelerate the recovery from repetitive, intense training in athletes. This double-blind, randomized, crossover study sought to quantify the effect of a protein-enriched, moderately-high carbohydrate feeding scheme on recovery and next-day repeated sprint cycling performance. Ten trained male cyclists (age: 35 ± 10 y; weight: 76 ± 4 kg) reported to the laboratory at 3 PM, 4 hours after their last meal, to complete a 2.5-hour

glycogen-depletion cycling protocol. Two different feeding schemes—protein-enriched (435 g carbohydrate, 218 g protein, 79 g fat) versus isocaloric control (640 g carbohydrate, 34 g protein, 79 g fat) were then administered in units at 30-minute intervals over a 4-hour recovery period followed by an overnight fast. Venous blood samples were collected 5 minutes post-exercise and every 30 minutes over a 3-hour period. On the following day, blood samples were collected before and after a small breakfast, after warm up, and during the repeated-sprint performance test (10×2.5 -min constant load, maximal sprints, at 5-min intervals). Results showed no clear effect on mean sprint power; however, the protein-enriched condition resulted in a 33% reduced creatine kinase response before the performance test, and cyclists reported lower ratings of tiredness and leg soreness during the sprints. Furthermore, protein enrichment resulted in higher testosterone levels during the 4-hour recovery period. After intense exercise, a protein-enriched, moderately high-carbohydrate feeding scheme may alleviate next-day muscle soreness and damage in cyclists performing in a vigorous repeated sprint protocol; however, performance per se may remain unaffected.

Summarized by Nanna L. Meyer, PhD, RD, CSSD, research associate and sports dietitian, The Orthopedic Specialty Hospital (TOSH Sport Science), Salt Lake City, Utah.



SCAN NOTABLES

■ In November 2007, an esteemed group of sports dietitians—**Jackie Berning, PhD, RD, CSSD**; **Leslie Bonci, MPH, RD, CSSD**; **Kristine Clark, PhD, RD, FACSM**; **Nancy Clark, MS, RD, CSSD**; **Nancy DiMarco, PhD, RD, CSSD, LD**; **Lisa Dorfman, MS, RD, CSSD, LMHC**; **Michele Macedonio, MS, RD, CSSD**; **Melinda Manore, PhD, RD, CSSD**; and **Nanna Meyer, PhD, RD, CSSD**—attended, by invitation, the First Performance Nutrition Seminar at the Colorado Springs U.S. Olympic Training Center to promote a collaborative sports nutrition network in the United States, provide elite level sports nutrition education to sports dietitians, and encourage dialog between sports dietitians and Olympic team coaches.

■ The Houghton Mifflin Company released earlier this year two publications written by **Anne Fletcher, MS, RD**: *Weight Loss Confidential Journal: Week-By-Week Success Strategies for Teens From Teens* and the companion book, *Weight Loss Confidential: How Teens Lose Weight and Keep It Off—And What They Wish Parents Knew*. The latter publication received first place in the “Health: Diet & Weight

Loss Category” for USA Book News 2007 Best Book Awards.

■ **Tammy Beasley, RD, CSSD, CEDSN** (certified eating disorder specialist in nutrition), has been asked to join the Dean’s Advisory Board for Auburn University’s College of Human Sciences. As a 1984 graduate of Auburn, she is honored to have this opportunity to give back to both her alma mater and her profession.

■ The fourth edition of *Nancy Clark’s Sports Nutrition Guidebook* will be released in April 2008. The first three editions of the book have sold about 500,000 copies. **Nancy Clark, MS, RD, CSSD**, is very appreciative of SCAN members’ continued support.

■ **Marie Dunford, PhD, RD**, freelance writer and previous sports nutrition instructor at California State University, Fresno for 16 years, and **J. Andrew Doyle, PhD**, associate professor of exercise physiology and chair of the Department of Kinesiology and Health at Georgia State University, are the authors of a new textbook, *Nutrition for Sport and Exercise*, published by Thomson/Wadsworth.

■ **Christopher Halagarda MS, RD**,

CSCS, a graduate of the Master’s Program in Health Care Policy and Management from State University of New York at Stony Brook, received the 2007 Distinguished Alumnus Award for his contributions to the profession.

■ As a participant with Team in Training for the St. Anthony’s Triathlon in St. Petersburg, Fla., **Kelly Rossi, MS, RD**, raised over \$4,500 in April 2007 for the Leukemia and Lymphoma Society. Kelly placed sixth among all female Team in Training participants.

■ **Susan Kundrat, MS, RD, CSSD**, and **Michelle Rockwell, MS, RD, CSSD**, have launched a series of nationwide sports nutrition workshops occurring between November 2007 and May 2008. These sessions provide registered dietitians interested in practicing advanced sports dietetics with the tools to prepare for the examination to earn the Board Certified as a Specialist in Sports Dietetics (CSSD) credential.

If you have an accomplishment that you would like to be considered for inclusion in an upcoming issue of PULSE, please contact Michelle Barrack at michellebarrack@gmail.com





OF FURTHER INTEREST

■ Join Your Colleagues at SCAN Symposium '08!

There's still time to register for the 2008 SCAN Symposium, to be held April 11-13 in Boston, Mass. Carrying the theme, "And the Beat Goes On—Heart Health and Sports Nutrition," this year's event is packed with cutting-edge information and outstanding networking opportunities. For details on the program and online registration, visit SCAN's Web site at www.scandpg.org.

■ SCAN Fields Questions from ADA's Student Community of Interest

Through a special question-and-answer forum held over one week last fall, ADA's Student Community of Interest (CoI) was introduced to SCAN and our four areas of expertise. Representing SCAN in this event were Christine Rosenbloom, RD, PhD, Jessica Setnick, MS, RD, and Melissa Ohlson, MS, RD. These SCAN RDs as well as participating students enjoyed the experience and benefited tremendously from this contact and communication.

The weeklong Q&A marked only the second time a dietetic practice group has worked with the Student CoI. It was a huge success and is under consideration to become an annual SCAN activity. *Student Scoop* (the Student CoI's newsletter) carried an article on the event in January, and key points from the Q&A have been posted on SCAN's Web site (www.scandpg.org) under the Student Corner tab.

■ Healthy Eating Index-2005 Scores for Americans Released

The report, "Diet Quality of Americans in 1994-96 and 2001-02 as Measured by the Healthy Eating Index-2005," has been released by the USDA Center for Nutrition Policy and Promotion (CNPP) and can be accessed at www.cnpp.usda.gov/HealthyEatingIndex.htm. The Healthy Eating Index-2005 (HEI-2005) measures the diet quality of Americans in terms of how food intakes compare with recommendations from the 2005 Dietary Guidelines for Americans.

Details on the intake surveys that yielded the data, the components measured, the scoring system, and development and evaluation of the HEI-2005 are available at www.cnpp.usda.gov/Publications/HEI/HEI-2005/HEI-2005TechnicalReport.pdf.

■ News from Sports Dietetics USA (SD-USA)

• **CSSD Flash Presentation.** Visit SCAN's Web site (www.scandpg.org) and check out SCAN's Flash presentation for RDs and students interested in the Board Certification as a Specialist in Sports Dietetics (CSSD) credential from the Commission of Dietetic Registration (CDR). Click "CSSD Promotion" under the Sports Dietetics tab to view the presentation and to download reproducible CSSD handouts. (*Note: viewing requires a Flash movie player; go to www.adobe.com for a free download.*)

• **2008 CSSD Exams.** The last CSSD examination window in 2008 extends from July 14 to August 1 (May 5, 2008 postmark deadline). You can apply for the CSSD credential if you have active status as an RD, have been an RD for two years, and can document the required specialty practice hours. Eligibility and application information is available from the CDR at www.cdrnet.org/whatsnew/Sports.htm.

• **"SD-USA Score" Newsletter.** Read the latest sports nutrition news in *SD-USA Score*, an electronic newsletter sent via e-mail to SCAN's SD-USA members as a membership benefit. You can receive the e-newsletter by joining SD-USA (see "Join Us!" on page 23). Back issues are archived on SCAN's Web site (www.scandpg.org) in the Members Only area. To submit sports nutrition news and information, contact Amy Goodson, MS, RD, newsletter editor, at amygoodson@alumni.tcu.edu.

• **Collegiate Sports RDs.** A special pre-SCAN 2008 Symposium workshop will be presented on April 10, in Boston, Mass. The target audience includes RDs who provide sports nutrition services to collegiate athletic departments and those interested in sports dietetics for collegiate athletes. A reception will follow the program. Go to SCAN's Web site (www.scandpg.org) to register online.

• **Is Sports Dietetics Private Practice Your Goal?** If so, you won't want to miss the pre-SCAN 2008 Symposium

workshop, "The Entrepreneurial Sports Dietitian—Sports Dietetics Practice from Start-up to Success," presented by SD-USA on the evening of April 10. Register online at www.scandpg.org.

- **Scope of Practice for Sports Dietetics.** A SCAN workgroup is working with ADA Quality Management to develop Standards of Practice (SOP) and Standards of Professional Performance (SOPP) for Registered Dietitians (Generalist, Specialty, and Advanced) in Sports Dietetics. SOPs and SOPPs are essential for documenting the scope of practice and range of services offered by sports dietitians.

- **Sports Dietetics Self-Assessment.** CDR has launched an online self-assessment instrument in sports dietetics as an "Assess & Learn" product. For information, visit cdrnet.org/products/product007.ht

- **"Student Corner" Updates.** Be sure to check for new contributions posted in SCAN's "Student Corner" under the Careers & Students tab on SCAN's Web site (www.scandpg.org).

- **Join Us!** The SD-USA subunit—a free benefit of SCAN membership—now includes some 800 SCAN members! You can join these growing ranks and receive the *SD-USA Score* e-newsletter by signing up for SD-USA on SCAN's Web site (www.scandpg.org). Simply go to "Member Profile" under the Members Only tab and check the box at the bottom labeled "Sports Dietetics-USA."

Also, you are invited to attend the SCAN SD-USA subunit meeting to be held during the upcoming SCAN Symposium in Boston, on Saturday, April 12, from 5 to 6 pm, in the Hyatt Regency Cambridge.

SD–USA Pre-Symposium Workshops

Thursday April 10, 2008

"Nutrition in Collegiate Sports"

1 – 5 pm

This marks the first-ever pre-Symposium workshop on sports nutrition in collegiate athletic departments. Learn from the speakers' unique perspectives about sports nutrition in the collegiate sports arena. Concluding this program will be an open discussion on how collegiate sports RDs might organize within SCAN.

3.5 CPEUs approved for this workshop

Speakers:

Dave Klossner, PhD, National Collegiate Athletic Association (NCAA) staff liaison
Mary Wilfert, NCAA staff liaison

Panel:

Amy Freel, MS, RD, CSSD
HokieSports Virginia Tech sports performance team

"The Entrepreneurial Sports Dietitian—Sports Dietetics Practice from Start-up to Success"

6 – 9:30 pm

Explore the nuts and bolts of sports dietetics private practice and gain skills, tips, and resources from the experts. Career options, marketing ideas, media communication, and working online will be examined. A portion of the workshop proceeds will be donated to the Ann Selkowitz Litt Scholarship Fund in memory of Ann's contributions to nutrition private practice.

3 CPEUs approved for this workshop

Keynote speaker:

Faye Berger Mitchell, RD

Panel:

Jenna Bell-Wilson, PhD, RD, CSSD
Nancy Clark, MS, RD, CSSD
Lisa Dorfman, MS, RD, CSSD
Michele Macedonio, MS, RD, CSSD
Brian Zehetner, MS, RD, CSSD

Space is limited. Register online at SCAN's Web site (www.scandpg.org).




UPCOMING EVENTS
April 3-6, 2008

International Association of Eating Disorders Professional (IAEDP) Symposium, Orlando, Fla. For information: www.iaedp.com

April 5-9, 2008

Experimental Biology (EB) Annual Meeting, San Diego, Calif. For information: www.eb2008.org

April 11-13, 2008

Join us for the *24th Annual SCAN Symposium* in Boston, Mass. "And the Beat Goes On—Heart Health and Sports Nutrition" is the theme. For information: SCAN Office, 800/249-2875, www.scandpg.org

May 28-31, 2008

American College of Sports Medicine Annual Meeting, Indianapolis, Ind. For information: www.acsm.org

July 14-August 1, 2008

CDR Sports Dietetics Specialty Examination (at various U.S. sites). Postmark deadline for applications: *May 5, 2008*. For information: Commission on Dietetics Registration, www.cdrnet.org

October 25-28, 2008

ADA Food & Nutrition Conference & Expo (FNCE), Chicago, Ill. For information: www.eatright.org/fnce

SCAN'S PULSE

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Appropriate announcements are welcome. Deadline for Fall 2008 issue: **June 1**. Deadline for Winter 2009 issue: **Sept. 1**.

Manuscripts (original research, review articles, etc.) will be considered for publication. Guidelines for authors are available at www.scandpg.org. Email manuscript to the Editor-in-Chief; allow up to 6 weeks for a response.

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