

Exercise and Obesity: The role of exercise in prevention, weight loss, and maintenance of weight loss

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ABSTRACT

The dramatic increase in overweight and obesity rates poses a public health threat a mandate for nurse practitioners to address this challenge in clinical practice. Exercise plays an essential role in prevention, initial weight loss, and maintenance of weight loss and recommendations for physical activity differ for each category. Intensity of exercise, duration, and effectiveness of various types of physical activity are reviewed. Possible reasons why exercise-focused weight loss goals are not attained are also explored. Nurse practitioners are assuming an increasingly important role in combating the obesity epidemic and can make a positive impact by implementing effective, evidence-based, exercise-focused strategies for prevention, initial weight loss, and maintenance of weight loss.

Keywords: Exercise; exercise intensity; obesity; prevention; weight loss; weight maintenance.

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Obesity and overweight are serious public health problems associated with many negative health consequences, including diabetes, cardiovascular disease, various cancers, orthopedic, and mental health challenges (Jensen et al., 2014; National Institute of Health National Heart Lung and Blood Institute [NIH NHLI], 1999). A new report estimates that by 2030, approximately 50% of Americans will be obese (Ward et al., 2019). The burden on individuals, families, communities, and the health care system must be recognized, and strategies must be developed to reduce obesity rates and address the challenges of this serious public health threat (Ward et al., 2019). Many factors contribute to obesity, including diet, lack of exercise, inadequate sleep, stress, insulin resistance, individual metabolism, metabolic changes over the lifespan, and various medical conditions. Other factors more recently identified include the role of genomics and the impact of an individual's gut microbiome. These topics are discussed in other articles in this special issue.

Physical activity is an important lifestyle behavior that can impact body weight, body composition, and influence both the prevention and treatment of overweight and obesity (Jakicic et al., 2018). Numerous additional health benefits of physical activity are summarized in **Table 1**.

Nurse practitioners are assuming an increasingly important role in combating the obesity epidemic by helping patients develop healthy habits, lose weight, and maintain their weight loss. Evidence-based answers to the many questions about the role of exercise in weight loss will help inform practice, so effective guidance can be provided to ensure that patients may successfully pursue and hopefully achieve their health and fitness goals. This review will focus on the effects of physical activity on the prevention of obesity and overweight, initial weight loss, and maintenance of weight loss. The most effective exercise-focused strategies to prevent weight gain, promote initial weight loss, and to help maintain weight loss will also be discussed.

Exercise intensity

Throughout this article, intensity of exercise will be discussed using the following definitions. Intensity of exercise is measured in metabolic equivalents (METs). The definition of one MET is the energy involved in sitting quietly. This is approximately one calorie for every 2.2 pounds of body weight in an hour; if a person weighs 160 pounds, they will burn approximately 70 calories sitting or sleeping for 1 hour (Harvard School of Public Health, 2020).

Low-intensity physical activity is defined as activities that are sufficiently strenuous to burn off 2–2.9 times as much energy per minute as when sitting quietly or when exercise is equivalent to 2.0–2.9 METs. Examples include strolling and slow walking (1.7–2.5 mph) (Physical Activity Guidelines Advisory Committee [PAGAC], 2018).

Moderately vigorous physical activity is defined as activities that are sufficiently strenuous to burn off 3 to 6

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times as much energy per minute as when sitting quietly or when the exercise is equivalent to three to six METs. Examples include brisk walking (4 mph) or bicycling (10–12 mph) (PAGAC, 2018).

High-intensity vigorous physical activity is defined as activities that burn more than six METs. Examples include hiking, jogging (6 mph), and bicycling fast (14–16 mph) (PAGAC, 2018). It is noteworthy that these definitions do not consider different fitness levels, ages, or if overweight or obese. A brisk walk might be easy for an athlete but very strenuous for an elder or for individuals who are overweight or obese (Harvard School of Public Health, 2020).

Exercise and prevention of obesity and overweight

Jakicic et al. (2018) in their systematic review emphasize the importance of implementing effective strategies to prevent weight gain to lower the incidence of overweight and obesity. As an example, data from the Look AHEAD trial, a study of 5,145 overweight or obese adults with type 2 diabetes, reported an inverse relationship between moderate-to-vigorous intensity physical activity and measures of adiposity (Fan et al., 2013; Jakicic, et al., 2010). Clinicians are advised to recommend patients to engage in regular physical activity even if they are normal weight, and certainly, if they are at risk for becoming overweight or obese (Swift et al., 2014).

In the context of obesity and overweight, even when physical activity is not associated with weight loss, it can provide health benefits by reducing abdominal adiposity (Despres, 2006) and associated cardiometabolic health risks, such as diabetes and cardiovascular disease (Ross et al, 2000). A systematic review by Jakicic et al. (2018) noted additional benefits of physical activity in obese/overweight individuals, independent of weight loss, included promoting cardiorespiratory fitness, which is associated with reduced mortality, lower blood pressure, and improved glycemic control. Researchers continue to study how much physical

activity is necessary to prevent weight gain (Jakicic et al., 2018). The PAGAC (2018), in their recently released scientific report, recommend 150–300 minutes weekly of moderate-to-vigorous physical activity. Despite these new guidelines, current physical activity recommendations in the literature vary and are therefore summarized in **Table 2**.

The PAGAC report (2018) also points out that half the adult population fails to achieve the recommended level of physical activity and that 30% of the US population gets no moderate-to-vigorous activity. Nurse practitioners are urged to take an active role in obesity/overweight prevention strategies aimed at children, adolescents, and adults, encouraging healthy habits including the recommended physical activity with the goal of preventing overweight and obesity (**Table 3**). Beyond the scope of this article, the physical activity considerations for selected populations (youth, pregnant women, older adults, and those with chronic diseases) are described in the new PAGAC scientific report. For help with exercise screening, especially of special populations, the reader is referred to the new American College of Sports Medicine (ACSM) guidelines for exercise testing and prescription (Riebe et al., 2018).

Initial weight loss and the role of exercise

The consensus of evidence including several recent comprehensive reviews supports that the most effective lifestyle plan for achieving initial weight loss should combine dietary changes focused on reduced calorie intake, increased physical activity, and behavior modification strategies (Jakicic et al., 2018; PAGAC, 2018; Swift et al., 2018). Multiple systematic reviews have reported that physical activity alone without dietary modification produces, at best, minimal to modest weight loss and only when the activity is moderately vigorous and of sufficient duration (approximately 60 minutes) (Cox, 2017; Franz et al., 2007; Jakicic et al., 2018; Swift et al., 2018). However, it is notable that when researchers compared dietary modifications alone to physical activity alone and when

Table 1. Evidence-based physical activity health benefits

Improved cognitive function for youth aged 6–13 years.

Reduced risk of heart disease, stroke, hypertension, type 2 diabetes, and excessive weight gain.

Reduced risk of cancer including breast, colon, endometrial, esophageal, kidney, stomach, and lung cancer.

Brain health benefits, including possible improved cognitive function, reduced anxiety and depression risk, and improved sleep and quality of life, possible reduced risk of dementia.

For pregnant women, reduced risk of excessive weight gain, gestational diabetes, and postpartum depression.

For older adults, reduced risk of fall-related injuries.

For people with various chronic medical conditions, reduced risk of all-cause and disease-specific mortality, improved physical function, and improved quality of life.

Note: Adapted from Physical Activity Guidelines Advisory Committee (2018). 2018 Physical Activity Guidelines Advisory Committee Scientific Report (p. A-6). U.S. Department of Health and Human Services. <https://www.health.gov/PAGuidelines/>.

Table 2. Exercise recommendations for prevention of overweight and obesity

Duration	Intensity	Study
60 minutes daily	Moderate to vigorous	Jakicic et al. (2018)
150–300 minutes week	Moderate to vigorous	PAGAC (2018) ^b
150–250 minutes week	Moderate to vigorous	Donnelly et al. (2009) ^a
167 minutes week	Moderate	Brown et al. (2016)
60+ min week	Vigorous	Rosenberg et al. (2013)

Note: Moderately vigorous physical activity: brisk walking, bicycling (10–12 mph); Vigorous physical activity: jogging or bicycling (14–16 mph).

^aDonnelly et al. (2009). American College of Sports Medicine (ACSM), position stand (2009).

^bPhysical Activity Guidelines Advisory Committee (PAGAC) (2018).

the same energy deficit was achieved, the weight loss was equal (Ross et al., 2004). This means weight loss can be achieved with exercise alone, but the exercise must be sufficient (in intensity and duration) to influence metabolism and subsequent weight loss (approximately 60 minutes 5–7 days a week). This is the author's experience working with students who have participated in her intensive 6-month online health and fitness mentorship.

Several recent literature reviews have reported that when dietary restriction is severe, the effect of physical activity on weight loss is minimized. Severe restriction is defined as energy intake less than what is needed to meet resting energy expenditure needs (≤ 800 kcal per day) (Donnelly et al., 2009; Jakicic et al., 2018). This concern must be considered when implementing calorie restricted nutritional plans for overweight/obese patients who are seeking to lose weight.

How much exercise is needed to produce weight loss?

The current and long-standing recommendation of approximately 150 minutes per week of moderate-to-vigorous physical activity is required to influence body weight regulation and subsequent weight loss (Donnelly et al., 2009; Garvey et al., 2016; Jakicic et al., 2018; PAGAC, 2018). This is

approximately 30 minutes of exercise five times a week. These guidelines also emphasize that more weight loss is achieved with greater amounts and intensity of exercise. Controlled research trials and self-reported data collected by the National Weight Control Registry (NWCR) all support longer duration of exercise (60 minutes) for greater weight loss. It is notable that in the NWCR, the group with the most weight loss was engaged in more physical activity (both duration and intensity), and they also reported higher levels of dietary restraint (Odgen et al., 2014). According to the ACSM and the American Diabetes Association (Colberg et al., 2010), the recommended physical activity of 150 minutes a week (30 minutes five days a week) may produce weight loss but a goal closer to 60 minutes most days of the week may be required when weight loss is being achieved with physical activity alone.

What intensity of exercise is required to influence weight loss?

The consensus of research, including data from the National Health and Nutrition Examination Survey, the Look AHEAD trial, and the PAGAC Scientific Report, have all reported that moderate-to-vigorous physical activity is

Table 3. Key physical activity guidelines for adults

Adults should move more and sit less throughout the day. Adults who sit less and get any amount of moderate-to-vigorous physical activity gain some health benefits.

For substantial health benefits, adults should get at least 150–300 minutes a week of moderate intensity or 75–150 minutes a week of vigorous-intensity aerobic physical activity or an equivalent combination of moderate- and vigorous-intensity aerobic activity. Preferably, aerobic activity should be spread throughout the week.

Additional health benefits are gained by engaging in physical activity beyond the equivalent of 300 minutes (5 hours) of moderate-intensity physical activity a week.

Adults should also engage in muscle-strengthening activities of moderate or greater intensity and that involve all major muscle groups on 2 or more days a week, as these activities provide additional health benefits.

Note: U.S. Department of Health and Human Services (2018). Physical Activity Guidelines for Americans (2nd ed., pp. 56). U.S. Department of Health and Human Services.

required to influence body weight regulation and weight loss (Fan et al., 2013; Jakicic et al., 2018; PAGAC, 2018).

Does the length of each exercise bout (episode) matter?

Previously, it was recommended that moderate-to-vigorous physical activity be accumulated in bouts or episodes of at least 10 minutes in duration (Jakicic et al., 2018). However, more recent studies summarized by Jakicic et al. (2018) and the PAGAC (2018) provide evidence that physical activity accumulated in bouts of <10-minute duration are also inversely associated with body mass index and measures of body fatness. This is why the consensus of evidence currently supports that any amount (duration) of moderate-to-vigorous physical activity (<10 and >10 minutes) contributes to the daily total accumulated volume of physical activity (**Table 1**) (PAGAC, 2018). The literature is unclear if there is a minimal amount of exercise (such as 5 minutes or less) per bout that would not contribute to the overall total of daily exercise.

Does more physical activity result in greater weight loss?

Jakicic et al. (2018) reported that total volume of physical activity, regardless of duration, may have a favorable influence on measures of body weight and adiposity. Numerous studies also support a total daily *dose-response* effect between physical activity and weight loss. The PAGAC (2018) suggests this daily physical activity *dose* be based on the acronym FITT; frequency, intensity, time (duration), and type of activity (e.g., aerobic, muscle strengthening). This means that a greater total daily *dose* of physical activity is associated with greater weight loss.

High-intensity interval training versus low-intensity steady-state training

High-intensity interval training (HIIT) is a popular exercise trend that offers significant health benefits, including primary and secondary cardiovascular prevention (Ito, 2019). HIIT alternates short periods of intense anaerobic exercise (approximately 15–30 seconds) with recovery periods of low-intensity aerobic exercise (approximately 30–60 seconds). These vigorous workouts typically are below 30 minutes and produce high energy expenditure (calories burned) in a short period. Approximately twice the calories are expended in half the time compared with low-intensity steady-state (LISS) exercise.

Used in HIIT, anaerobic exercise is short duration, and strenuous physical activity is intense enough to produce lactic acid. High-intensity interval training is used by athletes in nonendurance sports to promote strength, speed, and power and by body builders to build muscle mass (PAGAC, 2018). Examples include sprinting, cycling, rowing, and weightlifting. These physical activities are anaerobic when performed in excess of 90% of maximum heart rate. Compared with aerobic exercise, muscles trained using

anaerobic exercise develop differently, leading to greater performance in short-duration activities (PAGAC, 2018).

Aerobic exercise is dependent on oxygen and involves low-to-moderate intensity physical activity of longer duration. Often referred to as cardio or LISS exercise, examples include running, walking, rowing, and bicycling. PAGAC (2018) recommends approximately 150 minutes a week of moderately vigorous exercise to improve cardiorespiratory fitness.

The current research consensus is that both HIIT and LISS provide cardiovascular benefits and other health benefits. In addition, HIIT and LISS each provide some unique health benefits. Specifically, HIIT is more time efficient and therefore is especially useful for time limited workouts.

Does fasted exercise burn more calories?

Exercising in a fasting state, that is exercising approximately 8–12 hours since a last meal, is a popular trend promoted as a way to burn more calories. But what is the evidence for this approach? A first ever systematic review and meta-analysis (including six databases, five studies) examined the effect of overnight fasted exercise on weight loss and body composition. This comprehensive review found no differences in weight loss or changes in lean or fat mass in the fasted versus nonfasted aerobic exercise groups (Hackett & Hagstrom, 2017). However, research continues on this topic.

What about individual variability in weight loss in response to exercise?

Remarkably, the influence of physical activity on energy balance may differ among individuals, which could explain why there is variability in weight loss from person to person (Unick et al., 2010). In response to an acute bout of exercise, several research studies have shown different responses among individuals, with some experiencing an increase in postexercise energy, whereas others experience a decrease (Unick et al., 2010). This may explain why the same physical activity results in weight loss in some individuals, no weight loss in others, and even weight gain in some (Donnelly, 2005). This is the author's experience working with overweight/obese women desiring to lose weight.

How effective is resistance training for initial weight loss?

The health benefits associated with resistance training include reduction in adiposity including intra-abdominal fat and percent body fat (Schmitz et al., 2007), increased lean muscle mass (Olsen et al., 2007), and reduction in cardiovascular risk factors (Schjerve et al., 2008; Swift et al., 2018). Resistance training alone has not been found to be effective for weight loss (Swift et al., 2018) and so should not be recommended as a primary strategy for initial weight loss. Patients who are seeking to lose weight with resistance training should be counseled to combine this approach with

Table 4. How to start an exercise program^a

Get Medical Clearance before starting to exercise (esp. if older than 50 years)
Make time. Schedule your activity.
Develop a routine.
Choose activities and exercise you enjoy.
Wear properly fitted sneakers and comfortable clothing.
Set small, achievable goals.
Start with short periods of low-intensity exercise (like walking for 5–15 minutes).
Increase gradually over weeks, months (if older).
Increase frequency (how often) and duration (how long) before intensity.
Consider working with a certified trainer (to learn proper technique and reduce risk of injuries).
If you are older (older than 50 years) and/or have not been exercising and/or have any chronic health problems, consider working with a physical therapist.
Find an exercise buddy (friend, family) or join an exercise group, health club, or community center.
Listen to music or audio books to keep energized, entertained.
Record your activities using a calendar, notebook, or application ^b
Celebrate your Success and have FUN!
Your GOAL = 30+ minutes 3 to 5 times a week ^c

Note: Adapted from American Heart Association (2010). Getting started—tips for long-term exercise success. <https://www.heart.org/en/healthy-living/fitness/getting-active/getting-started—tips-for-long-term-exercise-success>.

^aSuggested patient education handout (may be used without permission).

^bApplications (apps) examples: MyFitnessPal, Apple watch, Fitbit.

^cReaching the desired level of activity may require a year or more, especially if elderly, obese, sedentary (PAGAC, 2018).

both aerobic training and calorie restriction (Swift et al., 2018). However, resistance training may play a role in weight loss maintenance and therefore will be discussed later.

What physical activity focused interventions promote weight loss?

The PAGAC (2018) includes a summary of major findings from a large body of scientific literature about promoting physical activity through different interventions. Based on strong evidence, the PAGAC (2018) suggest the following approaches:

- Individual-level interventions can increase the volume of physical activity performed by youth and by adults, especially when the interventions are based on behavioral change theories and techniques.
- School-based programs and community-wide physical activity programs.
- Environmental and policy changes that improve access to places where people can be physically active, modify the built environment to better support physical activity behaviors.
- Information and communication technologies, including wearable activity monitors, telephone and

smartphone programs, applications, computer-tailored print interventions, and the Internet, can be used to enable self-monitoring, deliver messages, and provide support, all of which are helpful in promoting regular physical activity (p.A-5).

Individual-level interventions for nurse practitioners include using motivational interviewing and providing education, counseling, and support to patients with the goal of promoting adherence to physical activity guidelines and the development of healthy habits. Educating patients about how to start an exercise program (see **Table 4** for a sample patient handout) is important especially with special populations, including overweight, obese, elder or those with acute or chronic health problems. Sharing community resources such as support groups, group exercise programs, online applications (apps), web-based, and social media resources may also help increase weight loss success (Box 1).

Weight loss maintenance

The research is clear. Maintaining weight loss over time is challenging and unfortunately, 80% of individuals are not

Box 1. Web Resources and Applications

- American College of Sports Medicine. www.ACSM.org
- American Diabetes Association. www.Diabetes.org
- DoYogaWithMe (Web). Yoga for all levels especially beginners. www.DoYogaWithMe.com
- eFit30 (YouTube). Pilates, Yoga, Body Workouts in 30 minutes. YouTube.com
- Freeletics®. Application for fitness aimed at beginners. www.Freeletics.com
- Move Your Way website of consumer resources. <https://health.gov/moveyourway/resources/>
- MyFitnessPal®. Application for fitness and weight loss. Used for tracking food, water, exercise, body weight, and other personal health/fitness/weight loss data. <https://www.myfitnesspal.com/>
- Noom®. Application for weight loss. Uses positive psychology and behavior modification. www.noom.com
- Obesity Medicine Association. www.ObesityMedicine.org
- Tone It Up's Daily Workout. Application of daily exercises with GIFs. YouTube.com
- Wearables—used to track daily activity. Apple watch®, www.Apple.com; Fitbit®, www.Fitbit.com
- WW Weight Watchers®. Application for weight loss. <https://www.weightwatchers.com>

able to maintain their lost weight (Wing & Phelan, 2005). In the context of this challenge, evidence-based guidelines recommend combining dietary modification and physical activity for both effective weight loss and weight loss maintenance (Jakicic et al., 2018; PAGAC, 2018; Swift et al., 2018).

In a recent study, Ostendorf et al. (2019) concluded that physical activity was more critical than diet for maintaining weight loss. Specifically, their research found weight loss maintainers who exercised were more successful than those who did not exercise after weight loss (Ostendorf et al., 2019). Melby et al. (2019) explain “Although it is apparent that increased exercise energy expenditure (ExEE) may be less effective in producing weight loss compared with calorie-restricted diets, we propose that following weight loss, increased physical activity energy expenditure (PAEE) via exercise can adequately increase energy flux to minimize weight regain” (p. 9). Energy flux is defined by Hand et al. (2015) as “the rate of caloric conversion from initial absorption into the body tissues to utilization in metabolism or its transformation into energy stores” (p. 599) (PAGAC, 2018).

A recently published pooled analysis of nearly 1.7 million US adults, who met both aerobic (150 mins week of moderately vigorous exercise) and muscle-strengthening (> twice a week) exercise guidelines reported lower obesity prevalence especially for those in higher obesity classes. This evidence encourages patients to incorporate both aerobic and muscle strengthening exercises in order to prevent obesity and assist in optimal weight management and weight loss (Bennie et al., 2020). The evidence reported in the 2009 American College of Sports Medicine Position Stand suggests that 150 and 250 minutes per week of moderate physical activity (30–40 minutes five times a week) will result in

prevention of weight gain in adults (Donnelly et al., 2009). In contrast, however, Jakicic et al., (2018) reported that more exercise is necessary to prevent regaining weight and so recommend 200–300 minutes per week (40–60 minutes five times a week) of moderately vigorous physical activity. Prospective data have also shown an inverse relationship between 60 minutes of moderately vigorous activity per day and prevention of weight gain over 3–5 years (Shiroma et al., 2012). Of note, the health benefits of reduced intra-abdominal fat/percent body fat and increased lean mass suggest a possible role for resistance training in maintenance of weight loss (Olson et al., 2007; Schjerve et al., 2008; Swift et al., 2018).

For those who have lost weight and are desiring to maintain that weight loss over time, the significant body of evidence described in this article is a call to action for clinicians to implement effective strategies (**Tables 3 and 4**). These strategies must encourage continued consistent engagement in significant amounts of moderately vigorous physical activity over time to reduce the risk of regaining lost weight (PAGAC, 2018; Swift et al., 2018). Weight loss maintenance is also enhanced by behavioral support, including encouraging adherence to dietary plans, regular body weighing, involvement in weight maintenance support groups, and using exercise coaches, trainers, and exercise partners (PAGAC, 2018; Swift et al., 2018).

This is also the author's experience noting that those former students who remain committed to approximately 60 minutes of near daily, moderately vigorous physical activity were more likely to maintain their weight loss over time. Other factors contributing to long-term success that the author has noted include continuing to self-monitor food intake (either by tracking or conscious self-awareness), periodic body weighing (and body measurements), and other key lifestyle factors such as developing healthy habits especially for managing stress and sleep. Another key component includes the importance of continuing to receive support from others, such as participating in support groups, exercise groups, having an exercise buddy and/or supportive family, friends, provider, coach, trainer, therapist, and the like (Hansen et al., 2018; PAGAC, 2018). This author also emphasizes that several of the most important factors she has noted that contribute to long-term maintenance of weight loss among her former students are the development of self-awareness, self-confidence, and a positive body self-image (Ohsiek, S., & Williams, M., 2011). Supporting this author's observations, a literature review by Ohsiek and Williams (2011) identified a number of psychological factors that were linked to maintenance of weight loss long term including “increased dietary restraint, perceived benefits outweighing costs, lower/stable levels of depression, and more positive body image” (p.592).

Summary

The dramatic increase in overweight and obesity rates, which are projected to continue to climb, poses a public

health threat and is a mandate for clinicians to implement effective, evidence-based prevention strategies (PAGAC, 2018). The current consensus of evidence informs clinicians that exercise plays an essential role in prevention, initial weight loss, and maintenance of weight loss programs. For prevention, the current physical activity recommendation for Americans includes approximately 150 minutes a week or 30 minutes of moderately vigorous exercise approximately 5 times a week. However, recent research indicates that short “bouts” of exercise, even below 10 minutes, contribute to the total daily amount of exercise.

The most effective approach for initial weight loss is a combination of both diet and exercise. The exercise component should involve approximately 30–60 minutes (150–300 minutes week) of moderately vigorous physical activity at least 5 times a week. If attempting to lose weight with exercise alone, up to 60 minutes a day may be required. Even without weight loss, exercise is associated with many health benefits for normal weight, overweight, and obese patients.

Because there is a tendency to regain lost weight, maintenance of weight loss is challenging. Research suggests that the risk of regaining can be reduced significantly by encouraging patients to engage in approximately 60 minutes of moderately vigorous exercise on a near daily basis. This level of commitment most likely will require providing patients with ongoing counseling, support, resources, and effective strategies they can implement over time. More research is needed to examine factors that might influence response to exercise related to initial weight loss and weight loss maintenance, including HIIT, fasted exercise, various resistance training regimens (e.g. circuit programs), optimal nutrition and timing of nutrition relative to exercise, and effects of sleep, stress, and social/psychological/emotional influences.

Competing interests: *The author reports no conflicts of interest.*

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