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# TRACK COACH

ISSUE 209


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# 2014 PODIUM EDUCATION PROJECT

*The Podium Education Project is an annual High Performance Coaches Symposium which brings elite coaches and sport scientists together to review and present the most cutting edge methodology and coaching practices to ensure the US athletes stay on top of the podium.*

**WHEN:** SATURDAY, **OCTOBER 25, 2014**, 1 - 5 PM
SUNDAY, **OCTOBER 26, 2014**, 9 AM - 12 PM

**WHERE:** South Point Hotel - Las Vegas, Nevada

**THEME:** Road to Rio

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# TRACK COACH

The official technical publication of USA Track & Field

USA TRACK&FIELD

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FALL 2014

209


RUNNING AND AGING

# TRACK COACH

Formerly *Track Technique*

## 209

## FALL 2014

The official technical publication of USA Track & Field

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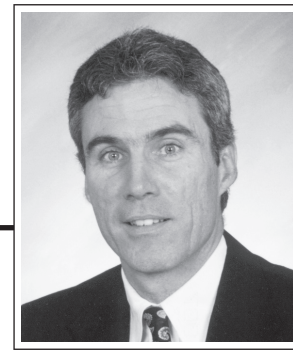
*From the Editor*

# Russ Ebbets



## END OF AN ERA

Our lives are defined by our actions. We get known for what we do – or did. For some people it is a shining moment of glory followed by a slow slide to the grave. Cynically *Walden* author Henry David Throeau summed it up saying, “Most men lead lives of quiet desperation.” “Most,” but not all.

Some men (and women) have the ability for reinvention, even rebirth. They trade one laurel for another. The ability to parlay personal accomplishment and fame into celebrity is an American staple, reality TV for better or worse. But some go one step further trading celebrity for the lasting contribution of foundations, institutions or humanitarian efforts that live on long after their death.

Lou Zamperini finally died July 2, 2014 at age 97. I say “finally” not as a statement of relief but almost disbelief. Most know his story. Plane crash survivor, castaway, POW, torture, alcoholism and suicidal despair; any one of these conditions could do in the average person—but not Lou Zamperini. Zamperini’s highs and lows were never average.

In 1959 Fred Wilt compiled a booklet called *How They Train*. It included some 150 profiles of runners from all over the world. Personal stats, intervals, racing strategies and what they ate for breakfast were included. Wilt even made “fartlek” an acceptable conversation topic for polite company.

*How They Train* came out in the early days of the modern running era when the scientific method and physiology were just starting to be used to improve performance. *How They Train* made references to the work of the Swedes, Franz Stampfl, Igloi and Hans Selye’s General Adaptation Syndrome.

But there was also space given to the “art” of coaching. A clip on Percy Wells Cerutty alternately detailed his charismatic, unconventional, even primitive training methods that were dismissed by some as animalistic. Yet *any* and all detractors could be quickly silenced with two words—“Herb Elliott,” whose undefeated career forced an echo of silence. Two points for sand hills.

*(Continued on page 6673)*

**On the cover:** Johnny Kelley, the Elder, shown finishing his 50th Boston Marathon in 1981. *Photo by Steven A. Sutton/Duomo.*

# If You Are Not Assessing, You Are Guessing

*The author describes three basic assessment tools to ascertain which of your athletes are most susceptible to injury.*

First things first. As coaches, we always try to get the best performance out of our athletes while reducing the risk of injuries and overtraining. What if I told you that there are three simple assessments that you can do on or off the track that can accurately predict who on your team is likely to get hurt before the season starts and track the athletes for overtraining.

**3 Basic Assessments:**

- Overall Body Posture
- Functional Movement Screen
- Y-Balance Test

## POSTURE

Dr. Shirley Sahraman, Ph.D. and physical therapist, stated in her well-known book *Diagnosis and Treatment of Movement Impairment Syndromes* that 90% of high school students have faulty posture due to a number of physiological, emotional, and lifestyle issues[1]. Simply learning to understand a simple posture assessment can show you what muscles truly need to be stretched and what muscles need to be strengthened in order to achieve optimal performance of the athlete injury-free.

*Structure dictates function.*

If your athlete has rounded shoulders, arched back (i.e. hyperlordosis), and flat feet while walking to track, then you have your work cut out for you because that athlete likely has upper and lower crossed syndromes[2]. You will likely have a number of wear and tear injuries

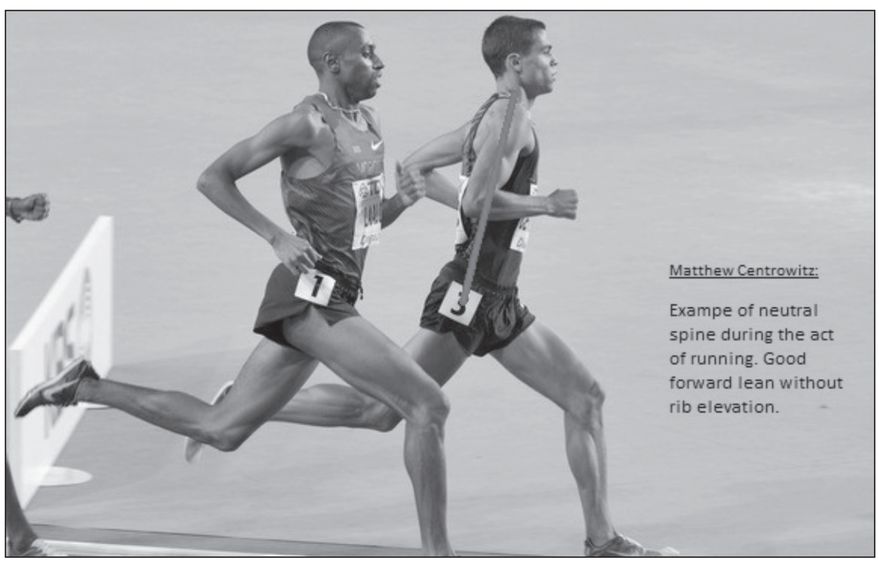



Figure 1

By Donald D. Shrump Jr. CSCS

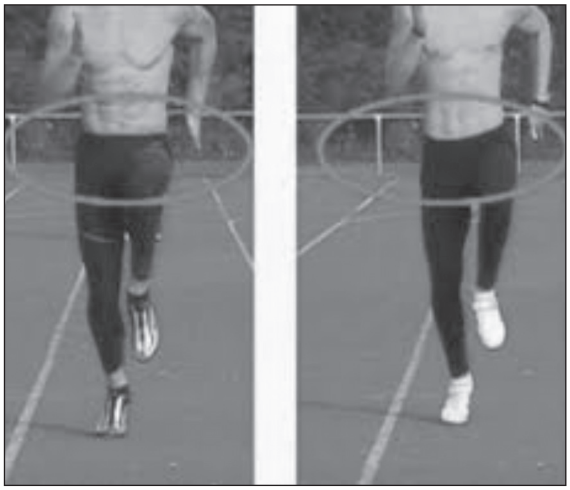


Figure 2


Figure 3

with that athlete due to the faulty posture. If structure does dictate function then we can understand the joint misalignments in the neck, shoulders, upper back, lower back, hips, knees, ankles, and likely in the feet. This athlete needs to stretch where they are tight: chest, traps, groin (not hamstrings, look to adductor magnus's 2 heads of muscles) and calves. Then you would want to strengthen where the muscles are long and weak: upper back, lats, glutes (especially glute medius (see Fig. 3), and hamstrings in order to get the athlete to perform at optimal level. However, this athlete needs to strengthen postural (tonic—slow twitch) muscles first before you go after their big movers (phasic—fast twitch) or else you will increase the likelihood of injuring the athlete[2].

I see parents, track coaches, and strength coaches working some good lifts with an athlete, only to hear later that the athlete developed tendinitis, a sprain, or some wear and tear injury that results in the athlete missing part or all of the season that he has trained all year for because the coach never assessed posture during running, throwing, or jumping.

**Table 1: Functional Movement Screen**

| Back: | Side: | Front: |
|---|---|---|
| Achilles | Fibula Head | Patella |
| Popliteal fossa | Popliteal fossa | Vastus medialis |
| Knees – Valgus/Varus | Greater Trochanter | ASIS |
| Ischial Tuberosity/Gluteal fossa | Lumbar spine/Abdominals | Arms |
| PSIS | Elbow | Ribs |
| Iliac Crest | Glenohumeral joint | Breasts |
| Lumbar spine | Auditory meatus | Clavicle |
| Scapula | Thoracic Rotation | Shoulders |
| Shoulders | Cervical – Flexion/Extension | Jaw |
| Cervical Spine | | Nose |
| Ear/Head | | Ears |
| | | Eyes |

## FUNCTION MOVEMENT SCREEN (FMS)

This is an assessment using a series of seven exercises that are graded 0 to 3 in order to identify dysfunction and asymmetric patterns in the body that have statistically proven to predict future non-contact injuries[3-5]. These seven simple exercises are used at the professional athlete level to predict who is likely to get injured, who is fully recovered from previous injury, and to see who is likely to improve performance. So why isn't every coach doing the same?

Think if you started each season by assessing your athlete or team to determine who needs some extra attention, in order to have fewer injuries and have the whole team perform at their best. To me, fewer injuries equals an increased likelihood of optimal performance across the board. FMS is easy to conduct and does not take a lot of time with a little training.

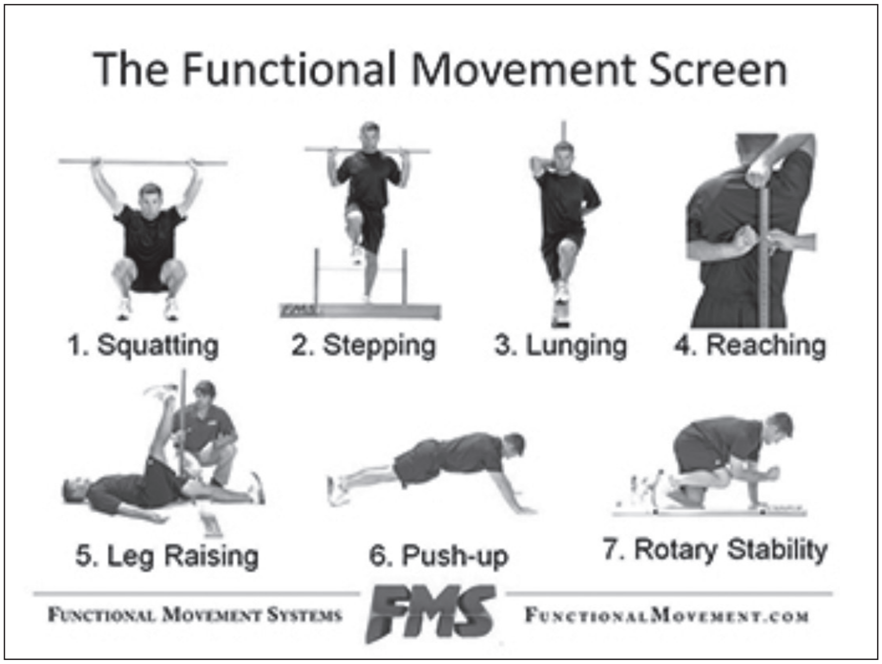



Figure 4

1. Overhead Squat
2. Hurdle Step-over
3. Inline Lunge
4. Rotary Stability
5. Trunk Stability Push-up
6. Active Leg Raise
7. Shoulder Reach

Each of these exercises are scored 0, 1, 2, or 3 with 3 being the exercise performed without any compensation, and 0 with some pain. The numbers would be tallied and a perfect score would be a total score of 21 or least likely to become injured. If the athlete scores less than a 14 and/or has pain in any of the movements, you should really consult a FMS qualified physical therapist or physician because the research findings suggest that these athletes have a 4x increased risk of serious injury [3-7].

The latest research on elite track and field athletes using FMS was able to predict which athletes would improve their long-term performance versus those who were more likely to become injured due to one or more asymmetries found on the FMS [4]. This can indicate to a coach where time should be spent in workouts on and/or off the track. Additionally, research in other sports found that as the season progresses and athletes are not recovering adequately or overtraining the athlete's FMS score decreased making the athlete more likely to be injured even though the athlete started the season with a good FMS score[8].

## Y-BALANCE TEST (YBT)

YBT is a single-leg or single-arm assessment that most accurately predicts many knee, ankle, and shoulder injuries, so this should be considered the minimum requirement of all athletes and can be done the quickest[9-12]. With the YBT, you will know who is 2.5-6x more likely to tear an ACL, sprain an ankle, or injure a shoulder. If you do not know what you are looking at for a posture assessment or FMS, then the YBT is the best test to learn because it uses simple numerical measurements. The athlete simply slides the white indicator box and you record the distance on the device. If the distances are too short when compared to the athlete's leg length or arm length, then the athlete has a significantly increased likelihood to get injured and under-perform.

Simple corrective exercises can be done to increase the athlete's sta-

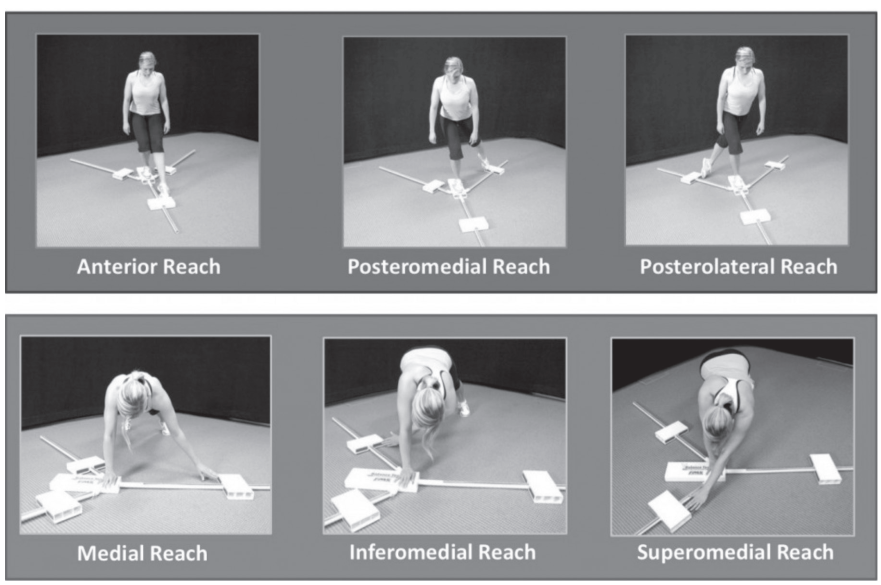



Figure 5

bility or strength. Or you can refer them to a YBT-trained professional or physician.

## BIOMOTOR ABILITY VS. NEEDS ANALYSIS

All athletes need to have certain attributes to be successful in their event. Some of these are obvious; in that a distance runner needs endurance (high $VO_2$max), however most coaches may not realize distance runners need great postural endurance to allow their joints to move efficiently for the duration of their race. Sprinters need great power and speed. Pole vaulters need power, speed, and coordination. Decathletes need a little bit of everything at a high level; however from personal experience, power and speed outweigh endurance on the scoring tables.

A simple needs analysis can be completed by determining on a scale of 1 to 10 what each event requires out of the eight possible biomotor abilities.

**8 Biomotor Abilities (scale of 1 -10)**

- Maximum Speed
- Coordination
- Power or Acceleration
- Agility
- Flexibility
- Strength
- Endurance
- Balance

**Example: 100-meter Sprinter**

- Speed = 10/10
- Coordination = 8/10
- Power = 10/10
- Agility = 5/10
- Flexibility = 7/10
- Strength = 7-10/10*
- Endurance = 2/10
- Balance = 5/10

*There are many elite athletes who never lift and are *not* considered strong by weight room standards. However, most athletes do become faster when a resistance training workout is programmed properly.

## PUTTING IT ALL TOGETHER

On the first day of cross country, indoor and/or outdoor track your goal should be to conduct one or more of the three basic assessments or should be to reassess each individual athlete and then think about the eight biomotor abilities needed for their respective events, so you can develop a needs analysis. What is needed for cross country should not be the same as for when that runner becomes in 800m runner for indoor or outdoor track.

OK, your 100m athlete's posture is aligned fairly well with only an increased anterior pelvic tilt. He got an 18/21 on FMS, and an 84% composite score on the YBT (so he still needs some work to get over 90%), but in your mind his max speed = 7/10, power = 6/10, and flexibility = 3/7. You can now focus your athlete's training on developing power with plyometrics, medicine balls, weight room exercises, or resisted runs. Then as you program out the season's training schedule you can focus on maximum speed training skills and nervous system overspeed training with long active rest periods to let the neuromuscular system recover. During the entire time you can work on the specific stretches need to improve the athlete's flexibility. In the end, you will get a better understanding of the intricacies of training to prevent injuries and optimize your athlete's performance.

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Donald Shrump was a decathlete at Rutgers. He has coached track at the high school level and now is a Certified Strength and Conditioning Specialist for NJ Fit Shore Personal Training, and has 10 years experience in sports specific training. He is a Doctorate of Chiropractic candidate at the University of Bridgeport. He focuses on assessment to screen for proper biomechanics in all movements of sport and exercise.

# Understanding Running And Aging

*This lucid description of the physical effects of aging and running is excerpted from Cathy Utzschneider's fine book,* Mastering Running *(Human Kinetics, 2014), a bible for masters runners. Dr. Utzschneider, a well-known masters runner herself, is a certified Level I USATF coach and is currently head coach of the Liberty Athletic Club, an all-women running club. She contributes to various running publications, including a regular column for* National Masters News. *She is a professor of competitive performance and goal setting at Boston College.*

Masters runners often ask how aging affects their running. They want context to understand and appreciate their performance. If you're over 30, and particularly if you're over 40 or 50, you're probably beginning to encounter the effects of senescence: normal physiological aging. While aging and the deterioration of the various systems ultimately affect performance, masters runners who understand it can learn to delay it to some degree.

## AGING AND THE PHYSICAL DEMANDS OF RUNNING

Aging and running each places its own demands on our bodies. Understanding their interrelated effects will help you plan your training and set your goals. You'll be able to remain optimistic but also realistic.

## INEVITABLE EFFECTS OF AGING

It's true that some masters runners we read about turn out unforgettable, inspirational performances that make us wonder, "Is that person immune to the aging process?" How can Ed Whitlock, for example, run a 3:15:54 marathon at age 80? But, we all know that no one—not you, me, or Ed—can escape the inevitable effects of aging. Aging may not look the same from individual to individual, but neither does growing. Given that the aging process follows general patterns—and that knowledge is power—you might as well know what to expect.

### Effects on Vital Signs

Masters runners should understand the basics about vital signs—heart rate, respiration rate (the number of breaths you take in a minute), blood pressure, and body temperature. Running obviously increases your body's demand for energy, affecting some of these signs. Knowing what happens to them during running as you age can help you understand what is healthy and what isn't, what to look out for.

*Resting Heart Rate*

Resting heart rate (RHR), the number of heartbeats per minute at rest, stays fairly constant through adulthood, provided that fitness level stays fairly constant. (Resting heart rate generally reflects fitness level.) Sedentary adults have rest-

*By Dr. Cathy Utzschneider*

ing heart rates of 60 to 100 beats per minute compared to 40 to 60 beats per minute for very active adults. This is because the cardiovascular systems of active adults are more efficient than those of sedentary adults.

Clearly, however, running increases your need for oxygen. To get enough of it, your heart must pump blood more quickly. When you run fast or race, your heart rate approaches maximum levels. Unlike RHR, maximum heart rate (MHR)—the highest number of heartbeats per minute (BPM) experienced at the end of a race or in maximal exercise—decreases with age. Whether you are sedentary or active, MHR declines about one beat per minute each year, or about 40 beats per minute between the ages of 20 and 60. A simple method to calculate your MHR, accurate to within about 10 beats per minute, is the formula 220 minus your age. For example, if you are 34, your predicted MHR is 186 BPM, or 220 minus 34.

Frankly, few masters runners from Liberty Athletic Club, where I coach, base their efforts on heart rate, relying more on pace per mile or perceived exertion or both. That said, if you are pacing your runs according to percentage of maximum heart rate and incorporating intense sprints at an effort above 95 percent of your maximum heart rate, check with your doctor first if you have health issues. That intensity challenges the heart, joints, and muscles. I've also seen many masters runners who race distances from the 5K and up limit the intensity of their hard days to 90 percent of maximum heart rate, and they're posting excellent results.

For an accurate measure of your maximum heart rate, take a 10-to-20-minute stress test at a qualified facility, such as a hospital or fitness testing center. During the test you will exercise to your limit—often on a treadmill while someone periodically increases its speed or slope—while you're attached to a heart rate monitor or electrocardiogram (ECG). One or the other will show your maximum heart rate during the final moments of maximal exertion.

*Respiration Rate*

Like heart rate, respiration rate—the number of breaths taken per minute—increases with running. As you know, when you run you breathe faster and deeper to supply your heart, lungs, and muscles with oxygen. While respiration rate remains fairly constant with age, it's harder for older runners to extract as much oxygen with each breath than it is for younger runners.

*Blood Pressure*

And what about blood pressure? That's also affected by running. Blood pressure refers to the pressure of the circulating blood on blood vessel walls and is divided into systolic and diastolic pressure. Systolic pressure refers to the force in the arteries when the heart beats, pumping out blood. Diastolic pressure refers to the force in the arteries when the heart relaxes between beats. In healthy adults, blood pressure remains the same through the decades. Normal blood pressure is 120 over 80, and ideally less than 120 for systolic and less than 80 for diastolic pressure. You may, however, be among those 20 percent of adults or the almost half of adults over 65 who have slightly elevated blood pressure. In any case, running raises not your diastolic, but your systolic blood pressure. Like other kinds of exercise that involve intensity, running can cause normal blood pressure to increase to 200 over 80 and as high as 300 over 80. These readings are dangerously high, indicating too much pressure on the blood vessel walls. The bottom line is that your blood pressure should be checked before you start a training program, and clearance from your doctor is important.

If you're at risk for developing high blood pressure, you can take routine measures in your training to moderate it. A warm-up before and cool-down after running help your blood pressure adjust gradually to different levels of stress. Warm up by walking or jogging slowly for at least 10 minutes. Cool down by walking or jogging for at least 10 minutes. (Stopping too suddenly after your run can cause a sharp drop in blood pressure, resulting in lightheadedness and cramping.) Don't hold your breath while running because that can raise blood pressure. In terms of diet, limit your salt intake and avoid caffeine, which can raise blood pressure before and during a run.

*Body Temperature*

Body temperature stays constant throughout life, but a strenuous run can raise it. In addition, running in hot and humid conditions can raise core temperature in any runner, and masters are more affected by humid conditions than open runners. Middle-aged bodies are less efficient at sweating, a cooling mechanism for the body. Masters runners are also more sensitive to cold. Their skin is less likely to constrict (shiver) to preserve body heat, and their metabolism is generally slower.

### Decreased Cardiopulmonary Function

You can appreciate performance as a master most if you know the effects of aging on your heart and lungs. You know the theme by now: heart and lung capacity declines with aging, too. Of all the physiological declines, those in the heart and lungs affect performance the most. One of the main reasons athletic performance decreases with age is that the heart and blood vessels become less efficient. As a review, the cardiopulmonary system includes the heart, both a reservoir for blood and a pump that circulates blood through the body, blood vessels, and the lungs, which deliver oxygen to and eliminate carbon dioxide from tissues.

What's useful to know about the heart, aging, and running? The heart weighs about .8 pound (363g) in young, healthy adults. It grows as we age, and as it does, it decreases the size of the left ventricular chamber from which newly oxygenated blood is pumped through the body. During maximal exertion, stroke volume—the amount of blood pumped out with each heartbeat—also declines. Less blood means less oxygen for energy for running. Cardiac output, the amount of blood pumped out each minute, also diminishes with aging because our blood vessels (veins, arteries, capillaries) become less able to stretch and pump blood.

Regarding the lungs, ventilation—taking in oxygen and expelling carbon dioxide—decreases. The diaphragm, the muscle that helps the lungs expand and contract and therefore draw air into the lungs, becomes weaker and stiffer. Also the alveoli, tiny grapelike sacs where oxygen and carbon dioxide are exchanged, decrease in size and number. And the capillaries that carry blood to the alveoli decrease in number as well. The result is that by the time you're 80, your maximum breathing capacity will be about 40 percent of what it was at 30. That looks like more labored breathing, whether you're running or walking to the mailbox.

### Decreased $VO_2$max

$VO_2$max, the single best measure of overall cardiovascular performance or fitness level, also declines. V represents volume, $O_2$ represents oxygen, and max is maximum. $VO_2$max is usually expressed in relative terms, as milliliters of oxygen consumed per kilogram of body weight per minute (ml/kg/min). Essentially, $VO_2$max is the greatest amount of oxygen that can be used at the cellular level by the entire body during physical activity. A high $VO_2$max generally correlates with high endurance performance.

How much does $VO_2$max decline with aging? In terms of percentages, it declines by an average of about 10 percent per decade in sedentary adults after ages 25 to 30. As an example, a 10 percent decline per decade translates to the equivalent of adding 30 seconds to a 10K personal best each year (or adding 5 minutes in 10 years).

Despite the general decline in $VO_2$max, though, continued vigorous training can slow the rate of decline per decade from 10 to 5 percent (Joyner 1993; Marti and Howald 1990). One 22-year longitudinal study found that while continued training can lower that decline to 5 to 7 percent, two exceptional elite male runners had declines of as little as 2 percent per decade between ages 22 and 46 (Trappe et a!. 1996; Marti and Howald 1990).

Some studies of masters athletes have shown that this decline accelerates at certain times, from the mid-50s to mid-60s, and then again in the mid-70s. One study of 2,599 masters runners by Dr. Vonda Wright, orthopedic surgeon at the University of Pittsburgh, pointed to an unusually sharp decline at age 75 (Wright and Perriceili 2008).

Having watched women from their 20s to 70s run weekly quarter- and half-mile intervals over 20 years, I can see this decline clearly on the track. Here's just one example of two national-class middle-distance masters runners (with aliases) that shows how the decline can accelerate from the mid-50s to the mid-60s. At 52, Sarah typically ran 5 to 6 seconds behind 40-year-old Linda on half-mile (800m) intervals. Both trained similarly and were equally talented. On those same intervals 12 years later, with similar continued training, Sarah, in her mid-60s, was 15 to 16 seconds behind Linda, then in her early 50s.

So what can you do to mitigate the decline in $VO_2$max? Granted, some things are out of your control. You can't control genetics, which accounts for 25 to 50 percent of variance in $VO_2$max. You can't always control disease, which lowers $VO_2$max. And you obviously can't control aging. But you can gradually raise your level of activity—distance or speed—and you can control the quality of your diet. Excess fat lowers $VO_2$max (So and Choi 2010). So take heart (and make the most of it)!

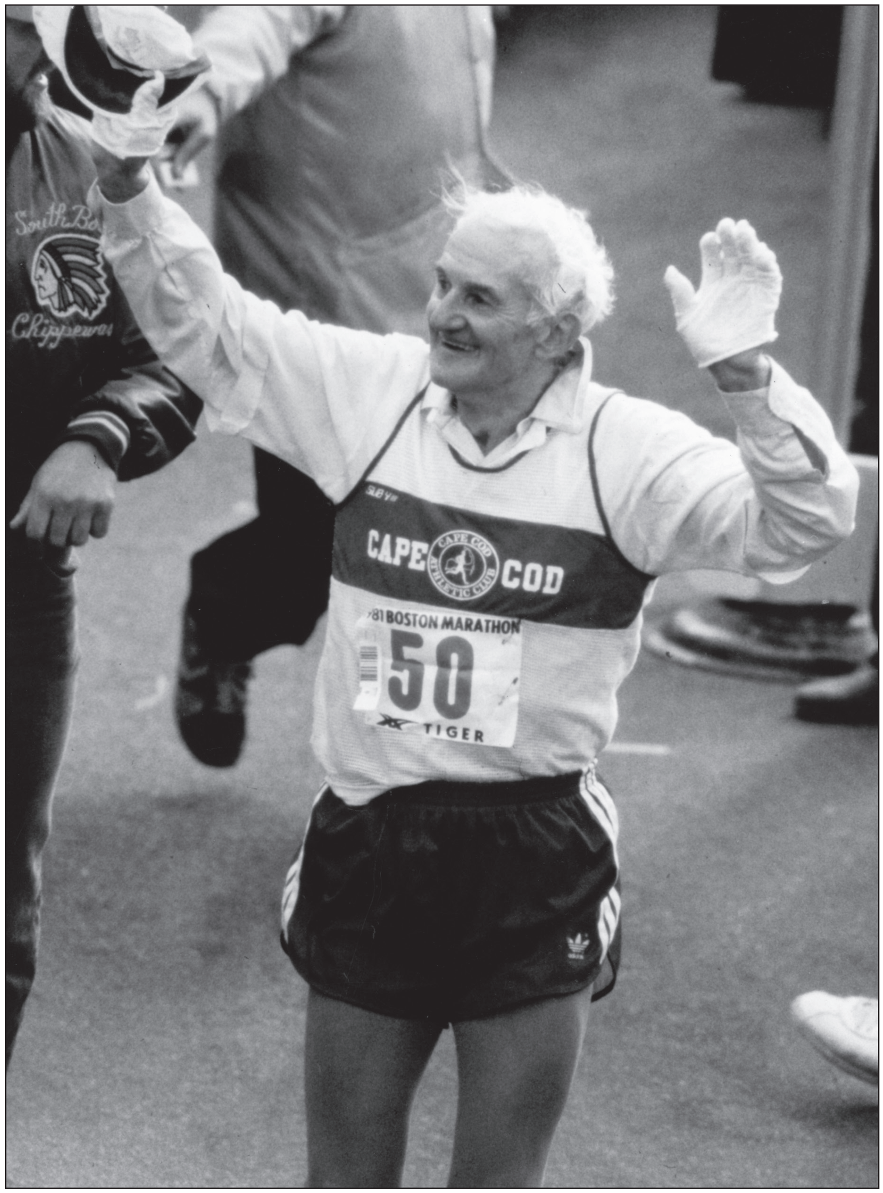
### Bone and Muscle Loss

The theme continues. With aging, you lose bone as well. Men and women alike experience age-related bone loss sometime between ages 20 and 30, and that loss continues in later decades. You lose bone strength and flexibility. The rate of protein synthesis and the production of human growth hormone, both essential for the strength and flexibility of bone, decrease and your bones begin to lose minerals like calcium and phosphate. Your bones become more porous and more susceptible to fractures. Bone loss is accelerated by a sedentary lifestyle, hormone deficiencies, poor nutrition including calcium or vitamin D deficiency, excessive caffeine and alcohol intake, and smoking.

Some of the effects of bone loss are visible and some aren't. If you see someone whose spine is curved, you're seeing the effects of bone loss; vertebral discs become compressed and there's less joint space between them. Older people lose height. By age 80, you can expect to lose approximately two inches (5 cm) of height (about half an inch [1.3 cm] per decade after 40). What is harder to see is loss of bone density throughout the body, which is osteopenia or osteoporosis, discussed later in this chapter.

Skeletal muscle begins to decline after age 30, particularly if you are sedentary. The decline is more rapid after age 50, and still steeper after 60 (Williams et al. 2002; Booth et al. 1994; Grimby and Saltin 1983). Skeletal muscle fibers (muscle mass) atrophy—they weaken and die—as you age. We are born with all the muscle fibers we will have. A biceps muscle of a newborn contains about 500,000 individual fibers. An 80-year-old man has about 300,000 fibers. The term for the age-related decline in the number of muscle fibers and in the strength per unit of muscle is sarcopenia.

If you wonder why explosive running events seem more challenging as you age than endurance events do, know that it's related to what happens to the two basic kinds of muscle fibers in our bodies: Type I (slow-twitch) and Type II (fast-twitch) fibers. Type I fibers contract slowly and use oxygen efficiently and are used for endurance events like marathons. Type II fibers, of which there are two kinds—Type IIa and Type IIb—contract quickly and tire easily. These are used for strong, explosive events like sprints. As we age, Type II fibers decrease in size and number more than Type I fibers do.




STEVEN A. SUTTON/DUOMO

**Aging didn't get Johnny Kelley down. A two-time U.S. Olympian in the marathon, he won the Boston Marathon twice (1935 and 1945) and finished second a record seven times. He eventually completed 58 Boston Marathons, his last one in 1992 at age 84.**

As you lose muscle fibers and mass, you lose strength and power, particularly if you don't strength train. From 30 to 80, you lose about 40 percent of the muscle strength in the legs and back muscles and 30 percent in the arms (Grimby and Saltin 1983; Holloszy and Kohrt 1995). The good news is that you maintain considerable muscle mass in your legs just from running, and if you strength train a few times a week with a focus on your other muscles, you can minimize that muscle loss considerably.

### Stress to Bones, Joints, Muscles, and Tendons

Yes, running is undeniably stressful on our skeletal muscles (all 640 of them), bones (206), joints (360), tendons (4,000 plus), and ligaments (900). It's said that we land with two to four times our body weight on every step and that the average runner takes approximately 1,500 steps per mile (1.6 km). That adds up. At 40 miles (64 km) a week, that's 60,000 steps a week and 3,120,000 steps per year.

That stress on bones, joints, and muscles increases with age. I can see that at Tuesday-night track practice. The masters runners in their 70s often call it quits on intervals before the runners in their 30s, 40s, and 50s. They feel the impact of pounding earlier than younger runners. And they're smart to listen to their bodies, a skill to practice as a masters runner.

How does running challenge your joints in particular? First, joints include bone, muscles, synovial fluid, cartilage, and ligaments. The repetitive motion of running can wear away the cartilage, the substance that lubricates joints, cushioning the ends of the bones. As cartilage erodes, bones rub together, causing a grating feeling, inflammation, and stiffness. Synovial fluid, a viscous fluid that reduces friction in joints, becomes thinner with aging.

Despite these stressors, know that weight-bearing exercise like running, if not overdone, can keep your cartilage and ligaments healthy. It can promote absorption of nutrients into cartilage and increase its hydration. Exercise can increase production of synovial fluid. Balance and moderation are key.

As joints become stiffer, masters runners, as you probably well know, lose flexibility. If you could touch the floor with your palms at 20, chances are you can't at age 50. Most likely, you've lost range of motion. You're more limited in your ability to extend and flex your hips.

Older runners have shorter strides than younger runners, as the results of one study showed, comparing strides in older and younger male marathoners (Conoboy and Dyson 2006). The strides of 40- to 49-year-old runners were 2.4 meters (7.8 feet). Those of the runners 60 and over were 2 meters (6.6 feet). Following a regular, focused stretching routine, especially after a run when your muscles are warm, can help you maintain flexibility.

Masters runners are also more likely than open runners to feel soreness, strains, and tears in their muscles and tendons. As noted earlier, older muscles have lower percentages of Type II muscle fibers than younger ones and the mitochondria (the power centers in cells where nutrients are broken down to create energy) in older muscle fibers become increasingly dysfunctional.

Hamstring and calf strains are among the most common muscle injuries that plague masters runners. In tendons, water content decreases with age, making them stiffer and less able to tolerate stress. Like many masters runners, I've had recurring Achilles tendinitis (inflammation of the Achilles) that sidelined me for four or five years in my late 40s. (I returned to periodic competition in my 50s.)

A progression of Achilles tendinitis, tendinosis is a degeneration of the tendon that's common among masters runners. To alleviate soreness and help circulation, many masters swear by regular massages including a technique called active release therapy, physical therapy, yoga, chiropractic appointments, and acupuncture. If you follow a thoughtful training plan, listen to your body, and avail yourself of the wide variety of practitioners in sports medicine, you can meet most challenges you'll face.

### Less Energy and Slower Metabolism

Decline also occurs in our metabolism and thus our levels of energy as we age. (That's hard to see in masters runners, though. Most masters runners are lean and energetic.) One of the main reasons basal metabolism slows is that the various enzymes crucial to metabolism decrease. After about age 25, metabolism begins to decline between 2 and 5 percent or more per decade. That feels like fatigue—you get more tired over the decades—and without exercise, that looks like fat. Between ages 25 and 75, sedentary adults can expect to see total body fat double as a proportion of the body's composition.

Like $VO_2$max and muscle loss, declining metabolism and energy involve factors you can control and some you can't. Age, size, and genetics determine 60 to 75 percent of your metabolism. You can, however, control what you eat and how much you exercise. Clearly, running burns calories, which is one of the main reasons many people start running in the first place. Of the 103 competitive masters female runners studied in my doctoral dissertation (Utzschneider 2002), all began running not for competition but for health and fitness. Furthermore, only 6 of the 103 runners, whose average age was 51, were unhappy with their weight. That's unusual for a population of middle-aged women.

Formulae for calculating calories burned while running vary (and some are complicated) and depend on several factors, including speed, distance, body weight, genetics, and age. No one formula fits everyone. One easy formula I use is to multiply your body weight by .65 by the number of miles run. Say you weigh 120 pounds and run 5 miles. Multiplying 120 by .65 by 5 you can figure that you burn about 390 calories.

**Prolonged Recovery**

Recovery is one of the basic principles of training, particularly for masters runners. If you want to get more fit—to "up the ante" in your workouts—you have to learn how to recover. If you're increasing the intensity, duration, or frequency of your runs or races, you need more rest to let your muscles repair and grow stronger. The swimmer Dara Torres is a good example of someone who recognized the importance of prolonged recovery for a master. At 41 at the U.S. Olympic Trials for the 2008 Beijing Olympics, she qualified for the individual 100-meter and 50-meter freestyle, the 4 x 100-meter medley relay, and the 4 x 100-meter freestyle relay.

But she withdrew from the 100-meter freestyle precisely because she knew that prolonged recovery from so many events would hurt her chances of succeeding in the 50 meters and the relays. The lesson: as a masters runner, be selective about what and how much you do.

What qualifies as recovery for masters runners? It may mean time off before or after a race, time easing off between seasons, cutback weeks when preparing for a major event, or rest after a track interval. It may be running easy instead of hard, cross-training (riding a bike, swimming, or water running, for example), weight lifting, or yoga, anything that gives your legs a break from intensive pounding so you avoid injury and illness.

What about examples of recovery? First, know that genetics, training history, and how you feel on a particularday all influence how much time you need for recovery. Sometimes recovery doesn't depend on age. I coach a world-class runner in her late-60s who's often ready for another interval sooner than some of the runners in their 20s. The following are my guidelines regarding recovery.

*Age*

The older you are, the more recovery you should take, no matter how fast you run. Train yourself to listen carefully to your body. Your own judgment trumps any rule. (If you're on the track with others, don't get distracted by their energy levels)

***Planning Your Race Year***

Your year as a masters runner should include several periods of relaxed weeks to recharge your mind and body and help you stay free of injury. There is no hard-and-fast rule for what relaxed weeks should look like. That depends on you and your race experience. Too much time off from running can make reentry difficult. Some rest during the year is helpful. Too much is not. In relaxed weeks, my runners typically reduce their mileage by 30 to 40 percent, cut out intense workouts and races, cross-train, and focus on other life priorities.

John Barbour, 60, has perspective on that balance for masters, having run since he was a freshman in high school; coached middle school, high school, college, and club teams; and been named USATF runner of the year among men 45 to 49. His personal bests are 14:42 for the 5K, 29:33 for the 10K, 1:07:05 for the half marathon, and 2:19:25 for the marathon, he told me recently. Comparing his days of running as an open runner to today, he said that "those days when everything clicks and you feel smooth and easy are fewer and further between. I've learned that, while rest is valuable, too much rest (i.e., long breaks) makes one more prone to injury during the comeback, so maintain some level of running activity even on down periods, whenever possible."

*Cutback Weeks*

While you can generally increase mileage by 10 percent each week, also incorporate cutback weeks every fourth or at least every fifth week. These refresh your training and prevent overload, not only in training but also in fitting it into the rest of your life. In cutback weeks you might lower your training by 10 to 25 percent and then return the following week to the level before the cutback week. If you're feeling unusually tired or if you feel a nagging soreness in a particular spot, have the courage to lower your running by as much as 50 percent and either cross-train or rest instead.

*Hard Workouts of the Week*

Some competitive masters runners include two hard workouts a week. Runners in their 30s, 40s, and mid-50s should take at least two recovery days between intense workouts. A Tuesday track workout may be followed by a Friday track workout, for example. Many runners in their mid-50s and older are better off with at least three recovery days between intensive training.

*Intervals (All Paces)*

If you're unsure whether or not you're ready for another speed interval, check your heart rate. It should be at least 120 beats per minute. If it's over that, wait until it returns to 120.

*Gender*

If you're a woman and you need more recovery time than some of your male running friends, know that hormonal differences give them an advantage. Men have more testosterone, the hormone that helps not only protein synthesis but also muscle repair and growth, including recovery from tough workouts.

### Declining Motivation

You think? Who wouldn't be surprised to hear that staying motivated can be a challenge for masters? Times slow, injuries threaten more often, and energy diminishes. Numbers of participants in older masters age groups—55 and particularly 60 and older—decline in all kinds of races. Running USA's 2011 road race age group distribution records of male and female finishers confirm this.

What helps masters runners stay motivated? First, don't take on too many responsibilities. Too many responsibilities, not injury, was the major obstacle faced by the masters runners in my doctoral study (Utzschneider 2002). Keep a journal and write down goals. Find a club. Train with a partner. Ask your family to help you stay motivated, schedule your runs, and eat healthily. I wrote my first book, *MOVE! How Women Can Achieve Athletic Goals*, precisely because motivation is such a major challenge for masters. It addresses the above issues.

## WEATHER AND ENVIRONMENTAL CONDITIONS

Here's more not-so-good news about the effect of aging on our bodies. They're more susceptible to extreme heat and cold. Older bodies are less able to regulate core temperature. In hot and humid conditions, they're more susceptible to heatstroke. Older bodies sweat less readily so they're unable to cool down as efficiently. Beginning signs of heatstroke vary but may include an extremely high body temperature (above 103 degrees F or 39.4 degrees C); red, hot, and dry skin (with little or no sweating); rapid, strong pulse initially, followed by a weak and rapid pulse; throbbing headache; dizziness; nausea; shortness of breath; and confusion. To avoid heatstroke, stay out of the sun, drink plenty of water, slow down, and wear lightcolored clothing made of fabrics like CoolMax or Dri-Fit that wick moisture away from your skin so cooling evaporation can occur.

Older athletes are also more sensitive to cold. They're less able to differentiate changes in temperature well and are more susceptible to hypothermia, which occurs when core body temperature is less than 95 degrees Fahrenheit (35 C).

In older people, vasoconstriction, the narrowing of blood vessels to maintain body heat, and shivering, a muscular response to generate heat, function less efficiently (Collins et al. 1980; Young 1991; Young and Lee 1997). Beginning signs of hypothermia are shivering and increased breathing rate, heart rate, and blood pressure. Below a core body temperature of 95 degrees, symptoms worsen and include confusion, lack of concentration, and slurred speech. At the worst stages, the heart beats irregularly. Hypothermia can be fatal. Side effects include chilblains, superficial ulcers of the skin, and frostbite.

Wearing the right kind of clothing in wet, cold, and windy conditions can help you withstand the most adverse conditions. If you run in the rain or wind, you want clothing that is water resistant or waterproof, breathable, and wind resistant. In cold weather, you want thermal, breathable underwear (look for polypropylene fabric). Breathable gear for everything—neck warmers, hats, socks, gloves, even face masks—helps wick sweat away from your skin so it stays dry and you stay warm. One winter during a three-week double-digit subzero cold spell, two of my masters runners discarded their egos and donned face masks to train for the February Hyannis Half Marathon. "We were toasty after 15 minutes!" one of them said recently.

Dress for your run as if it's 10 degrees Fahrenheit warmer than the actual outside temperature. You'll be slightly chilled for the first 10 minutes or so, but then toasty warm for the duration. Among materials that many runners like are Gore-Tex, Activent, and Dryroad. Materials like these can keep you smiling on the coldest, wettest, or windiest days.

## SPECIAL CHALLENGES FOR WOMEN

Masters female runners face unique issues for a range of reasons. Women's physiology, with monthly hormonal changes and menopause, presents its own issues, one being susceptibility to anemia from blood loss. Less obvious but also apparent are societal pressures for women of all ages to be thin. Some women masters runners do struggle to hold an "ideal" weight to race their best.

### Female Athlete Triad

The female athlete triad—the three-part syndrome consisting of eating disorders, amenorrhea, and premature osteopenia (a mild form of osteoporosis)—is not just a young woman's condition today. More and more women in their 30s and 40s and even 50s are joining the ranks of young female runners, gymnasts, and skaters who suffer from at least a few aspects of the triad. While there's little research on the triad in masters female runners, there are aspects of it in some who are gaunt and apparently not fueling their bodies to the extent they should given their activity level. Signs of the female triad are bony hips and shoulders, brittle hair, and dry skin. Some women say that they appreciate the fact that light weight will help them run faster, and many of them have had children, so irregular menses is not a concern. These women generally take calcium, knowing that they don't eat enough calcium-rich foods, such as milk and cheese.

I've occasionally noticed what I'll call a lemming effect in groups of female runners, including masters: if a faster runner in a group starts losing weight, it's not discussed but others around her also start losing weight. A Division I college runner recently confirmed the lemming effect, saying that it works both ways with female athletes. Her college team was unusually free of eating disorders because its captain, one of the fastest runners, modeled and encouraged healthy eating habits.

Coaches shouldn't hesitate to tell women whom they suspect are underfueling themselves that eating enough and getting proper nutrition, including calcium and fat, can mitigate signs of the syndrome. If you eat more calcium, you'll be less susceptible to osteopenia.

I've occasionally asked women who appear too thin—the main sign of the triad—to check their body mass index (BMI). BMI is a number calculated from your weight and height. According to the National Institutes of Health, if your BMI is less than 18.5, you fall in the malnourished category. (A BMI of 18.5 to 24.9 is in the normal and healthy weight range.) You can calculate your BMI by dividing your weight in pounds by your height in inches squared and multiplying that result by 703. Using a metric equation to calculate BMI, divide your weight in kilograms by the square of your height in meters. There are numerous web-based BMI calculators to help you calculate your BMI, if you don't want to do the math yourself. Of course skinny doesn't always mean healthy (something many women already know), and it doesn't always mean fast. Healthy nutrition and a body mass index in the healthy range are the goals. Sometimes heavier is even faster. I've seen quite a few masters runners post personal bests in races after gaining a few extra pounds. (I ran my personal best mile and 5K carrying a few extra pounds.)

### Diet and Self-Image

Related to the female athlete triad, diet (to achieve low weight) and self-image are growing concerns for women in middle age. Driving the increase is a sometimes unrealistic societal expectation that women should be too thin in middle age: the skinny ectomorph is the ideal body image, our advertisements and movies suggest. At the same time, slowing metabolisms and menopause threaten waistlines with the midriff "spare tire." Some women do everything possible—including running, weight training, walking, and limiting caloric intake—to avoid it. Focus on diet and thinness also gives a sense of control at a time when mounting responsibilities, such as juggling the demands of a full-time job with the pressures of caring for children, grandchildren, and ill parents, leave women little time for themselves. Interestingly, more than a handful of elite masters female runners have said that the "spare tire" of five additional pounds (2.3 kg) that appeared during menopause miraculously disappeared 5 to 10 years later.

Increasingly, women of middle age are determining their self-worth by their weight and body image. According to a study of 1,849 women 50 and older published in the International Journal of Eating Disorders (Gagne et a!. 2012), 62 percent said their weight or shape negatively affects their life, and 64 percent think about their weight at least once a day. They used several unhealthy methods to become thin, including diet pills (7.5%) and excessive exercise (7%). "Fifteen years ago, it was very rare to have a patient with an eating disorder at midlife," said Ann Kearney Cooke, PhD, a Cincinnati psychologist who specializes in eating disorders. "Now, half my patients are women 35 to 70." (Moyer 2012, p. 1)

One of the worst eating and control disorders, anorexia, is increasingly common, unfortunately, among middle-aged women in many countries, including the United States, Britain, and Australia. According to Holly Grishkat, PhD, director of The Renfrew Center, an eating disorder treatment center, eating disorders among middle-aged women have increased by 42 percent from 2001 to 2010 (Sheridan 2012). An Australian study found that from 1995 to 2005 the rate of fasting and binge eating increased significantly among women age 55 to 64 (Hay et al. 2008).

### Iron Issues

With all that women masters runners are juggling in their lives, it's not unusual for them to be tired. While fatigue may be caused by many things, including crazy schedules and insufficient sleep, you may find you're anemic, or low in iron. If you are, in addition to being generally exhausted, your running times are likely to rise (you'll get slower). Other symptoms of low iron levels are pale skin, headaches, being unable to recover from a poor night's sleep, and unexpected shortness of breath during exertion. Iron deficiencies are also difficult to detect because they develop gradually.

Masters female runners are more prone to anemia than many groups for several reasons. First, not many of them (as far as I can see) eat a lot of red meat, one of the best sources of iron. Second, foot strike during running destroys red blood cells, the cells that "grab" oxygen and distribute it throughout your body. Third, iron loss occurs not just through menses but also through sweating. Several runners I coach at the Liberty Athletic Club found they were anemic after they felt unusually tired and slow. All of a sudden their 5K running times increased. After learning from blood tests that they were anemic, they took iron supplements and were back to full energy levels and improved race times in three to six weeks.

To stave off anemia, be sure you're consuming enough iron-rich foods. In general, you should consume at least 15 milligrams of iron daily if you are a premenopausal woman and 10 milligrams if you are postmenopausal.

How can you prevent iron depletion?

- Eat foods like liver, lean meat, oysters, egg yolks, dark-green leafy vegetables, legumes, dried fruit, and whole-grain or enriched cereals and bread.
- Eat three to four ounces (85-113 g) of lean red meat or dark poultry a couple of times per week.
- Eat or drink foods rich in vitamin C with meals to increase iron absorption.
- Know that drinking coffee and tea with meals reduces iron absorption.

Use cast-iron pans for cooking. They increase the iron content in your food.

Finally, if you have found that you are low in iron, retest your blood every three months. Three months gives you time to build up iron stores and evaluate progress.

### Osteoporosis and Osteopenia

Masters female runners should be aware that they're not immune to osteoporosis and its milder precursor, osteopenia. These conditions result in low bone mass (density) and diminished strength. Osteopenia and osteoporosis are common among both men and women over 50, 55 percent of whom have one or the other (Pray and Pray 2004). If you are one of the many masters female runners who don't consume enough calcium, consider supplements. As always, consult your physician first.

The causes of osteopenia and osteoporosis, considered silent diseases because they have no obvious symptoms, are many and complex. They include genetics and a history of irregular menses, stress fractures, taking corticosteroids for one year or more, and smoking. Other causes include body weight less than 127 pounds (58 kg) for women and inadequate nutrition, including too much caffeine, which can strip calcium from bones, and getting too little protein, vitamins, and minerals such as calcium and vitamin D (which helps your body absorb calcium). Excessive exercise that leads to irregular or nonexistent periods and too little weight-bearing exercise are also causes. Menopause, which causes women to lose the estrogen that helps their bodies absorb calcium, is another cause.

The good news is that you can take action to ascertain your bone mass and to reverse the effects.

- Check with your doctor and ask for blood work to check your calcium and vitamin D levels and ask how much you should take given your medical history.
- Ask for a bone mineral density (BMD) test to learn the density of the hip bones and spine. If you haven't already, start a weight-lifting regimen at least twice a week, particularly for the back, abdomen, and upper body.
- Limit alcohol intake to no more than two drinks a day and limit your coffee or tea intake to three 8-ounce (237 ml) cups a day. (Limit those grandes!)
- Check your diet to be sure you're eating enough calories.
- Eat at least .8 grams of protein per 2.2 pounds (1 kg) of body weight daily.
- Maintain a healthy body weight at a body mass index of 18.5 to 24.9.
- If you smoke (I don't know a masters woman runner who does), give it up.

**Menopause**

Mention menopause and women roll their eyes. (How many 45- to 55-year-old women have nothing to say about menopause?) They visualize night-and-day sweats, moods fluctuating because of hormones, sleepless nights, weight gain, and bloating. Menopause is at the least a nuisance for most female masters runners. The new bloating around their waistlines is irritating. Despite training and eating well, they wonder where that tire came from. (Some say trying to maintain their premenopausal weight feels like they're fighting World War III). Even elite masters female runners may put on two to five pounds (1 to 2.3 kg) that often disappear by the late-50s.

The good news is that most masters female runners don't think menopause negatively affects their running times (which were slowing with age, anyway). In fact, the average age of the 103 female runners in my doctoral study was 52, and only 10 percent felt that menopause was an obstacle to competition (Utzschneider 2002). Most all masters runners feel that running helps alleviate the symptoms of menopause. It helps them control their weight and, even more important, it helps them sleep and regulate their moods.

**Female Endurance Advantage**

With the long-term physiological challenges women face—childbirth being the ultimate one—it's no wonder women are particularly strong in events requiring perseverance and patience. Given their smaller size relative to men, they're unusually strong in ultrarunning, distances longer than the marathon. Women are quickly becoming the fastest-growing segment of endurance athletes, and they do well against men in these races. Consider the 2010 Hardrock 100 Endurance Run in Silverton, Colorado, where 39-year-old Diana Finkel finished second overall in the 100-mile (160 km) race. Or the 2010 Vermont 100 Endurance Run where Kami Semick placed third overall, just 41 minutes behind the overall winner (whose winning time was 16:01:40). By contrast, how many marathons see women finish second or third overall?

The reasons that women have advantages when running ultradistances are not clearly understood. Perhaps one is that ultracourses often include considerable downhill sections, which are less demanding on smaller bodies than on larger bodies. Or perhaps women's greater fat stores give them a competitive edge. Increased body fat may be a fueling asset. We know that after about 18 miles (29 km) of running, the body begins to get low on glycogen and hits the wall, turning increasingly to other energy stores to continue. Could women be more efficient at using that body fat early in a race and saving the glycogen for the long haul? Whatever the advantage, consider it.

# Maximizing 800m Training

*If you're not getting desired results with traditional training, try a fundamentally different approach. Sinnott and Rizzo did and the results speak for themselves. Sinnott is now the freshman distance coach at North Central College.*

## BACKGROUND

Non-sprint running events at the high school level typically include the 800, 1600, 3200. At West Aurora High School, we have chosen to maximize our training time towards the 800 and 1600 meter events for their collective impact to the team's performance and we have experimented with different workouts and training models with increasing levels of success.

Our biggest goals were to be able to develop distance athletes who would be able to be competitive at the invitationals on our schedule and ultimately develop state qualifiers and/or medalists. For the open 800m, 1600m, and the 4x800 relay in the Aurora area, 2:02, 4:45, and 8:15 or better, respectively, could be considered competitive times that would score points at most invitationals, so this was our first target.

Ten years prior to this writing, West Aurora High School did not have a single sub-2:02 runner in the 800, with the closest having been around 2:05. Within five years of what was thought to be "traditional training" for the 800m, the program had yielded only two sub-2:02 athletes. In the next five years, however, we have experimented with non-traditional indoor microcycles and race simulation workouts in an attempt to cater to the strengths of our athletes and reach a higher level of competition.

These experiments have produced significant results for our distance program, and ultimately, our track team as a whole. In fact, what was once our biggest deficiency in scoring at track meets had very recently become one of our most consistent strengths. As shown in Table 1 below, from 2009-2013 we have produced 10 sub-2:00 800m runners, four consecutive state qualifications in the 4x800, two individual state qualifiers in the 800m and 1600m, and nearly every school record in the distance open and relay events for both indoors and outdoors has been broken.

## TEN YEARS AND TWO GROUPS

The control group in our study has been the group of middle distance runners who have come through West Aurora from 2004-2008. These athletes had followed a generally "traditional model" of 800m training with emphases on aerobic development through moderate pace distance running and goal-race-pace interval training. We utilized a standard 7-day microcycle and alternated hard and easy days while racing nearly every weekend.

Interval workouts were usually 3-4 sets of 3-4 intervals of 300's, 400's, or a combination of the two. The rationale was always to keep the workout 3-4 times the race distance in the pre-competition phase while decreasing in volume and increasing intensity as the season progressed. Over the time of the season, the athletes would complete the workouts with greater consistency in splits while getting faster. However, from

*By Matt Sinnott & Tony Rizzo, West Aurora H.S., IL*

**Table 1: Comparative View – By the Numbers**

| | Control Group 2004-2008 | Experimental Group 2009-2013 | *Continued Success (2014 –present)*** |
|---|---|---|---|
| WAHS School Record – 800m | 1:57.04 (set in 1977) | Lowered to 1:56.68 in 2010 | *Lowered to 1:55.02 in 2014* |
| WAHS School Record – 1600m | 4:19.24 (set in 1979) | 4:21, 4:22, 4:24, 4:25 – closest attempts by 4 different athletes | *4:21, 4:22, 4:22, 4:24 – closest attempts by 4 different athletes* |
| WAHS School Record – 4x800 Relay | 7:58.50 (set in 1993) | Lowered to 7:50.73 in 2011 | *No change* |
| Number of sub-2:02 800m Athletes | 2 | 12 | *14* |
| Number of sub-4:45 1600m Athletes | 3 | 17 | *18* |
| Number of sub-8:15 4x800 Relays | 2 | 18 | *18* |
| Fastest 4x800 Relay & Splits | 8:11 – (2:02, 2:00, 2:04, 2:05) | 7:50 – (1:59, 1:56, 1:56, 1:57) | *No change* |
| State Qualifiers | 0 | 2 individuals (800, 1600) 4 relays (4x800) | *3 in 800m, 1 in 1600m, 4 relays (4x800)* |

*** To illustrate more continued success, in June of 2014, West Aurora's very own Connor McCue won the USATF Youth Outdoor Championship 1500m (age 17-18) in a time of 4:04.95 as a sophomore.*

year-to-year, we were not making much progress towards the goals of invitational scoring or state qualifying standards.

The experimental group in our study (2009-2013) has been the athletes who were a part of the change in approach. These athletes have been following a non-traditional 12-day microcycle throughout the indoor season and the interval/repetition days have been focusing on race-specific modes of pacing and training. Our goals were to try some things "out-of-the-box" while paying more attention to the Law of Specificity as it pertains to race performance.

## 12-DAY MICROCYCLE

For the indoor season, our distance program has embraced a 12-day microcycle as opposed the traditional 7-day. We keep this 12-day pattern from January until around spring break when the outdoor season begins. Our rationale has been that we can maximize recovery, hard workouts, and long runs easier within 12 days, as opposed to seven. It enables athletes to train through the winter months in an extended 8-week pre-competition phase, as opposed to the typical 3-4 weeks, where indoor meets are used as reference points for the training.

Much like the shift in workout philosophy, we wanted a "think-outside-the-box" approach to the training. The old method simply was not working for us, so we needed to implement something fresh. There was some literature on Billy Mills having done a 10-day cycle, and we used that as our platform to experiment from (Applegate).

When the two training cycles are put side by side (see Table 2), it is apparent that we have been able to get in more aerobic and lactate tolerance conditioning than before. In a 14-day span with the traditional cycle, there would be, on average, only four interval workouts.

**Table 2: Microcycle Comparison**

| 2-weeks | Traditional 7-Day | Experimental 12-Day |
|---|---|---|
| Day 1 | Intervals | Intervals |
| Day 2 | Medium Recovery | Long Run |
| Day 3 | Intervals | Short Recovery |
| Day 4 | Long Run | Intervals |
| Day 5 | Short Recovery | Medium Maintenance Run |
| Day 6 | Med. Maintenance Run | Short Recovery |
| Day 7 | Rest or Short Run | Intervals |
| Day 8 | Intervals | Long Run |
| Day 9 | Medium Recovery | Short Recovery |
| Day 10 | Intervals | Intervals |
| Day 11 | Long Run | Rest: Flexibility/Cross Train** |
| Day 12 | Short Recovery | Rest: Flexibility/Cross Train** |
| Day 13 | Med. Maintenance Run | Repeat Day 1 - Intervals |
| Day 14 | Rest or Short Run | Repeat Day 2 – Long Run |

** Cross Training has been at the athlete's discretion, but we have encouraged swimming, biking, yoga, and also complete rest while discouraging things like basketball and flag football.

**Table 3: Control Group: Typical Workout Samples**

| Workout A | Workout B | Workout C |
|---|---|---|
| Warm up<br>4x200m (*45sec rest*) / Target: 30sec<br>2 min recovery<br>4x200m (*45sec rest*) / Target: 30sec<br>2 min recovery<br>4x200m (*45sec rest*) / Target: 30sec<br>Cool down | Warm up<br>3x300m (*60sec rest*) / Target: 45sec<br>2:30 recovery<br>3x300m (*60sec rest*) / Target: 45sec<br>2:30 recovery<br>3x300m (*60sec rest*) / Target: 45sec<br>Cool down | Warm up<br>200-300-300 (*60sec rest*)<br>2:30 recovery<br>300-200-300 (*60sec rest)*<br>2:30 recovery<br>300-300-200 (*60sec rest*)<br>Cool down |
| Total Distance = 2400m<br>Rationale: 3x race distance, 30sec muscle memory for 200m | Total Distance = 2700m<br>Rationale: 3x race distance, maintain race pace for longer than 200m | Total Distance = 2400m<br>Rationale: 3x race distance, surge in the 200m rep. |

In the same 14-day span with our new cycle, we have been able to incorporate our recovery time differently to allow for a fifth without overtraining or overstressing the athlete. Consequently, we have also been able to increase the number of long runs from two to three in those same 14 days. This means that aerobic training is not being compromised from the increase in anaerobic or special endurance training.

The biggest challenge for us, at first, was to build trust in the athletes to do, on their own in most cases, whatever was on the prescribed calendar over the weekend. Because our official practice times never included Sundays, this new cycle meant that we tasked our athletes to either do a run on their own or to organize one amongst themselves. For the motivated runners, this was not a concern, but at the high school level, there are varying degrees of engagement towards the training. In time, however, we found that this approach initiated more dialogue between the coach and athlete, fostered more trust between the two, and promoted more autonomy within the athlete than we had previously seen before the change was made.

## WORKOUTS

During interval workout days for the control group, the workouts typically consisted of repeat 200's and/or 300's. The long-term goal was to work up to the desired race pace as it was broken up in workouts. For example, a goal of 2:00 for 800m would be split into four 30-second 200m chunks. Workouts would be designed for the athlete to be consistent at 30-seconds through as many intervals as possible.

Over the course of time, the number of consistent intervals increased; however, the desired effect was not transferring into a race performance. Many of our athletes could make it to 600m in a race at 1:30 but didn't have that final push to hold it or negative split for the last 200m. With no progress being made in this approach, we needed to try something different. It should be noted that initial target times were determined by current race ability and no active rest was utilized between reps or sets.

For the experimental group, interval workouts became much more specific to what an 800m race would actually be like. While the specifics of the workouts would change from workout to workout, there were several core concepts emphasized in every one.

First, each workout would begin with a set of short rest 200's to calibrate pace. Each group of runners (grouped by ability) had their own target times to hit, but the calibration allowed them to dial into that pace and know what it would feel like on that day to go slower or faster.

For example, the group shown in Table 4 below was our top group of 10 runners of similar ability along with their target times. If done properly, all of their efforts after those first 200's were just a matter of making slight changes to either speed or distance to what was done at the beginning of the workout.

Secondly, we incorporated active rest in order to maximize the aerobic benefits in between hard efforts. Maintaining a jogging effort in between sets and reps was the expectation, however there was no specific jogging pace recommended. Subjectively, it was noted to be a slower jog near the beginning of the season, and with greater fitness near the end, the pace was more rapid.

Thirdly, each interval workout consisted of at least two major sets of efforts. The first set was typically a bit longer in overall distance and/or contained the longest interval effort. The second set or additional sets thereafter would then contain faster intervals. All sets were separated by four minutes of active recovery running.

Finally, each workout would end with a short set of full rest 60's, or about 8-9 second bursts, to incorporate speed into each workout. Mentally, it reminded them at the end of an 800m race, there would always still be that final kick. Physically, the single set of 3x60's never taxed anybody for any length of

**Table 4: Experimental Group: Sample Workouts**

| **Workout A – Early February**<br>**Transition to Interval Training** | **Workout B – Early March**<br>**Indoor Conference Tune-up** | **Workout C – Early April**<br>**Transition to Outdoor Racing** |
|---|---|---|
| Warm up<br>3x200 @ 32sec (*45sec rest*)<br>2min AR*<br>500m (go through 400m @ 64sec)<br>2min AR<br>300m (go through 200m @ 32sec)<br>2min AR<br>300m (go through 200m @ 31sec)<br>2min AR<br>200m (@ 31sec)<br>1min AR<br>200m (@ 30sec)<br>***4min Set Break – AR***<br>200m (@ 30sec)<br>1min AR<br>400m (@ 62sec)<br>1min AR<br>200m (@ 30sec)<br>1min AR<br>300m (go through 200m @ 30sec)<br>1min AR<br>400m (@ 62sec)<br>***4min Set Break – AR***<br>3x60m FAST (8-9sec bursts, full rest)<br>Cool down<br><br>* *AR = Active Rest* | Warm up<br>3x200 @ 31sec (*45sec rest*)<br>75sec AR<br>300m (go through 200m @ 28sec)<br>75sec AR<br>250m (go through 200m @ 29sec)<br>75sec AR<br>250m (go through 200m @ 27sec)<br>75sec AR<br>200m (@ 30sec)<br>***4min Set Break – AR***<br>200m (@ 30sec)<br>60sec AR<br>250m (go through 200m @ 28sec)<br>60sec AR<br>250m (go through 200m @ 28sec)<br>60sec AR<br>300m (go through 200m @ 27sec)<br>***4min Set Break – AR***<br>3x60m FAST (8-9sec bursts, full rest)<br>Cool down | Warm up<br>3x200 @ 30sec (*45sec rest*)<br>75sec AR<br>300m (go through 200m @ 29sec)<br>75sec AR<br>200m (@ 28sec)<br>75sec AR<br>100m (@ 14sec)<br>***4min Set Break – AR***<br>300m (go through 200m @ 29sec)<br>75sec AR<br>200m (@ 28sec)<br>75sec AR<br>100m (@ 14sec)<br>***4min Set Break – AR***<br>300m (go through 200m @ 29sec)<br>75sec AR<br>200m (@ 28sec)<br>75sec AR<br>100m (@ 14sec)<br>***4min Set Break – AR***<br>3x60m FAST (8-9sec bursts, full rest)<br>Cool down |
| Total Distance = 3780m | Total Distance = 2780m | Total Distance = 3480m |
| Rationale: longer recovery between sets to compensate for higher volume | Rationale: slight decrease in volume to tune up for indoor championship meets | Rationale: target times are beginning to get faster as volume begin to decrease. |

time across any fitness level, so we continued to utilize it throughout the entire season.

Keeping with our belief that no 800m race is identical, we rarely repeated the same workout. In fact, our style of pace changing and non-predictable nature of the workout specifics was actually popular with the Hungarian coach Mihaly Igloi whose intensive but effective use of interval training was controversial in the late 1960's (Karp 64-69).

While his methods utilized relativistic terms for each athlete such as 'fresh,' 'good,' and 'hard,' we have chosen to quantify those paces and provide target times. Also, contrary to Igloi, we have chosen to incorporate interval training as one of many tools in the toolbox rather than using it as the primary method of training.

Nevertheless, it was in hindsight that we noticed that our connection and perhaps subconscious influence from Igloi's methods lay in co-author Tony Rizzo's training experiences under mid-distance runner and 3-time Olympian Jim Spivey. A "coaching-family-tree-of-sorts" traces back to Igloi.

## SUMMARY AND RECOMMENDATIONS

We have enjoyed the process in making these big changes in our mid-distance program at the high school level. For us as coaches, it has been exciting to take a chance and try something fresh. Once we started achieving some of our goals along the way, it was certainly easier for the next year's group to trust in what *we were doing* and believe in what *they were doing.* The athletes became as excited as we were to take these risks too.

Scientifically, it should be noted that there were of course two major factors that could have had some influence over our results. First, we had no control over which athletes entered our program. Without a strong feeder program, we have been used to "growing our own" once they come in as freshmen.

It could very well be that in the last five years, we were just working with a group of more talented runners than in the first five years. Secondly, it could also be that it took the first five years to establish the running culture in the school whereas before, there wasn't much presence. Our distance squad of around 15 athletes in 2004 turned into a consistent 45+ as the culture grew and became more successful. We do believe that any strong running culture, along with traditions of success, will ultimately lead to greater and more consistent success for any program.

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# FROM THE EDITOR

*Continued from page 6654*

The list of profiled runners included upcoming high schoolers right through to Olympic champions. For those with the greatest accomplishments, world records or Olympic medals, Wilt expanded their profiles to include training philosophy, personal interests and life-shaping events that contributed to their greatness.

*How They Train* was a concise history of distance running of the early modern era presented as a mosaic. Paavo Nurmi, Gunder Hägg, Vladimir Kuts, Sándor Iharos, John Landy and Emil Zátopek all got paper. American profiles included Bill Dellinger, Hal Higdon, Wes Santee, Glenn Cunningham, Tom Courtney and Horace Ashenfelter. Wilt also profiled Lou Zamperini.

With Zamperini there was mention of being a 19-year-old Olympian, meeting Hitler, the Pacific plane crash, 47 days adrift in a life raft, the POW torture, starvation and his survival. His autobiography, *Devil At My Heels*, details how he lived to tell the tale. And he did live through it all—national hero, Hollywood celebrity, disciple of evangelist Billy Graham and a guiding light for troubled youth.

I met Lou Zamperini one night about 10 years ago at the Armory. He was in the lobby signing copies of *Devil At My Heels.* He was in his 80's, sharp as a tack and I drew a big smile from him when I told him I read about him in *How They Train.*

I mentioned *Track Coach* and told him I knew Fred Wilt figuring they must have crossed paths in their athletic careers. Zamperini was NCAA mile champion in 1938 and 1939. Wilt was NCAA two-mile champion in 1941.

He gave me a smile I couldn't quite read. Whether it was, "I used to beat that guy like a drum," or "Why is this guy telling me this?" I couldn't say. Anyway, I bought a book, he signed it and I got back to work.

In 2010 author Laura Hillenbrand (of *Seabiscuit* fame) re-did Lou's story and produced a *New York Times* bestseller, *Unbroken*. Hollywood and director Angelina Jolie are making the movie. Lou Zamperini's life may have ended this past July but now he will live on as a celluloid hero. How American.

This issue marks the last printed edition of *Track Technique/Track Coach*, the end of an era. After 54 years, 209 issues and some 6700 pages the journal makes the transition to digital. I fully expect to continue with the same standards and quality as we make the transition from one era to the next. I have had some good role models on how to do that.

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# Predictors Of Personal Best Performance In The Glide And Spin Shot Put For U.S. Collegiate Throwers

*According to this study power clean strength is more predictive of eventual competitive results in the shot put than back squat or bench press bests. This article first appeared in the* International Journal of Performance Analyss *in Sept. 2012.*


## ABSTRACT

The preseason one repetition maximums (1RM) for the bench press, back squat and power clean were collected from the coach of each 53 collegiate or elite athletes together with and the subsequent personal best effort in the glide or spin shot put during the competitive season. The data was analyzed first via partial correlations (controlled for gender) and secondly through ratio of 1RM strength to distance thrown between the glide and rotational style athletes. Partial correlations controlled for gender revealed that preseason bench press ($r=0.767$, $p<0.001$), back squat ($r=0.771$, $p<0.001$) and power clean ($r=0.868$, $p<0.001$) were all significantly related to best mark achieved with the shot put during the competitive season. Independent t-test revealed for the male participants the ratio of bench press strength to personal best in the shot put was significantly ($t=2.132$, $p = 0.044$) higher in the glide throwers (11.03kg per meter ± 1.2) versus the rotational shot putters (9.98kg per meter ± 1.2). A similar significant difference ($t=3.166$, $p=0.004$) was between the glide (6.62kg per meter ±0.63) and rotational (5.69kg per meter±0.87) among the female participants. Based upon these results higher levels of bench press strength may be required for athletes using the glide technique.


## INTRODUCTION

The science of throwing provides a factual basis for coaching strategy; successful shot put coaches become students of the event. Considerable research has been conducted on the task of shot


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putting (see reviews in Judge & Young, 2011; Lanka, 2000; Zatsiorsky et al., 1973; Young, 2009). Research conducted on the shot put has been both qualitative and quantitative in nature. Most of the research that has been conducted on the event has used male participants employing the glide technique (Judge & Young, 2011). This is likely due to the fact that the spin has only recently become commonly used in the past two decades and also due to the simplicity in analyzing the more linear movement of the glide as opposed to the spin. Men have generally been used as the participants in studies largely because until recently more funding has been available to sponsor research on men's athletics than women's (Judge & Young, 2011). The applicability of research conducted on one gender to another remains to be seen; however, there is some evidence (Alexander et al., 1996) to suggest that male and female athletes may perform the task quite differently.

## STRENGTH

One of the physical parameters, which determine the power production of a muscle group (or the total body), is muscular strength, but the relationship between strength and shot put performance has not been thoroughly examined. Several studies (Alexander et al., 1996; Bartonietz, 1996a; Hubbard et al., 2001; Linthorne, 2001; Young, 2009) have speculated on important parameters related to shot put performance. Shot putting places a premium on being able to create very large forces over a relatively short period of time. Strength is the ability to produce force (Judge, 2007; Siff, 2000; Stone et al., 2002) and, as might be expected, several prominent experts have noted its importance to shot putting (Bakarinov & Oserov, 1985; Bartonietz, 1994c; Judge, 2008; Marks, 1985; Poprawski, 1988; Tschiene, 1973a).

Numerous researchers support the value of maximum strength to shot put performance (Egger et al., 1994; Kokkonen et al., 1988; Stone et al., 2003b; Terzis et al., 2003; Uppal & Ray, 1986). For instance, one intervention study found that shot put performance is improved by strengthening the flexor muscles of the toes and fingers (Kokkonen et al., 1988). Uppal and Ray (1986) reported similar findings on the importance of hand and arm strength to shot put performance.

Why is strength so important in the shot put? Stronger athletes are able to hold the positions necessary to master technique (Judge, 2008). Optimal shot put technique is a set of muscle contractions and relaxations coordinated and synchronized to produce maximum acceleration of the implement (Judge, 2007; Sale, 2002; Schmidt, 1975). Weight room 1 repetition maximums (1RM) have been shown to relate to performance in the throwing events (Judge et al., 2011; Judge et al., 2010; Reis and Ferreira,

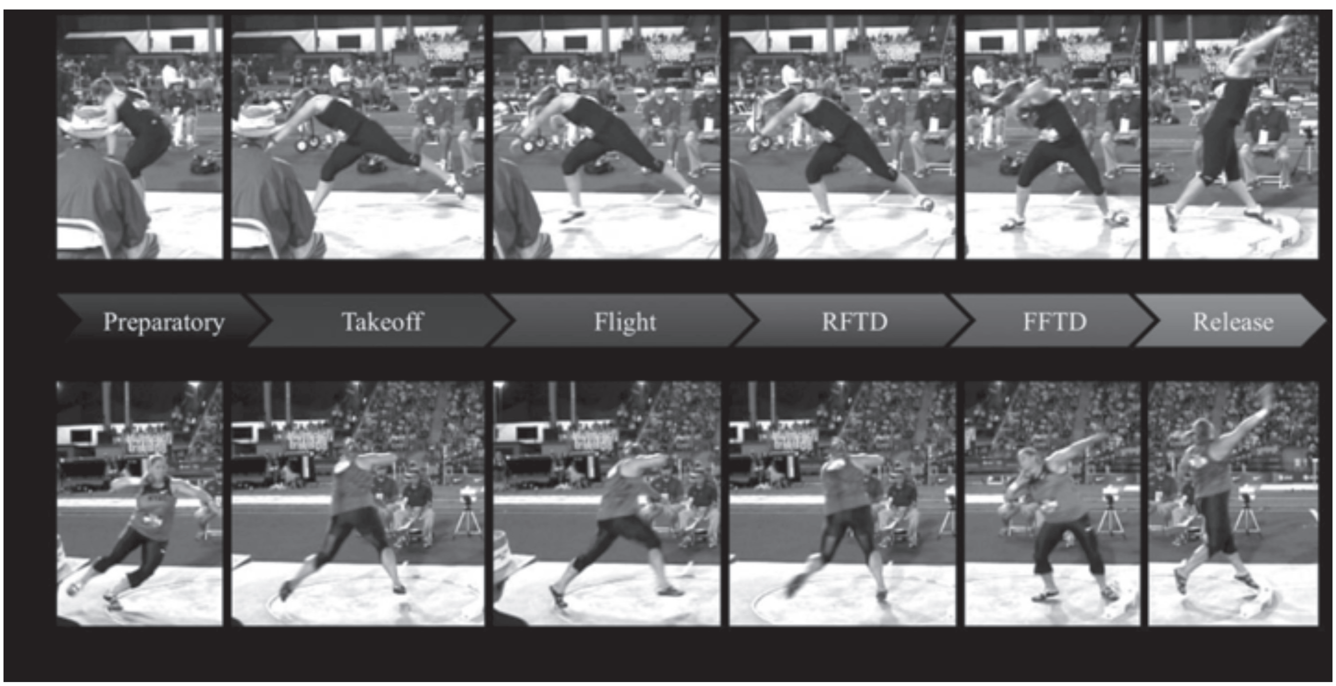



**Figure 1: Example of athletes executing the glide technique (Top—Elizabeth Wanless) and rotational technique (Bottom—Jill Camarena-Williams) at the 2008 Olympic Trials (Photos by Mike Young).**

2003). However, the shot put event (see Figure 1) involves the use of a much lighter load (4 kg for women, 7.26 kg for men) than those used frequently during weight training sessions.

## POWER

Power is the mechanical quantity that expresses the rate of performing work (Enoka, 1994) and is largely dependent upon peak force production (i.e., maximum strength) (Schmidtbleicher, 1992; Stone et al., 2003a; Stone et al., 2003b). Although the value of strength to shot putting appears undisputable, several authors have recommended that explosive power is actually a more important physical characteristic (Bakarinov & Oserov, 1985; Bartonietz, 1994b; 1996b; Billeter et al., 2003; Jesse, 1964; Jones, 1998; Marks, 1985).

Numerous studies and review articles have reported evidence and logical arguments for the use of explosive exercises for throwers (Bondarchuk, 1994; Judge, 2007; Judge, 2008; Stone et al., 2003b). Olympic-style lifts (Clean, Jerk, and Snatch) and their derivatives (Pulls and Shrugs) are the core of the resistance training program. A study by Poprawski (1989) provided support for this notion. This study examined ten elite shot putters and found that shot put performance is more closely related to tests of speed and power than maximum strength. Other studies have also linked explosive leg strength to shot put performance (Terzis et al., 2003; Tschiene, 1988; Uppal & Ray, 1986).

## STRENGTH-POWER RELATIONSHIP

From a practical standpoint, the previous section begs the question of whether shot put training should be more focused towards the development of maximal strength or maximal power output. This question, however, may be addressed by understanding the relationship between maximal strength and power output. Power is the product of force and velocity and as a result, changes in force produce changes in power output.

But it should be noted that increases in force are generally offset by decreases in velocity such that maximum power is generally achieved while utilizing around 30% of an individual's maximum strength. Schmidtbleicher (1992) suggested that maximum strength is the primary influencing factor on power output. Consequently, maximum strength could potentially affect peak power because a given load would represent a smaller percentage of the athlete's maximum, thus making the load easier to accelerate.

It is possible that a person with a higher maximum strength level would have a greater percentage or greater cross-sectional area of type II fibers, which strongly contribute to high power outputs.

Results from a study by Stone and colleagues (2003b) confirmed the relationship between maximum strength and power and also provided insight to their effect on shot put performance. This study examined the relationship between strength and power indicators for 11 well-trained collegiate shot putters and found that maximum strength was strongly associated with peak power output, even with lighter loads such as the shot.

Another study by Reis and Ferreira (2003) evaluated the validity of several strength and power tests to predict performance in the shot put. The study provided mixed results as some tests of power (such as a variety of jumping tests) did not correlate with performance where throwing tests (power) and weight lifting tests (strength) showed a significant association with performance.

## GLIDE VS. SPIN TECHNIQUE

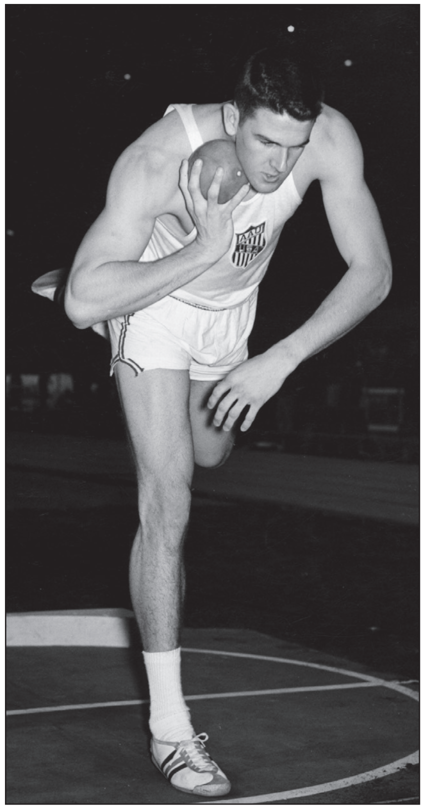
The shot put event in track and field has an interesting history with significant changes to technique being made throughout the years. In 1951, American shot putter Parry O'Brien refined the sidestep technique to one that is now known as the glide. American men dominated the shot put event in the 1960's and 1970's setting many world records with the glide technique culminating with the gold medal in the 1992 Olympics by Mike Stulce. Since the early 1980's, the rotational technique, also called the spin technique, has been gaining popularity among coaches involved in all levels of track and field (Judge and Young, 2011; Rasmussen, 1998). In the mid-1990's, many American coaches abandoned recommending and teaching the glide for the spin technique (Judge & Young, 2011). This change may have occurred because the glide may be less efficient mechanically (Judge & Young, 2011).

At the 1992 NCAA Division I outdoor nationals, 15 of the 18 qualifiers, including five of the top six placers in the men's shot put, used the spin technique (Judge & Young, 2011). This trend has continued into the 21st century in the United States in the men's shot put as all three members of the last three Olympic teams utilized the spin technique. Despite this fact, the spin has not caught on quite as quickly for the women (Judge & Young, 2011). All eight finalists in every modern Olympic Games in the women's shot put utilized the glide. This trend may change, however, with Jill Camerena's (USA) recent bronze medal finish using the spin technique in the 2011 World Championships.

In the glide shot put technique (Figure 1), progression across the circle is dominated by linear motion with some rotation occurring during the delivery phase (Bosen, 1985). In contrast, movement across the ring in the spin (Figure 1) technique is primarily rotational in nature and linear force application is not a dominating factor other than in the final moments of the throw (Bosen, 1985).

Besides this obvious difference others have observed several important differences. For example, the total time to complete the throw is considerably longer in the spin (McCoy et al., 1984b) and temporal parameters throughout the course of the throw are considerably different (Young & Li, 2005).

Despite these differences however, neither technique has a clear edge in performance. There seems to be a consensus that the glide technique is better suited to athletes who are especially strong and massive (Bosen, 1985; Egger et al., 1994; Oesterreich et al., 1997). No such consensus exists in regard to the spin. In fact, despite Booth's (1985) suggestion that taller athletes have an advantage regardless of the technique used, both he and others (Egger et al., 1994) have conceded that if a smaller, weaker athlete has the necessary qualities, the spin technique may allow him/her to compete at a higher level than the glide would otherwise permit. It would appear that both the techniques require distinct physical characteristics and different skills. The question is does the training emphasis differ for athletes utilizing spin technique versus the glide technique?



**American male shot putters dominated in the 60's and 70's. Shown is Randy Matson, 1968 Olympic Champion.**

Statistical analysis of the training variables for throwing events can serve as a road map to success: the research not only identifies but demonstrates the importance of key physical and technical variables athletes need to display to throw benchmark distances. Having discussed numerous considerations for improvement in the shot put, we believe it is vital that coaches prioritize training stimuli.

When considering the variables that make up the training program (i.e. training load, training volume, exercise selection, and training frequency) the distribution of each variable in the plan could depend upon the athlete's training age, his or her strengths and weaknesses, the phase of the training year, as well as many other factors including the type of technique (glide vs. spin) utilized (Hori et al., 2009). For a shot putter, there must be a balance between the training loads and the restorative and prophylactic measures (Judge, 2007).

In order for coaches to properly emphasize the key components to training a shot putter, it is also imperative that the coaches understand which variables are most essential to glide and spin shot put success. *The purpose of this study was to investigate which components of normal weight training for a shot put athlete were most associated with performance.*

## METHODS

**Table 1: Participant Characteristics (Mean ± *SD*)**

| Variable | Male (n=24) | Female (n= 29) |
|---|---|---|
| Age | 20.4±1.1yrs | 20.2±1.6yrs |
| Height | 1.87±0.06m | 1.76±0.08m |
| Weight | 123.2±10.8kg | 95.5±16.3kg |
| Bench Press 1RM | 177.0±34.1kg | 97.0±22.2kg |
| Squat 1RM | 255.2±49.2kg | 153.9±40.8kg |
| Power Clean 1RM | 139.2±22.6kg | 96.1±25.2kg |
| Shot Put SB | 16.93±2.45m | 15.24 ±2.84m |

## PARTICIPANTS

The present investigation was approved for human participants by the local university institutional review board. Participants for the present investigation were selected based upon participation as a shot putter on a collegiate track and field team. Participants were also chosen based upon their coach being either a Level III coaching certified coach, or had earned the distinction as a Master Coach by USA Track & Field. This criterion was included in order to limit, in some fashion, the differences in technical instruction received by the athletes. All 53 participants gave consent and were selected to be part of the present investigation.

## DATA COLLECTION

After giving consent, the coach of each athlete was asked to report via a datasheet the age, height and weight for each athlete, the technique (Figure 1) the athlete utilized (glide or rotational), as well as their season's best in the shot put event and weight room 1RM for the bench press, power clean and squat exercises (Table 1). In total, the datasheet consisted of eight items inclusive of a participant identification number. Following the coaches report, the data for each athlete was entered into a spreadsheet program and the data report sheets were destroyed in order to maintain athlete confidentiality.

## STATISTICAL ANALYSIS

Variables of interest were based upon previous work (Judge et al., 2010; Judge et al. 2011) which demonstrated relationships between the squat and power clean and track & field throwing event and also included known differences by gender. In addition to these variables, the bench press was included based upon the delivery phase in the shot put requiring the use of the muscle of the shoulder girdle and elbow extensors.

Variables of interest were analyses for relationships with season's best performance via partial correlations (controlled for gender). Subsequently, semi partial correlations were used to assess the strength of the relationships among the 1RM assessments and the season's best throw.

Strength differences were also examined between techniques (glide vs. rotational, Figure 1) for each gender to assess if differences in strength levels were associated with performance. A modern statistical software package was used to perform the analysis (SPSS ver 17.0) and statistical significance was set a priori at alpha<0.05.

## RESULTS

Partial correlations controlled for gender revealed that preseason bench press (r=0.767, p<0.001, Figure 2), back squat (r=0.771, p<0.001, Figure 3) and power clean (r=0.868, p<0.001, Figure 4) were all significantly related to best mark achieved with the competition shot put during the competitive season. Semi-partial correlations (generated via multiple regression analysis with gender as a dependent variable) revealed that only the power clean (r=0.357, p=0.001) was significant. The back squat (r=0.118, p=0.067) and bench press (r=0.071, p=0.266) failed to achieve the criteria for significance for relationship with season best shot put performance when examined with the covariance of the other lifts and gender accounted for.

Strength differences were also examined between techniques (glide vs. rotational) for each gender to assess if differences in strength levels were associated with performance. In order to assess this relationship, a ratio score was calculated (kilo-

**Table 2: Ratio of Kilograms Lifted to Personal Best in Shot Put by Technique and Gender**

| Gender | Technique | Lift | Ratio kg/meters Mean±SD |
|---|---|---|---|
| Male | Glide | Bench Press | 11.03±1.19* |
| | | Back Squat | 15.29±2.53 |
| | | Power Clean | 8.26±0.69 |
| | Rotational | Bench Press | 9.98±1.21 |
| | | Back Squat | 14.86±1.41 |
| | | Power Clean | 8.24±0.93 |
| Female | Glide | Bench Press | 6.62±0.63* |
| | | Back Squat | 10.21±1.51 |
| | | Power Clean | 6.29±0.76 |
| | Rotational | Bench Press | 5.69±0.87 |
| | | Back Squat | 9.50±1.95 |
| | | Power Clean | 5.88±0.96 |

*Ratio of Kilograms lifted during 1RM assessment of the Bench Press, Back Squat and Power Clean exercises to the Personal Best effort in the shot put in meters. (*) indicates statistically different than the ratio for the Rotational technique (p<0.05)* grams lifted/meter distance) for each of the three lifts and compared subsequently between techniques by gender (see Table 2). Independent T-test revealed for the male participants the ratio of bench press strength to personal best in the shot put was significantly (t=2.132, p = 0.044) higher in the glide throwers (11.03kg per meter ± 1.2) versus the rotational shot putters (9.98kg per meter ± 1.2). A similar significant difference (t=3.166, p=0.004) was between the glide (6.62kg per meter ±0.63) and rotational (5.69kg per meter±0.87) among the female participants.

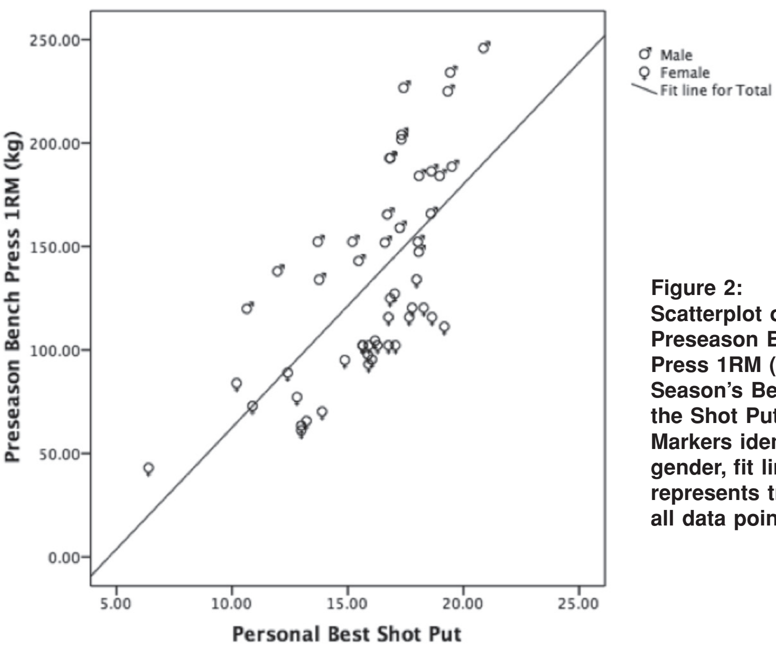



**Figure 2: Scatterplot of Preseason Bench Press 1RM (kg) to Season's Best in the Shot Put (m). Markers identify gender, fit line represents trend for all data points.**

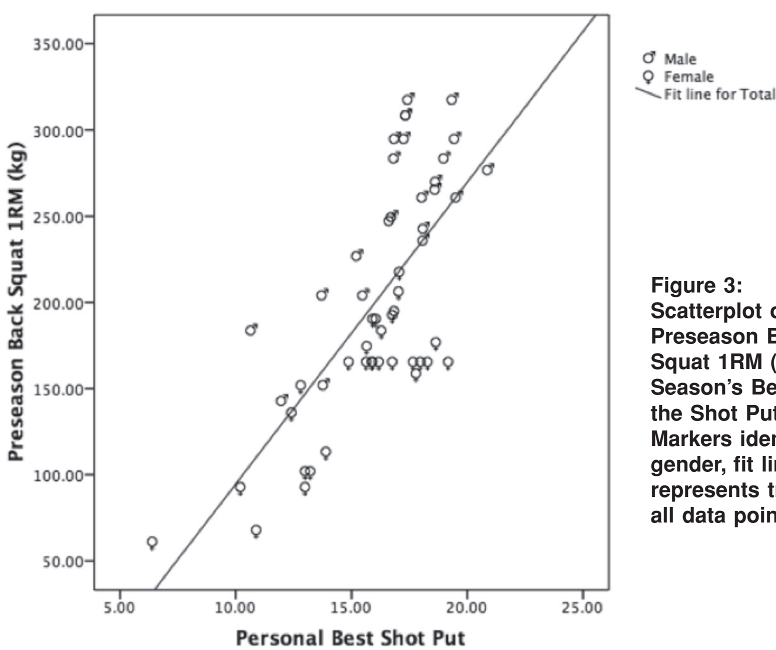



**Figure 3: Scatterplot of Preseason Back Squat 1RM (kg) to Season's Best in the Shot Put (m). Markers identify gender, fit line represents trend for all data points.**

## DISCUSSION

In the current study, it should be noted that the average season's best performance among the male and female participants would have qualified for the preliminary rounds of the NCAA Division 1 outdoor track & field championships this past season, and among the group there were a number of NCAA outdoor national participants and event champions. The group of shot putters examined, therefore, was composed in general of very highly skilled athletes. Further criteria included that the coach of the athletes had to either possess a USATF Level III or Master Coach distinction; this further attests to the likelihood that these athletes had well-developed and consistent technique, making for a good sample from which to draw conclusions about the relationships of preseason strength to competitive season performance. The preseason strength numbers were chosen for comparison because during the competitive season the vast majority of coaches of the shot put switch focus towards the development of event specific strength and technique and are no longer devoting as much practice time to the development of absolute strength. This study does demonstrate that in order to attain a level of performance necessary to be included among the best of collegiate athletes, high strength levels are a necessity. The mean kilograms lifted for all three lifts for both male and female athletes was very high and in all cases well above the body weight of the athletes, which is impressive given the mass of the athletes in question.

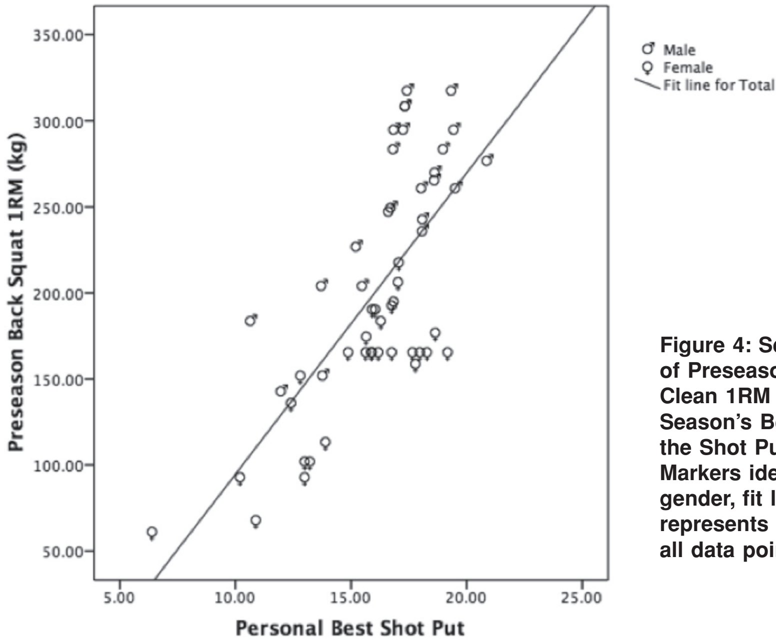



**Figure 4: Scatterplot of Preseason Power Clean 1RM (kg) to Season's Best in the Shot Put (m). Markers identify gender, fit line represents trend for all data points.**

## THE IMPORTANCE OF STRENGTH

Though it has long been known that strength is a necessary component of the performance in track & field throwing events (Anton and Ivan, 2009; Judge et al., 2010; Kyriazis et al., 2009; Ojanen et al., 2007; Terzis et al., 2003) including the shot put (which the results of the present investigation serve as a further testament to), it is not well understood what the relationships of the individual lifts are to competitive season performance.

In discussions with college coaches one can find that there is a lack of consistent thought about which of the three lifts—the bench press, back squat or power clean—is the most important for the shot put event. Most sources of training information for coaches suggest that all three lifts need to be covered within a training plan for a shot put athlete (Silvester, 2003; Judge, 2007; Judge, 2008; Judge and Young, 2011).

Based upon the results of the present investigation it is apparent that the power clean is more related to event performance than the bench press or back squat lifts. This is not to say that the bench press is not related, but simply that when examined as a trio, the bench press lift is the least predictive of the three.

Terzis et al. (2003) examined a group of shot putters and concluded that performance in the shot put was directly related to the strength and muscle fiber composition of the triceps brachii. However, this study was conducted on a relatively small sample and did not take into account the impact that lower body strength and power had on the performance of the athletes in question. In the present investigation it would appear, based upon a larger sampling of athletes, that strength in both the lower and upper body is critical to performance in the shot put, and that the ability to overcome a heavy resistance during a complex lift such as the power clean may be the most predictive of success in the shot put event. But keep in mind that strength numbers can be misleading or misrepresented.

## TRAINING EMPHASIS: GLIDE VS. THE SPIN

The techniques employed by the shot putters in the present study varied between the rotational (spin) and glide styles. Some evidence suggests that less upper body strength is needed for spinning and there appears to be a common notion that the glide technique is more dependent on strength than skill (Bosen, 1985; Egger et al., 1994), while the spin is a more complex movement more heavily dependent on skill and speed (Booth, 1985; Egger et al., 1994; Johnson, 1992; Judge & Young, 2011; Oesterreich et al., 1997). For the male participants in the present study the ratio of bench press strength to personal best in the shot put was significantly higher in the glide throwers versus the rotational shot putters.

A similar significant difference was also noted between the glide and rotational among the female participants. That would make the spin ideal for women, who are less strong in the upper body than men relative to leg strength.

Beyond physical characteristics, distinct motor abilities may also help to answer the questions of training emphasis. There has also been discussion that success in the rotational technique may rely more on biomechanical advantages rather than on the strength of the athlete (Lemke et al., 2003).

There are differences inherent between the two different styles (Luhtanen et al., 1997), which extend to the creation of a great amount of pre-stretch in the musculature of the upper body in the rotational technique prior to the delivery of the implement (Harasin et al., 2010). If greater pre-stretch is created in successful rotational shot putters then these muscles may react with higher force production, allowing athletes with lower levels of strength to deliver the shot put more effectively at the end of the movement. This may in part explain why a higher ratio of absolute strength in the bench press lift to personal best distance was revealed in the present investigation for glide throwers as compared to rotational throwers.

Presumably, if development in the spin technique was more dependent on skill, beginners would likely perform better with the glide technique. Research on this very subject is inconclusive. Suggestions from practitioners indicate that the most important characteristics to be successful in the glide technique are size (both height and weight) and strength (Bosen, 1985; Egger et al., 1994; Judge, 2009; Oesterreich et al., 1997). Similarly it has been suggested that athletes using the spin technique possess good balance, coordination, flexibility and speed (Pagani, 1985; Paish, 2005; Turk, 1997).

## CONCLUSION

Based upon the results of the present investigation it can be stated that strength in the power clean is strongly related to the distance achieved in the shot put event. This suggests to coaches of the shot put event that development of training plans to maximize power clean strength may be warranted in conjunction with the development of proper technique in order to achieve the greatest level of performance with shot put athletes.

The study also suggests that coaches of glide shot putters should focus more attention on training the bench press lift in order to achieve the highest level of strength possible. The answers to these questions become the goals and training variables for an annual plan. Without concrete goals, objectives and priority meets, planning resistance training workouts becomes misguided and the plan will lack controls over training outputs.

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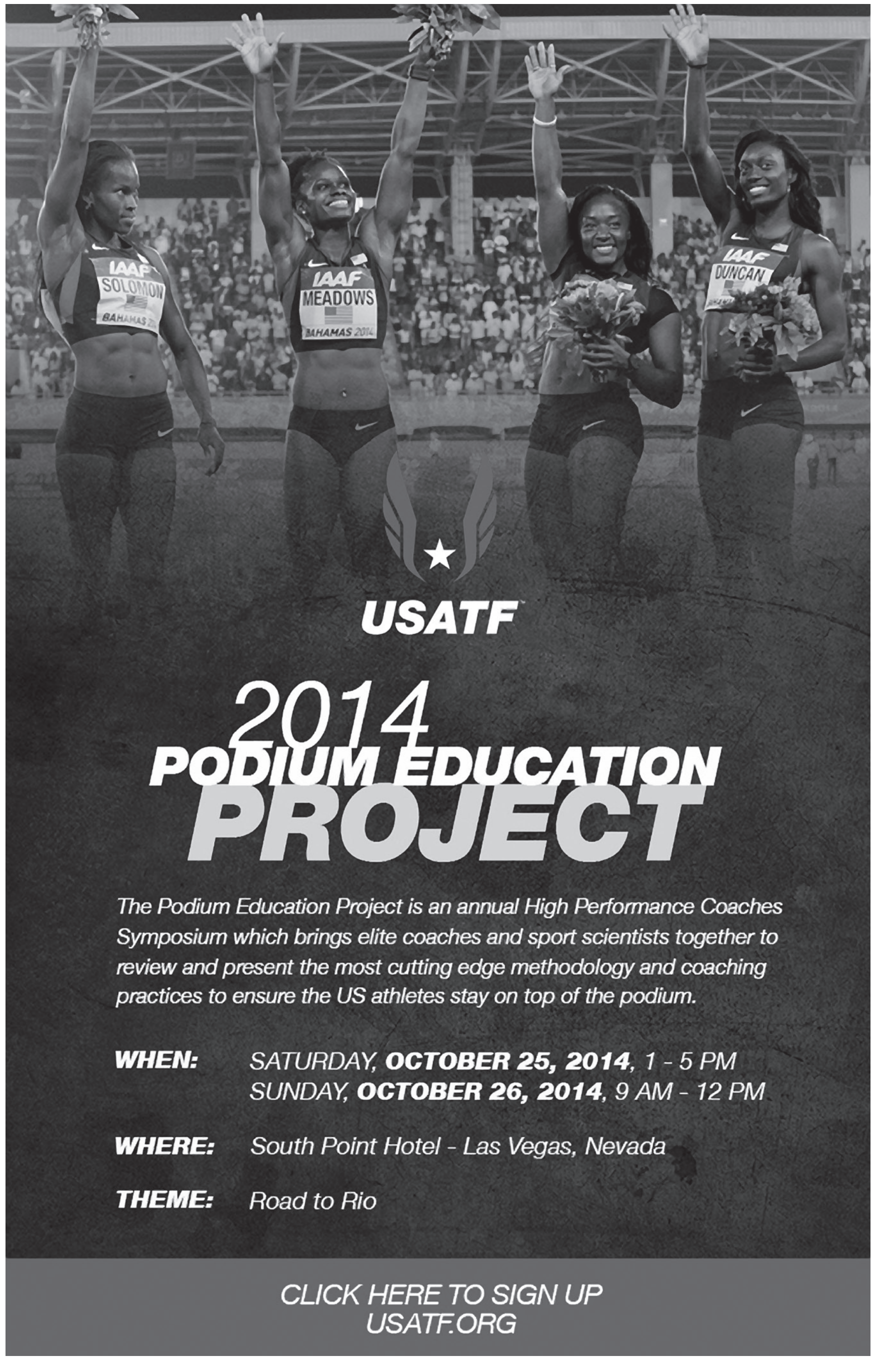

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