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ED FOX.....PUBLISHER
RUSS EBBETS.....EDITOR
TERESA TAM.....PRODUCTION & DESIGN
FRED WILT.....FOUNDING EDITOR

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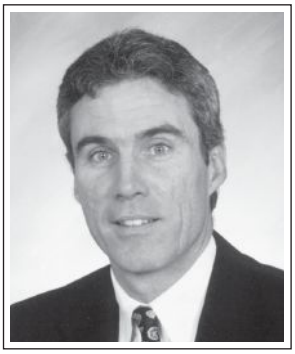
FROM THE EDITOR

RUSS EBBETS



FOUR GLOBAL CONCEPTS

Back in the '80's Tudor Bompa came out with a book called *Theory and Methodology of Training.* Despite its broad, high-falutin title it offered a good comprehensive overview of how to organize athletic training from novice to elite and everything in between.

Since that time *Theory and Methodology of Training* has gone through several incarnations and is available today as a tome called simply, *Periodization.* Updated with the latest information it remains an important cog in any coach's library. One of the great take-home points of the book is that there are four global training concepts that need to be addressed at all levels of training, all the time. This is important as it fosters the development of the athlete in a safe and progressive manner.

Physical preparation, technical preparation, tactical preparation and psychological preparation are the four global areas that warrant attention. I have seen them presented in a one-dimensional triangle type diagram but it would be more accurate to think of these concepts as a pyramid, something with not only width and height but depth. But even a layered pyramid only partially does justice to the overall concept. As with most things in life the reality is the layers are intertwined. Thought of this way the layers and pyramid become fixed into a moveable whole.

Physical preparation is the ground layer. Modern athletic participation requires greater and greater levels of physical fitness and improvements in an athlete's work capacity. This work is not necessarily glamourous but supports the adage that the broader the base the higher the peak.

Technical preparation works towards developing efficient movement skills. Coincidentally physical preparation is a limiting factor in technical development. Fundamental power positions or arm and leg actions determine the speed and power an athlete can generate. While one can achieve marginal results with sloppy technique the fluid movement of excellent technicians aesthetically stands head and shoulders above their ratcheting competition. Efficient body actions allow stretch reflexes to snap in sequence and an orderly summation of bodily forces. Not only are these efforts more efficient but they are safer in the long term with the coordinated efforts producing less stress at critical joint structures extending seasons and careers.

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COACHING FEMALE RUNNERS

Jason Karp, whose doctorate is in exercise physiology, is a familiar author in *Track Coach,* much appreciated for his clear exposition of complex topics. He is the author of six books, including *Running For Women,* which this piece is adapted from.

BY JASON R. KARP. PHD

Men and women are from different planets. There are obvious differences between women and men in anatomy, physiology, hormones, and metabolism. So why do nearly all coaches and running books and articles take a one-sex-fits-all approach to training?

While a male's hormonal environment is pretty stable, a woman's hormonal environment is constantly changing. Any physiological changes resulting from menstrual cycle-induced fluctuations in estrogen and progesterone are exacerbated when running, especially if the workout is intense. When your female athletes run hard, the concentrations of estrogen and progesterone in their blood increase during both the follicular and luteal phases of the menstrual cycle. And that has many implications for how a female should train. The female runner's training should be strong enough for a man, but made for a woman.

ESTROGEN AND THE MENSTRUAL CYCLE

Estrogen is the single biggest thing that differentiates your female athletes from the guys on your team. It's a powerful hormone, influencing many aspects of a woman's physiology, from metabolism to glycogen storage to lung function to bone health. Indeed, the amount of circulating estrogen has the greatest influence on a female runner's bone health. Any condition that lowers estrogen level significantly increases a female runner's risk for a stress fracture.

Since estrogen has such a big effect on bone health, the time of the month should be considered when increasing weekly volume. Avoid increasing weekly mileage during menses or the early part of the follicular phase and the latter part of the luteal phase of the menstrual cycle, as those are times of the month when estrogen concentration is low. Conversely, good times of the month to increase weekly mileage are during the latter part of the follicular phase and the mid-luteal phase, when estrogen concentration is high.

Avoid challenging workouts around menses, especially if your athletes don't feel well at that time or if they

VICTOR SAILER/PHOTORUN

feel bloated due to the rapid drop in progesterone as they transition from the luteal phase to the follicular phase. For example, if a runner has a 28-day cycle starting on Monday, and menses occurs on days 1 to 3 (Monday to Wednesday), plan their hard workout on Thursday or Friday that week.

If you have two workouts planned, schedule them on Thursday and Saturday, or schedule just one workout the week of menses and two workouts during the other three weeks of their cycle. If menses lasts five days (Monday to Friday), schedule one workout the week of menses and two workouts during the other three weeks of their cycle. For those lucky runners who are not adversely affected by their periods and don't experience much discomfort, it's okay to do the workouts and see how they respond.

MENSTRUAL IRREGULARITIES

Many female runners who train hard and train a lot and who have a low body fat percentage often experience irregular or even absent menstrual cycles, which reduces estrogen levels. Women who start training before menarche (their first period) delay their menstruation for almost a year, compared to women who already have menstrual cycles when they start training. In other words, training, especially intense training, can cause a delay in menarche for up to a year. Once menstrual activity commences, its continued occurrence is also sensitive to training. In response to heavy training, the first change in menstrual cycle activity is a shortening of the luteal phase, followed by cycles without ovulation and, finally, cessation of menses called amenorrhea.

Amenorrhea (defined as 0 to 3 periods per year) results in constant low levels of estrogen and progesterone. A female runner with amenorrhea has about one third the estrogen concentration and about 10 to 20 percent the progesterone concentration of a normal menstruating woman. Thus, endocrinologically, the amenorrheic female runner experiences an estrogen-deficient state similar to that of a postmenopausal woman.

The incidence of menstrual irregularity or amenorrhea is variable—some female runners can train with high volumes and never disrupt or lose their menstrual cycle activity, while some women notice changes in cycle activity with relatively little training. High training volumes, low body weight, and endurance sports like distance running increase the incidence of menstrual irregularities.

Inadequate caloric intake to match caloric expenditure, rather than the stress of exercise, is responsible for the loss of menstrual activity. Consuming more calories to compensate for the large caloric expenditure from running can prevent amenorrhea. Therefore, if your athletes run a lot, they need to increase how many calories they consume throughout the day to keep up with the large number of calories they expend by running.

One of the biggest ramifications of menstrual irregularity or amenorrhea is its effect on your athletes' bones. Any disruption to the menstrual cycle can cause a decrease in their bone density, increasing the risk for osteoporosis and stress fractures.

Estrogen is extremely important in facilitating the absorption of calcium into bones. Female runners with irregular or absent menstruation have significantly lower bone density than those with regular menstruation, even compared to non-athletes. Furthermore, there is a significant loss in bone density, particularly at the lumbar spine, in amenorrheic athletes. A female runner with irregular menstrual cycles runs the risk of decreasing bone density to such an extent that stress fractures occur with only minimal impact to the bones.

Along with the other two characteristics of the female athlete triad—osteoporosis and disordered eating—menstrual irregularities greatly increase a female runner's risk for stress fractures. Therefore, if you coach a team of female runners who are at risk for menstrual irregularities, the runners' bone density should be checked on a regular basis and you must take extra care in planning their training program so they don't increase their running volume or intensity too quickly. At-risk athletes need to do everything they can to strengthen their bones and prevent a stress fracture, including adequate intake of calcium and vitamin D and strength training. They may also want to take oral contraceptives, which supply them with estrogen.

METABOLISM

Perhaps the most significant effect of estrogen is a shift in a woman's metabolism to a greater reliance on fat and less on carbohydrate. Women use about 75 percent more fat than do men while running at 65 to 70 percent VO_2max. Women get about 39 percent of their energy from fat during exercise at 65 percent VO_2max, while men get about 22 percent of their energy from fat. However, the percentage of energy derived from fat varies significantly from person to person because factors such as training status, muscle fiber type, muscle glycogen content, and mitochondrial density all play a role.

Because humans' carbohydrate stores are limited, this metabolic shift gives female runners an advantage for very long endurance activities, during which there is a greater need to conserve carbohydrate and a greater use of fat because of the slower pace.

GLYCOGEN

Women don't increase muscle glycogen as much as men in response to consuming more carbohydrate in their diets. However, when women increase their total caloric intake as they also increase the amount of carbohydrate in their diets, they increase their muscle glycogen content by a similar amount as men. From a training perspective, while men simply need to increase the percentage of their calories coming from carbohydrate in order to carbo load and store more glycogen, women need to also increase the total number of calories in their diets to get the same effect.

BODY TEMPERATURE

Body temperature changes rhythmically throughout the menstrual cycle, peaking during the luteal phase in response to the surge in progesterone. Progesterone acts on the brain's hypothalamus (the temperature control center), which increases set-point temperature. A higher body temperature during the luteal phase makes it harder to run in the heat during this phase, as runners don't begin sweating to dissipate heat until they have reached a higher body temperature.

Estrogen has the opposite effect on the hypothalamus, decreasing body temperature, which explains why body temperature is lower during the estrogen-dominant follicular phase. Female runners also have a decreased ability to dilate the small blood vessels under the skin, which compromises their ability to release heat to the environment.

Hyperthermia—an increased body temperature—is one of the factors that cause fatigue during prolonged exercise. Thus, long, intense workouts and races in the heat, such as 10,000 meters, half-marathons, and marathons, can be more difficult during the luteal phase of the menstrual cycle. The increased body temperature during the luteal phase can also put a runner at an increased risk of developing heat illnesses like heat exhaustion and heat stroke.

MUSCULAR STRENGTH

Since muscular strength and power are proportional to muscle size, female runners can't get as strong or as powerful as the male runners on the team since men typically have bigger muscles and more testosterone to make those muscles bigger. But women can cheat the system a bit if they alter their training based on their hormones and capitalize on being female. Although women are not any stronger at certain times of the month than they are at any other, their menstrual cycle can influence how they respond to their workouts. For example, a study in

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International Journal of Sports Medicine found that weight training with 3 sets of 12 reps every second day during the follicular phase of the menstrual cycle and once per week during the luteal phase increased maximal quadriceps strength by 32.6 percent compared to just 13.1 percent by training once every third day over the whole menstrual cycle. It appears that doing more training in the estrogen-dominant follicular phase and less training in the progesterone-dominant luteal phase leads to greater strength gains.

ANEMIA

When females bleed a lot during menstruation, their blood's hemoglobin concentration can decrease, which can negatively impact their ability to transport oxygen in the blood. Since iron is an important component of hemoglobin, iron loss often accompanies a lot of bleeding. If this happens, your athletes may need to supplement their normal diet with iron. Many female runners exhibit athletic anemia (low blood iron levels due to physical activity), especially if they lose a lot of blood during menstruation. Athletic anemia is very common among female runners, especially those training at altitude.

Jason Karp, PhD, is the 2011 IDEA Personal Trainer of the Year, 2014 recipient of the President's Council on Fitness, Sports & Nutrition Community Leadership award, and creator of the Run-Fit Specialist certification. He has more than 200 published articles in international running, coaching, and fitness magazines, is the author of six books, including *Running for Women* and *Running a Marathon For Dummies*, and speaks around the world.

From The Editor

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Tactics and tactical preparation require a high level of technical proficiency. In running the ability to repeatedly surge can be a great tactical advantage but if one does not have the physiological preparation or runs with sloppy running mechanics repeated surges will dull any tactical advantages and create early exhaustion.

The capstone of the pyramid is psychological development. Wherever an athlete is career-wise the psychological component represents the common thread that ties the physical, technical, tactical development together. Psychological traits such as diligence, problem solving, co-operation all work together to create excellent teammates and a dynamic practice environment. It is this dynamic practice environment that fosters growth and development and with the early application, refinement of these powerful, lifelong traits.

Individually the four global concepts are important. Most programs no doubt spend time daily or weekly addressing some of the skills, but all the skills on a daily basis? Now that takes some planning. But the trained athlete who has been honed with daily attention to the larger picture could expect to develop more fully, more thoroughly and achieve with more certainty their ultimate potential.

SCHOLASTIC TRACK & FIELD IN A NEW MEDIA AGE

WHO'S #1?

Who pays attention to those media rankings so prevalent on the Internet?
A veteran high school coach offers his thoughts.

BY JIM VERMEULEN

"You know I'd go back there tomorrow. But for the work I've taken on Stoking the star maker machinery …."

"Free Man In Paris" Joni Mitchell

A few months ago, Bill Meylan of the respected www.tullyrunners.com web site e-mailed me. A sports reporter from an upstate New York newspaper had contacted him with questions about an 11-year-old runner who was to be the subject of a magazine article. The girl had attracted attention following a 10:33 3k cross country race as a 10-year-old and a 5:02 1500 at an area all-comers indoor meet. She also had a road race 5k PR of 18:33, and the reporter wanted to make a comparison between that and the 18:28.5 winning time in the previous fall's NY Section III Cross Country Championship. That happened to be the time of one of my freshman runners. Mr. Meylan had advised against comparing road and cross country races, but my reaction was different.

It had been only three months since the Armory track & field announcer at the New Balance Scholastic Indoor Nationals brought 7th grader Katelyn Tuohy back onto the main floor following her grade-record time in the mile and exhorted the crowd to "give it up" for her performance, one which bested the old record held by Mary Cain. And it had been only a week or so since ny.milesplit.com had invited subscribers to "Watch Mary Hennelly Lower Her Own 7th Grade Steeple Record to 7-Flat."

My reaction to the sports reporter's request would probably have been matched by those of other coaches whose track & field institutional memories stretch back further than last Friday, coaches who, like myself, have watched a burgeoning track & field media world with a mix of emotions. Comparing an 11-year-old to a high school freshman in the press? My response was a bemused dismay. We are, after all, likely to see more of this, not less.

Several decades ago, unless the summer Olympics were on tap, national and world-class track & field athletes toiled in general anonymity—and their scholastic counterparts were even more invisible.

When I competed in New Jersey high school track back in the mid-60's, recognition would come if you won a meet event. The daily paper (sometimes only the weekly) printed your event, last name and first initial. Cross Country was the same. Mostly, we knew of only the other good runners in our leagues. As far as talent from around the state or beyond was concerned, they might as well have been competing on the moon. You'd have to advance far into the season's championships to ever meet them.

Times change of course, and Darwin long ago warned about the failure to adapt. The digital world we live in now pivots on the swift availability of data, of information. Any media institution that does not constantly seek to maximize rapid access to data through developing technologies will soon cease to exist. A name in the weekly paper may have proved exciting enough for a scholastic athlete in the 60's or 70's—but not now.

Old fogies like myself aside, the typical expectation of any current scholastic track or cross country athlete who notches a noteworthy event effort is that the result will be posted on some local or regional internet site within hours—if not instantly. This proliferation of readily available results has led quickly to the compilation of those results.

Massive athlete data bases now exist on web sites so anyone and everyone can quickly view the competition resumé of a scholastic athlete. Picture archives of meet events have been quickly superseded in importance by videos, the de rigeur staple of many sites. I recently viewed scholastic races not from a national—or even state—championship, but from a local track & field invitational. More than one elite high school athlete has become the subject of a video (or video series) chronicling his or her rise to scholastic stardom. As a result, many of today's varsity athletes simply cannot imagine a world without instant access to information about themselves and their competitors, whether locally or nationally.

Not surprisingly, this proliferation of information (i.e. publicity) has led to both accolades and criticisms. On the plus side, more and more hardworking athletes are receiving the tributes and attention they rightly deserve. Competitive coaches are only too happy to have ready access to a host of performance information on other athletes or teams. And everyone appreciates quick postings of competition results. The existence—and ease of access to—a growing amount of media information on track and cross country now grants any athlete access to a larger sports world. Those benefits, many argue, can only strengthen the sport on a scholastic level.

The annual participation survey by the National Federation of State High School Associations certainly lends credence to that view. In the 2007-08 school year, boys track & field was the third most popular sport nationally by number of actual participants. Girls track & field was #2 in that same 07-08 category. By the 2013-14 school year, the boys rose to #2, and girls track & field was the nation's most popular sport by number of participants.

There are, however, critics of media's growing presence in the scholastic track/cross country realms. Media sites, after all, are not financed by altruism. Except in rare circumstances (www.tullyrunners.com may be one of those), they exist via advertising revenue. Not surprisingly, advertisers don't like broadcasting to empty rooms, so those media sites survive because they can tap into—or create—markets for their advertisers. The overall role that these sites play, then, is open to interpretation or argument. Do they—with their results, databases, videos and articles--simply inform about the sport, making it more visible and popular? Or do they instead ultimately fall into patterns of attempting to shape to their purposes the very sports they cover? Common awareness and the participation statistics suggest that increased media attention to scholastic cross country and track have raised the public profile of both sports. And unless coaches and athletes don't want attention directed toward their efforts and accomplishments, it's difficult to criticize this new state of affairs where 11-year-olds garner their own magazine articles or a high school senior graduates with a three-part video series about her scholastic running career. None of this would have occurred even a scant 15 years ago.

What should get the attention of these same groups, however, are the methodologies, attitudes and gimmickry media sites employ to gin things up, to create the buzz that attracts attention to their sites and thus their advertisers. These shaping strategies are not new. One only has to look at political reporting to understand it is possible to hype a situation or create news where little ultimately exists. Though our sports are, like every sport, about competition, one of the strategies increasingly employed by the media

sites is to increase the perception of conflict and rivalry between athletes or teams through the use of those time-tested fight analogies. Our sport has been famously collegial, with male or female competitors going at each other tooth and nail during an event, and then embracing and chatting together afterward like best friends. The media, however, prefers more frosty relationships and less mutual admiration, so a recent preview of a contest between two elite 100-meter high hurdlers noted: "They went to war against each other in the California 100-meter hurdles state finals two weeks ago." War?

The media also wants us to believe that athletes lay claim to titles and records and are more about building legacies than competing and improving as athletes. "Both are looking to solidify their all-time ranks at [the] Brooks PR 2-mile," another media site previewer assumes about two talented scholastic distance runners. Rest assured that particular previewer never asked either whether they were primarily concerned about bolstering their running reputations with a win. This kind of words-in-the-mouth projection mirrors those broadcasters who repeatedly tell us what competitors are supposedly thinking during their races. As many post-race interviews reveal, they don't have a clue. They are merely using imagined internal monologues to jack up viewer excitement.

These and other daily examples exemplify a conscious or unconscious attempt to shape the expectations of media site consumers. They want to dictate (or at least suggest) what we, the consumers of their information, should be excited by. So-called rivalries between athletes or teams, attempts at all-time performances—the media presumes to know what's exciting for us. While not on the scholastic level, the 2015 Penn Relays Collegiate 4x1mile was a classic case of racers not conforming to the announced expectations of broadcasters, who wanted an attempt on the collegiate 4x1mile record. Instead, they expressed disappointment in the abundance of strategy involved, including an almost comical fourth leg with deliberately slowed paces by elite athletes that would not have challenged many strong high school milers. The outcry was immediate and vociferous, drowning the defense of those strategies and conveniently downplaying the goal of big meet races and championships, which is to win.

The shaping strategy, however, reaches its highest form in the proliferation of top-dog status reports that exploit our cultural preoccupation with winning. Not content with the meet and championship results that used to decide such things, media site viewers are presented with an array of "Who's #1?" polls and prognostications that supposedly determine for us on a weekly basis the best athletes or teams. At one time or another, we've all watched those animated and over-enthusiastic soothsayers of scholastic track shove around athletes names on a magnetic blackboard to arrive at the week's rankings.

At some state media sites, using comparative data, it is even possible to find out "Who Won the Weekend" following Saturday invitationals. A Who's #1 crescendo of sorts came recently. The national milesplit.com site published two top-10 lists that had almost nothing to do with competitive performances. Instead, it was separate rankings of what boys and girls scholastic competitors had received the most "hits" on their athlete data bases during the competitive year--in other words, a popularity contest. The writer explained this followers' phenomenon using one of the athletes' preferred terms. An attempt at authenticity aside, there was something disconcerting about the use of a title "Top 25 Most MileSplit Stalked Girls Athletes Of The Year" to create yet another Who's #1 list. For various reasons, more than a few coaches (and parents) are probably hoping their elite athletes never make that list.

What though, in our scholastic fields of cross country and track, is the overall effect of this media saturation? As one might expect, that depends on who you talk to. Hoping to enlarge the opinion pool, I conducted a small and unscientific poll of local coaches and my own athletes using Survey Monkey. For the coaches and athletes, these quick surveys were limited to ten multiple choice questions for the former and nine for the athletes. Some questions were either similar or identical for both groups. Twenty-one coaches from my upstate New York section responded while forty-one athletes on my cross country or track teams took the survey. It was a small sample, but while neither inclusive nor conclusive, the results offer a snapshot on the issue of media presence in our scholastic sports—and perhaps help frame the issue more realistically.

Responses to the question, "How often do you visit internet media outlets covering scholastic XC/ Track & field" might cause pause by those media outlets if they are indicative of the larger athlete population. Only 2.5% of my athletes responded "Daily" and 10% noted

they check such sites "Several Times a Week." 40% said "Occasionally" while 32.5% said "Seldom" and 15% claimed "Never." 21% of coaches claimed to visit daily, with 52.6% visiting sites several times a week and 26.3% occasionally. No reporting coaches claimed to never view such sites.

For majorities of both coaches and athletes in my survey, the primary reason for viewing the sites was to find competition results (coaches—79%; athletes—55.3%). Also in the majority were respondents who chose "local sites" (as opposed to state/regional/national) as the "most useful for scholastic XC/Track & field." 52.6% of coaches and 73% of the athletes believed local sites were preferable, which might suggest that the interest in local competition information still prompts most media site visitations. Interestingly, to that question of primary reason for visiting sites, only 21.1% of the athletes said it was to check rankings. 0% of the coaches claimed that reason. If at all representative, this raises questions about the actual appeal of that myriad of ranking polls and "Who's #1" listings.

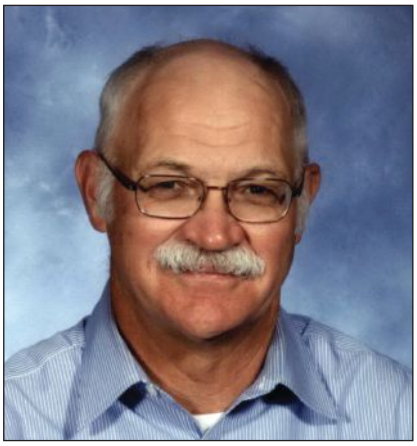
Clear majorities in both my surveys indicated that the growth of media coverage for scholastic XC/T&F had "Generally Positive" effects (Athletes—63.9%; Coaches—73.7%). And although 26.3% of coaches and 19.4% of athletes felt the effect of this growth was "mixed," only one respondent in either group felt that media coverage was primarily "negative." Both athletes (51.4%) and coaches (57.9%) felt that the "frequent local/state/national rankings of athletes and teams" had a positive motivational effect on athletes. Fewer than 6% of those coaches or athletes responded that such rankings bothered or pressured athletes.

These responses seem to suggest what we've seen before in other areas where 'cults of celebrity' have been promoted. It may well be that athlete motivational levels directly affect attractions to the media covering scholastic athletes. Motivation has been demonstrated to be influenced by skills levels, with the talented athletes driven to a greater degree by extrinsic factors, one of which is publicity. This contrasts with the internal motivations more often described by neophyte or "average" young athletes who participate for reasons of self-satisfaction, pleasure or mastery. Their more talented, more accomplished teammates are the ones who wind up in the season previews, on the leaderboards and fielding questions at post-race video interviews. So it's not surprising that those upper echelon athletes would follow themselves—and their also talented competition—more closely in the available media.

Contrast this with the average athlete, one not destined for such publicity. Their curiosity about who's up and who's down in the state or nation probably more closely mirrors the comment of one of my runners when referring to a state leaderboard: "Who cares?" All the data, the videos, the leaderboards apparently have little effect on his personal running world—or at least he sees it that way. The media can't get close enough to shape him, and he possibly speaks for a majority of scholastic athletes, those largely uninterested in Who's #1 for the week.

In this regard, those media outlets have a challenge on their hands if they expect to achieve any significant degree of "market penetration." The elite-centered, celebrity-driven content of the scholastic track/XC media may have a dedicated audience, but one suspects it's small, a limited audience that is unrepresentative of what happens daily in these sports for the overwhelming majority of school-aged participants. Should the current scholastic media be more attentive to the "who cares" athletes? In their defense, any content changes from the present hyping and star-making of school-aged athletes would be like running into a strong headwind. Our current culture thrives on that stuff. The alternative, however, is not attractive either. Stay the course and you risk a perpetually limited and insular audience while losing an opportunity to actually grow the sport from youth on up. The scholastic track and cross country media are gambling that hero worship will work for them as it does for other sports. But if my runner is at all representative, what the scholastic media is currently selling, a majority of school-aged athletes—their desired audience—simply aren't buying.

Jim Vermeulen is the head Cross country, Indoor Track and Outdoor Track coach at the West Genesee School District in upstate New York.



GRADY WEIGHS IN ON U.S. 4X100 FORTUNES IN BEIJING

Dennis Grady has written several articles on the American 4x100 teams and their mixed fortunes. We asked him to comment on the Beijing 2015 races

BY DENNIS GRADY

After the two-year break between the IAAF World Championships and leading into the XXVIII Olympics at Rio de Janeiro in the summer of 2016, a review of the recent U.S. 4x1 relays at the Beijing WC's, in particular, and the overall state of the U.S. relay program in general, seems appropriate. For all the new readers of *Track Coach,* this is my sixth article on this topic with the last one appearing in TC #206 (Winter 2014).

At the end of that article I made several specific recommendations, the last one being: Please no more excuses when things go wrong. But before we get to that an analysis of the Beijing relays will be presented. (See TC 206 for London 2012 and Moscow 2013 relay analyses).

The American women's 4x1 relays have won medals in the last four major championships (OG's and WC's), two gold and two silvers. They also set a new world record (40.82) at the London Games. The team of English Gardner, Allyson Felix, Jenna Prandini, and Jasmine Todd took home the silver (41.68) at Beijing where the Jamaican team won gold (41.07)—a new World Championships record and a national record.

The U.S. women did not use any substitues this time or in Moscow; same with the men's 4x1. This was another recommendation I proposed: no subs for the 4x1 except for injuries. With the 4x4 relays substituting makes plenty of sense and carries very little risk for the U.S. not making the finals. For the 4x1 subs make no sense at all. Time will tell if this becomes the new standard practice for the Team USA.

Here is how I saw the Beijing 4x1 for the American women:

- Only one returnee from 2013 Moscow, English Gardner. Felix the only one from World Relays at Bahamas in May 2015.

- Bronze medalist Torie Bowie, the only U.S. woman in the 100 final, was not on the relay. She did not attend the mandatory relay camp in Japan. Having her on the anchor would not have changed the result of this race.

- Start: Lane 5, Jamaica in lane 6. Good start by Gardner, gave up some ground to Jamaica's Veronica Campbell Brown; lots of lateral motion in her running technique which may have cost a little time.

- 1st Exch: Felix left a tad late causing Gardner to ease up for the pass and leaning back. Got baton to Felix early in the zone which is good. Two-point stance for Felix (more on that later).

- 2nd Exch: two-point stance for Prandini, excellent; made Felix run to catch her deep in the zone, with full extension and a beautiful pass.

- 3rd Exch: two-point stance but Todd did not drive out low, was upright on her first step; alignment was good—Jenna on the inside of the lane and Jasmine on the outside. Receiving hand was not steady, turn of the head to see baton, but always better to look to ensure the pass.

- Summary: The Jamaicans had three 100m finalists versus none for the US. As we saw in the 4x4 with Jamaica's four 400m finalists, that portends good things for relay success. Superior speed with very good passes for Jamaica equals big win.

For the U.S. men's 4x1 relay the troubles continued. In the last six majors the U.S. men have one medal, a silver at the 2013 Moscow WC's. Their silver at 2012 London OG's was negated by the doping DQ of Tyson Gay. The bright spot was a new American record (37.38) in the London rounds with Jeff Demps, Darvis Patton, Trell Kimmons and Justin Gatlin. The Jamaican men, on the other hand, since their loss to the U.S. in 2007 have won six straight gold medals and notched a world record (36.84).

My take on the U.S. men's 4x1 in Beijing:

- Two returnees from 2013 Moscow, Mike Rodgers and Justin Gatlin; with Tyson Gay, three from the Bahamas World Relays winning team; therefore, an experienced U.S. team. Ryan Bailey, who anchored that team, did not make the U.S. squad.

- No subs, as in 2013; but a change in the order from the World Relays with Rodgers going to anchor and newcomer, Trayvon Bromell, given the leadoff duty. Changing a winning order is seldom a wise move to make. Having a veteran to hold off Bolt was the likely reasoning.

- All four Americans in 100m final: finished 2nd, 3rd, 5th, and 6th. Jamaica had two, Bolt and Powell.

- Sufficient speed to win this race.

- Start: U.S. in lane 6, Jamaica lane 4. Bromell late getting into set position with the other runners realizes it and as he gets set the gun goes off. Good recovery. Gave U.S. the lead.

- 1st Exch: looked very good. Got stick to Gatlin in stride and smoothly. Attacked the zone. Swift and accurate pass into Gatin's left hand. No problem.

- 2nd Exch: Gay got out well but Gatlin still had to ease up while making his pass. It appears that Gatlin is reaching across his body with the left hand to give to Gay's right hand – that would mean he is not staying in the outer half of his lane.

- 3rd Exch: Rodgers leaves early (his go mark tape is back even with lane 5's mark, too far?). Gay runs in the outer half of the lane and not the inner half (he did in the earlier heat also) thereby not getting proper alignment for the pass. When Rodgers finally slows down enough, Tyson winds up with a high right arm swing and doesn't release the baton until they are out of the zone.

- Summary: The U.S. had a lead going into the third and final exchange. Jamaica's 1st and 2nd passes were shaky, especially the second pass. Whether Bolt could have caught Rodgers is debatable; I would not bet against Bolt. The undeniable fact is that the U.S. men have thrown away another medal and the prize money that goes with it. And once again it is the veterans with the most experience who are making the costly mistakes.

BLAME IT ON THE FRENCH IN LANE 5 . . .

A Facebook post by noted biomechanics figure Dr. Ralph Mann as it appeared on the *Track & Field News* forum message board:

Actually, Michael, I just finished analyzing the race and, yes you did leave early - but only by 0.6 meters. In fact, the pass should have been made. The problem was that the runner in lane 5 (France) was the only athlete to begin with

a standing start. In doing so, his stance put his body well into your lane (see image), forcing Tyson to run to the outside of the lane. This slowed him down enough to make it impossible to catch you. These relays are always a disaster waiting to happen, which is why the failure rate is 25 percent. With all of the practice you and Tyson did, no one could foresee this happening. You don't miss your Go Line, and you didn't this time. In fact, you can see Bolt has also started, and Tyson was well ahead of Ashmeade [Jamica's third runner]. By the rules of the event, France should have been disqualified under the "out of the lane impediment rule". If France didn't start like a high school team, you would have had a slightly late pass, but it would have been made—and with the lead you would have had, I don't think Bolt could have caught you. These things happen, but you should know that this one was not your fault. [note: the image referred to could not be presented here.]

Okay, we blamed the Brits when Doc Patton ran into their anchorman in 2011, might as well blame the French anchorman - and give them a taste of our sour grapes- for our latest snafu.

First, Dr. Mann contradicts himself from the start: "you did leave early" but then states, "you don't miss your Go Line and you didn't this time." So which is it? Did he leave early or didn't he? Everyone who watched the race knows the answer. And the result.

Second, the French anchor in lane 5 is not well into lane 6, standing start or three-point stance. In fact, it is in the three-point stance that the hips are swung to the outside as the head turns to see to the Go mark. Tyson Gay runs on the outside of the lane the whole turn, and he did so in the earlier qualifying round. Who was he avoiding then?

Third point is the claim "these relays are a disaster waiting to happen" with a failure rate of 25 percent. Well for this WC, the women had 16 teams run in the heats without a mistake, though two of the eight in the final, Netherlands and Russia, did DQ and DNF. For the men two of 14 failed the test in the heats (Brazil and South Africa) and again two in the final, the U.S. and Great Britain. So the real failure rate total in Beijing is 6 out of 48 or 12.5%. And, I might add, these teams stretch their exchanges and take more risks than the U.S. ever has to. Also, the U.S. men's **success** rate for the last six majors is one in six, i.e. 17%; while the Jamaican men, our only real rival in this event, are batting a golden thousand. Seems these disasters are waiting to be made by the USA.

Finally, there is the claim that a standing start that the French used is "like a high school team". As noted in my analysis above, the U.S. women used a two-point stance, notably Allyson Felix and Jenna Prandini –who I guess you wouldn't call high school athletes—as well as Ryan Bailey on the anchor at London. In my last article I recommend this start: better sight lines to the Go Mark and consistently ***leaving on time.*** Basic things the U.S. men have difficulty doing, but which the U.S. women are much more proficient at, judging by medal counts and prize-money amounts.

Going into an Olympic year, USATF has problems that still need to be worked out. My recommendations in *TC #206* for the relays are still the same I would make today. I am optimistic that USATF will continue to avoid using subs for the 4x1, as they have the last two majors. They have changed relay coaches and may again for Rio. Several decisions on selection and the order of the runners, namely the women's 4x4 and the men's 4x1, seemed questionable. I have encouraged USATF to have clarity and transparency regarding the relay program. Those were lacking in the Torie Bowie decision, which I support, but I see no reason that it should not have been made public, well before the WC's began, that she was not a candidate for the 4x1, regardless of how well she ran in the open 100.

So where do the relays stand as The Road to Rio begins? I see the U.S. women aware of and ready to face the challenges presented by the Jamaicans. Prior to the London OG's in *TC #193 (Fall 2010)* I predicted a U.S. team could run 40.74; they ran 40.82 and set the World Record. The Jamaican women ran 41.07 at Beijing; they are definitely within striking distance of that WR. The 4x1 relay in Rio should be a great race.

For the U.S. men I see problems. Gatlin's break in form in the final meters of the 100m dash and Rodgers's early departure on the final exchange are the most obvious examples. My prediction for the U.S. men going into London was to run 36.82. The Jamaicans ran 36.84 for their WR. Unlike the U.S. women, the U.S. men may simply have to accept that the Jamaican men are just better sometimes in the 4x1. The evidence of six consecutive gold medals is hard to deny. But let's not resort to a ready-made excuse: blame it on the anchorman in the next lane.

EFFECTS OF WRIST WRAPS ON THROWING DISTANCE IN HIGHLY SKILLED SHOT PUT ATHLETES

To wrap or not to wrap—here is a detailed research experiment that suggests performance benefits from heavy wrist wraps. Adapted from a study that first appeared in *The International Journal of Performance Analysis in Sport,* 2015, 15, 343-358.

LAWRENCE W. JUDGE[1], JEANMARIE M. BURKE[2], TIFFANY J. PATRICK[3], TYLER D. GUIDRY[3], DONALD L. HOOVER[4], ELIZABETH A. WANLESS[1] AND DAVID M. BELLAR[3]

[1]SCHOOL OF PHYSICAL EDUCATION AND SPORT, SPORT AND EXERCISE SCIENCE, BALL STATE UNIVERSITY, MUNCIE, IN. [2]RESEARCH DEPARTMENT, NEW YORK CHIROPRACTIC COLLEGE, SENECA FALLS, NY. [3]SCHOOL OF KINESIOLOGY, UNIVERSITY OF LOUISIANA LAFAYETTE, LAFAYETTE, LA. [4]DOCTOR OF PHYSICAL THERAPY PROGRAM, WESTERN KENTUCKY UNIVERSITY, BOWLING GREEN, KENTUCKY.

ABSTRACT

Shot put throwing distances of 18 male Division I track & field athletes in the United States were compared among three wrist wrap conditions: 1) a large heavy wrist wrap, typically worn by athletes competing in the shot put event, 2) a small light wrist wrap and 3) no wrist wrap. The average and maximum throwing distances when the athletes were wearing the heavy wrist wrap ($12.31 \pm 1.699_{maximum}$; $11.92 \pm 1.627_{average}$) were greater than when the athletes were not wearing a wrist wrap ($12.05 \pm 1.550_{maximum}$; $11.70 \pm 1.457_{average}$). Performance increases exceeded criteria for the smallest worthwhile improvements in the shot put event, suggesting that heavy wrist wraps provide a competitive advantage. These results revealed previously undocumented, beneficial effects of taping and bracing on sports performance in the shot put throw.

INTRODUCTION

Functional bracing and compression are widely used in training and competition in a number of sports (Born et al., 2014). There is wide acknowledgement in both sport and medical sciences that bracing and compression are useful when there is evidence that they increase performance, decrease risk of injury, decrease pain, or achieve one or more of these aims simultaneously (Rishiraj et al., 2009; Rishiraj et al., 2010; Rishiraj et al., 2011). For example, the sport of power lifting allows both functional bracing and compression through the use of back belts and compression suits ("USA Powerlifting," n.d.).

Olympic weightlifting and the shot put throw in track & field allow forms of functional bracing and compression during competition, and governing bodies in all three of these sports (power lifting, Olympic weightlifting, and shot put) allow athletes to use heavy wrist wraps during competition.

Interestingly, while many studies address the potential performance benefits of back belts and compression garments in a variety of populations (Clark et al., 2012; Kurustien et al., 2014; Brophy-Williams et al., 2014; Born et al., 2014; Hill et al., 2014; Bernhardt & Anderson, 2005), a systematic review of multiple electronic databases for sport science indicated no published studies exist on the potential ergogenic benefits of the wrist wraps widely used in strength/power sports such as power lifting, Olympic weightlifting, or shot put. The present study addresses the effects of wrist wraps on shot put throwing performance in collegiate athletes.

The shot put is an explosive athletic event that requires male competitors to accelerate a 7.26 kg metal sphere (110-130 mm in diameter) to a maximum release velocity from the dominant hand. This power/strength event occurs through a series of rehearsed movements that transpire within a circle with a diameter of 2.13 meters (Figure 1) (Judge, 2015). Previous research has indicated that 65 to 80 percent of the total release velocity is achieved after the initiation of elbow extension of the throwing arm (Judge & Young, 2011). The final release velocity of 13.5 m·s-1, on average, requires not only exceptional recruitment of Type II muscle fibers throughout the body's kinetic link system in a proximal to distal sequence but a great deal of accuracy in propelling this heavy sphere (Enoka, 2008).

Some athletes and coaches believe wrist wraps help to control wrist motion during throwing, thus serving as an ergogenic aid. Additionally, elite shot put athletes place a great deal of stress on the wrist and digits as a result of the acceleration of the implement at the moment of arm strike (Judge & Young, 2011). Novices often require time to allow for adaptation of the hand to account for these forces placed on the upper extremity during training and competition (Bresnahan & Tuttle, 1937).

During the shot put throw, there is considerable torque that develops outside the thrower's center of mass, imposing high resultant forces on the athlete's body in general and on the throwing arm in particular (Judge & Young, 2011). Back belts and wrist supports may facilitate the skillful execution of the shot put

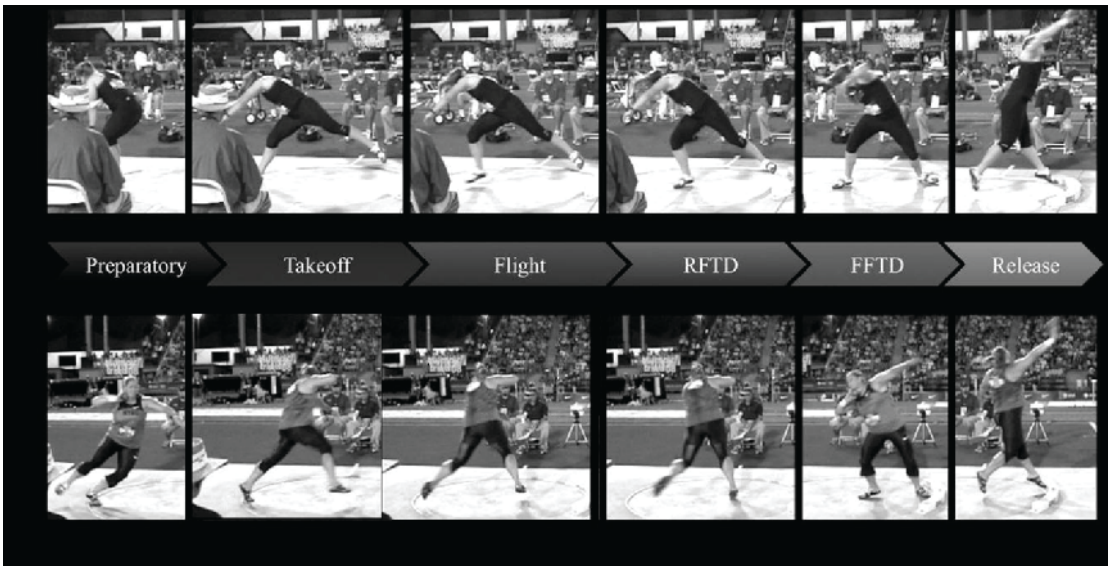


Figure 1: Sequential action of the glide and spin technique shot put technique and arm strike.

throw by helping the athlete better control the degrees of freedom of the body's many segments during the shot put throw (Latash, 2010): the importance of this should not be overlooked, as the shot put requires very high muscular force outputs in order to generate great acceleration values of the body's center of mass and component segments, occurring all within a relatively small competitive space (e.g. the throwing circle).

Similarly, wrist wraps likely augment the passive resistance naturally created by the many muscles that cross the wrist joint (Su et al., 2005; Burgess et al., 2008; Leite et al., 2012; Palmer et al., 2013), further controlling the degrees of freedom in this joint during the high force/high velocity execution of the shot put throw (Newell & Vaillancourt, 2001). Back belts and wrist wraps as ergogenic aids also may further help in protecting the body against large resultant forces that occur during the shot put throw (Judge & Young, 2011).

As noted above, ample research has been conducted on back belts, suggesting their use is warranted as a performance booster in competitive sports (Kingma et al., 2006; Miyamoto et al., 1999; Clark et al., 2012). However, the findings are mixed, as it relates to their use as a functional brace aimed at reducing injuries, with results differing in respect to variables such as age group, resisted activities included in the design/research question, work or exercise setting, and other factors (Giorcelli et al., 2001; Minor, 1996; Hodgson, 1996). Despite the widespread use of wrist wraps in sports such as power lifting, Olympic weightlifting, and track & field throwing, a review of sport science and medical science electronic databases suggests that their effects on competitive sports performance has yet to be evaluated.

Many strength/power athletes in power lifting, Olympic weightlifting, and the shot put also espouse a view that wrist wraps help to reduce their risk of injury in training or competition. While addressing this injury-prevention role is beyond the scope of the present study, risk of injury is a concern among strength/power athletes. Injuries to the shoulder, elbow and wrist are common in strength/power sports involving lifting and throwing movements (Braun et al., 2009; Haupt, 2001; Siewe et al., 2011). Edouard and co-investigators reported that among elite track and field throwers, the incidence of throwing injuries to the upper extremity was 0.36 per 1000 hours of exposure (Edouard et al., 2010). During the shot put delivery, wrist extension is the last motion in the kinetic chain of events and imposes a large amount of stress on the wrist joint (Judge & Bellar, 2012; Judge & Young, 2011). Excessive use of the wrist extensors can contribute to the onset of lateral epicondylitis, and this condition is reported to occur in approximately 50% of overhead throwing athletes (Field & Savoie, 1998).

In addition to the ergogenic effect of helping to control the degrees of freedom in the final segment of the kinetic chain (Latash, 2010, 2012; Newell & Vaillancourt, 2001; Enoka, 2008), the restricted joint motion imposed by wrist wraps likely helps the thrower to better direct the application of force in the dominant arm at the desired release angle, and it may also conceivably reduce strain on the connective tissues in the wrist region during the shot put delivery (Su et al., 2005; Burgess et al., 2008; Currier & Nelson, 1992). While Verhagen and co-investigators cautioned that restricted range of motion does not necessarily increase joint protection (Verhagen et al., 2001), the lack of a known increase in joint protection does not preclude an ergogenic effect through the common practice of wrist wrap use.

DURING THE SHOT PUT DELIVERY, WRIST EXTENSION IS THE LAST MOTION IN THE KINETIC CHAIN OF EVENTS AND IMPOSES A LARGE AMOUNT OF STRESS ON THE WRIST JOINT

Thus, given the widespread prevalence of strength/power athletes who report that wrist wrapping aids their competitive performance, the present research objective was to empirically determine if the use of wrist wraps by highly skilled collegiate athletes affected their shot put throwing distance, the index of performance in this sport. To meet this research objective, we compared shot put throwing distances executed under three wrist wrap conditions: 1) a large heavy wrist wrap, typically worn by athletes competing in the shot put event, 2) a small light wrist wrap and 3) no wrist wrap. Given its widespread use in contemporary track and field, it was hypothesized that shot put throwing distance would be greater when the athletes were wearing the heavy wrist wrap as compared to no wrist wrap condition. The secondary hypothesis was that the small light wrist condition would not increase shot put throwing distance as compared to the no wrist wrap condition.

METHOD

2.1. Participants

The participants were 18 male U.S. collegiate track & field athletes competing in the shot put event at the NCAA Division I Level (age: 21.1 ± 3.69 years; height: 187.7 ± 5.07 cm; weight: 120.8 ± 19.61 kg). Competitive accomplishments of the athletes in this sample included: two NCAA Division I National qualifiers, one USATF Outdoor National Championships qualifier, four NCAA Division I Conference champions, and one past USATF Junior Nationals competitor. All athletes were coached by an individual with over 20 years of experience at the collegiate, national and international levels in teaching the techniques of the shot put and who achieved the designation of Master Coach by USA Track and Field. The athletes were informed of the procedures necessary to volunteer for the present investigation and provided their informed written consent prior to the start of the procedures. The Institutional Review Board at the University of Louisiana at Lafayette approved the present investigation for the inclusion of human subjects.

2.2. Procedures

The athletes were required to report three separate times to a competition shot put venue with no less than 24 hours and no more than 96 hours transpiring between the three visits. All testing sessions occurred during June and July, e.g. similar climate. Each testing session for an individual athlete occurred at the same time of day, as a means of further standardizing the experimental conditions.

At each of their visits, the athletes were randomly assigned to one of the three wrist wrap conditions: 1) No Wrist Wrap, 2) Light Wrist Wrap or 3) Heavy Wrist Wrap. The athletes followed the same procedures on each visit. The athletes performed an agility warm-up routine that included 15 minutes of general warm-up and dynamic stretching exercises. Once the warm-up exercises were completed, the athletes were allowed three warm-up shot put throws that were not measured.

There were three minutes of rest between each of the warm-up shot put throws. Following the last warm-up shot put throw and an additional three-minute rest interval, the athlete was ready to perform the three test shot put throws that were measured and recorded. The distance of each test shot put throw was measured in accordance with NCAA rules, by using an open reel tape measure extending from the circumference of the throwing circle along a line to the nearest mark made by the fall of the shot put. There were three minutes of rest between each experimental shot put throw, standardizing the period so as to afford participants uniform time for recovery of the phosphocreatine energy system (Girard et al., 2011; Bishop et al., 2011; Plowman, 2011). The athletes used the standing shot put technique on all warm-up and experimental throws. The shot put used was a competition quality implement (7.26kg, 128mm diameter lathe-turned iron shot put).

2.3. Application of the Wrist Wraps

The heavy wrist wrap measured 8 cm in width and 65 cm in length and had a mass of 100 g. The light wrist wrap measured 8 cm in width and 50 cm in length and had a mass of 40 g. Athletes were instructed to wrap their wrists tightly around the base of the wrist using the thumb loop for leverage. Athletes wound the wrist wrap in concentric circles 1) until the end of the wrap was secured using the hook and loop strips and 2) they perceived that the wrist wrap offered them the appropriate support for throwing the shot put. After application, the thumb loop was unhooked, as required by NCAA rules.

2.4. Measurements of the Material —Properties of the Wrist Wraps

Each unused wrist wrap was tested to determine the change in resistance (kg tension) for a given change in length (cm). This was undertaken with the use of a load cell that was fixed to a solid surface. The wrist wrap was secured to the end of the load cell (Interface SM-1000-16, Interface, Scottsdale, AZ, USA) and the opposite end was stretched to a minimum of ten different lengths, determined via a 1-meter long steel measuring stick secured against a level surface. The measurements were repeated a minimum of three times and an average value for kg of tension was regressed ($r2>0.98$) against the length in cm to determine the elastic constant.

Subsequent to the measurement of elastic constant, each wrist wrap was fixed to the load cell at one and then wrapped around a pressure cuff that was pre-inflated to 60 mmHg (similar in diameter to the human wrist). Using the load cell to measure force, 10 N of force was applied to the wrist wrap. With 10 N of force applied, the increase in cuff pressure from 60 mmHg was recorded as the pressure exerted by each wrist wrap. Pressure in mmHg exerted by each wrist wrap on the

cuff was converted to Pascals.

2.5. Data and Statistical Analyses

The dependent variables were the ***average throwing distance*** of the three test shot put throws and the ***maximum throwing distance*** achieved on any single attempt among the three test shot put throws. The primary analysis consisted of one factor repeated measures ANOVA model that was used to reveal differences between the three wrist wrap conditions. Secondary analyses included one-tail paired t-tests between the no wrist wrap condition and each of the two wrist wrap conditions, light and heavy. Primary and secondary analyses were conducted using the customary 0.05 level of significance. There were no corrections for multiple comparisons in the secondary analyses, e.g. Bonferroni adjustments. The p-values of the multiple one-tail paired t-tests were reported to address inflation of the Type I error rate. SPSS Version 19.0 was used for calculating descriptive statistics, including the mean, standard deviation, and 95th confidence intervals as well as conducting the primary and secondary analyses.

Magnitude-based inferences were derived using the methods published by Hopkins (2007) to determine if the effects of wrist wraps on shot put performance provided a competitive advantage (i.e. practical importance). This notion of practical importance is also known in the sport science literature as smallest worthwhile improvement and in the medical literature as clinically meaningful difference, and it has great importance in helping to evaluate the relevance of research findings to application "in the real world" (Portney & Watkins, 2008).

Magnitude-based inferences are derived from the observed p value of the null hypothesis test (Hopkins, 2007). Magnitude-based inferences also require justification of the smallest worthwhile improvement and establishing a confidence interval about the uncertainty of the smallest worthwhile improvement (Batterham & Hopkins, 2006). Previous research indicated that a difference of 0.9% to 1.5% was the *smallest worthwhile improvement* in shot put performance that may provide a competitive advantage (Hopkins, 2005). This smallest worthwhile improvement in shot put performance corresponded to a standardized change of 0.20 (i.e. small effect size) (Cohen, 1988). A 90% confidence interval is thus recommended, as the probabilities of the true experimental effects being unlikely positive or unlikely negative are both 5% (Batterham & Hopkins, 2006; Hopkins, 2007).

In the current study, magnitude-based inferences expressed the effect of each wrist wrap condition on shot put performance as 90% confidence limits and likelihoods of true effects being beneficial or substantially positive, negligible or trivial, and harmful or substantially negative (Batterham & Hopkins, 2006; Hopkins, 2007). Magnitude-based inferences were derived from the pairwise comparisons of maximum and average throwing distances among the three experimental conditions. Likelihoods were measured as the quantitative chances (%) that the true experimental effects of the wrist wraps were beneficial, negligible or harmful to competitive shot put performance. The likelihood that differences in shot put performance among the three experimental conditions provided a competitive advantage was based upon the quantitative chance that the true experimental effects of the wrist wraps were beneficial.

RESULTS

3.1. Material Properties of the Wrist Wraps

The elastic constant of the light wrist wrap was a 0.6 N increase in tension for every increase of 1 cm in length. The elastic constant of the heavy wrist wrap was a 1.5 N increase in tension for every 1 cm of increased length. In response to applying a 10 N load, the pressures exerted by the light and heavy wrist wraps on the 60 mmHg inflated pressure cuff were 2,667 Pascals and 3,067 Pascals, respectively. The elastic constant was 2.5 times greater for the heavy wrist wrap as compared to the light wrist wrap, while the pressure exerted was only 1.1 times greater for the heavy wrist wrap than the light wrist wrap.

THE LIKELIHOOD THAT DIFFERENCES IN SHOT PUT PERFORMANCE AMONG THE THREE EXPERIMENTAL CONDITIONS PROVIDED A COMPETITIVE ADVANTAGE WAS BASED UPON THE QUANTITATIVE CHANCE THAT THE TRUE EXPERIMENTAL EFFECTS OF THE WRIST WRAPS WERE BENEFICIAL

3.2. Shot Put Throwing Distance

The main effect of wrist wrap condition was not significant for either

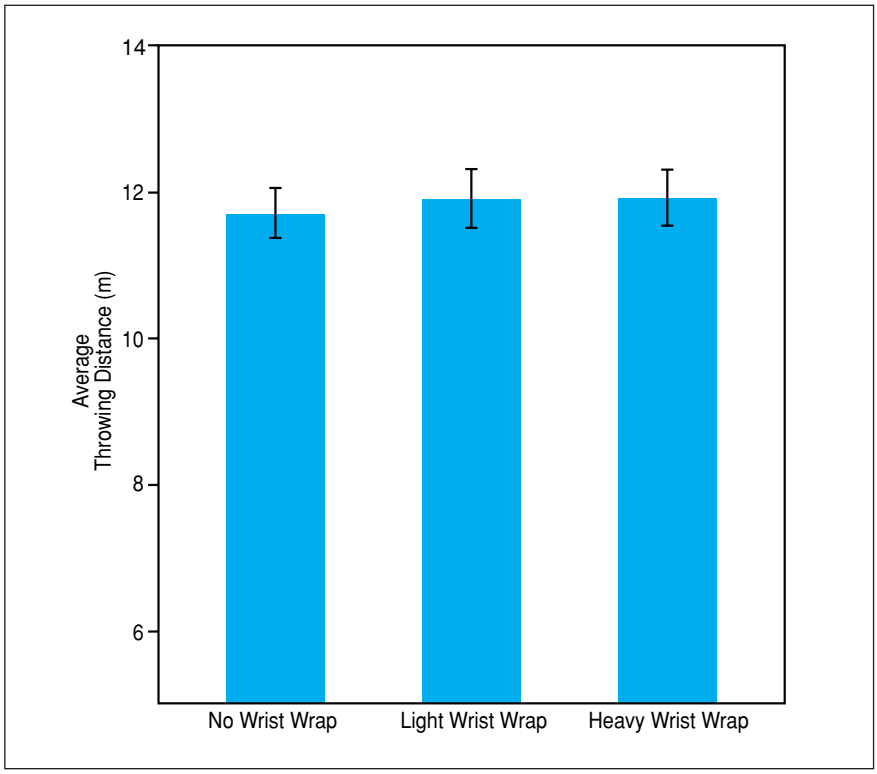


Figure 2: Means of the Average Throwing Distance by Wrist Wrap Conditions. Error bars represent one standard error from the mean.

average throwing distance (F(2,34) = 2.05, p = 0.144) or the maximum throwing distance (F(2,34) = 1.76, p = 0.187). The secondary analyses detected that the average (t17 =1.89, p = 0.038) and maximum (t17 =1 .94, p = 0.035) throwing distances were significantly greater when the athletes were wearing the heavy wrist wrap, compared to the no wrist wrap condition (Figures 2 and 3). In addition, the measured improvements in average (1.9%) and maximum (2.2%) throwing distances for the heavy wrist wrap condition exceeded the criterion of 0.9% to 1.5% for smallest worthwhile improvement in the shot put event.

Improvements in average throwing distance for the light wrist wrap condition (1.7%) also exceeded this criterion for the smallest worthwhile improvement in the shot put event, although there was no statistically significant difference between this condition and the two other conditions. However, the increase in average throwing distance when the athletes were wearing the light wrist was not significantly greater than when the athletes were not wearing a wrist wrap (t17 = 1.28, p = 0.110).

3.3. Interpretation of the Practical Importance of the Effects of Wrist Wrap on Shot Put Performance

Magnitude-based inferences for the effects of wrist wrap conditions on maximum throwing distance were different between the light and heavy wrist wraps. The derived likelihoods of the effects of the heavy wrist wrap condition and the light wrist wrap condition on maximum throwing distance were: likely beneficial or substantially positive (68.9% and 12.3%), negligible or trivial (31.1% and 87.6%) and very unlikely to be harmful or substantially negative (0.0% and 0.2%). The likely beneficial or substantially positive effect of the heavy wrist wrap on maximum throwing distance as compared to the light wrist wrap was 33.5%.

Magnitude-based inferences for the effect of each wrist wrap condition on average throwing distance were similar. The derived likelihoods of the effects of the heavy wrist wrap condition and the light wrist wrap condition on average throwing distance were: likely beneficial or substantially positive (58.0% and 48.6%), negligible or trivial (42.0% and 51.2%) and very unlikely to be harmful or substantially negative (0.0% and 0.2%).

DISCUSSION

Functional bracing or compression typically leads to improved performance, reduced risk of injury, or decreased pain during physical activity. This study assessed the ergogenic effects of wrist wrap conditions on shot put throw distance, the only performance index that truly matters in this sport. The results provided insights on the beneficial effects of taping and bracing on competitive sports performance that have not been previously documented in the scientific literature. Competitive sports performance in the shot put event depends upon a single best score. Thus, the effect of the heavy wrist wrap on maximum throwing distance was deemed the primary evidence for the beneficial effects of taping on competitive sports performance. Improvements in maximum throwing distances of 2.2% occurred when the athletes were wearing the heavy wrist wrap than when not wearing a wrist wrap. A difference of 0.9% to 1.5% was

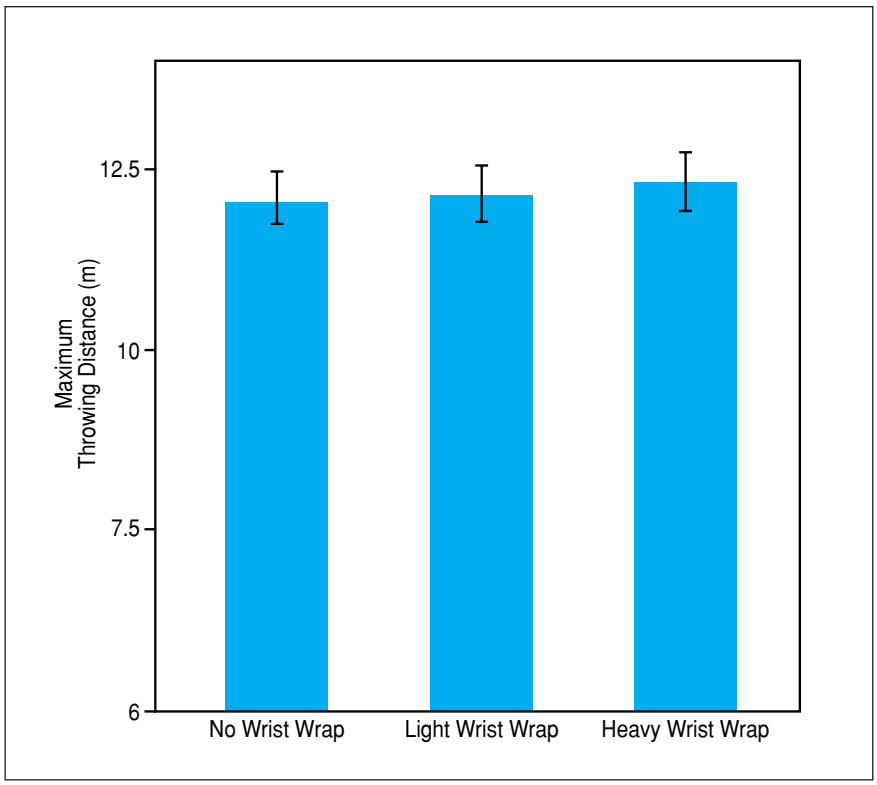


Figure 3: Means of the Maximum Throwing Distance by Wrist Wrap Conditions. Error bars represent one standard error from the mean.

the smallest worthwhile improvement in shot put performance that may provide a competitive advantage (Hopkins, 2005). The derived likelihood that the small effect of the heavy wrist wrap on shot put performance would be beneficial was 68.9%. Null-hypothesis testing and magnitude-based inferences indicated that the light wrist wrap condition did not induce similar beneficial effects of taping on shot put performance.

Often at collegiate competitions, particularly at meets such as conference championships and national championships, throwing distances of only a few centimeters separate athletes who achieve podium finishes from those who do not. The research of Hopkins (2005) suggests that, in the sport of track & field, meaningful differences in performance are often observed at much smaller overall percentages of change than in other areas of sport performance. A review of previous research on the purported benefits of taping and bracing also suggests that taping and bracing would induce small changes, if any, in outcome measures (Nunes et al., 2013; Raymond et al., 2012; Williams et al., 2012). Based upon the present findings, the use of power lifting style wrist wrap is advisable for the shot put athlete to enhance sports performance.

When throwing the shot put, wrist extension is the last motion to act in the kinetic chain of events and imposes large stresses on the wrist joint (Judge & Bellar, 2012; Judge & Young, 2011). Excessive motion in the wrist of the throwing hand negatively impacts shot put technique, as athletes typically compensate by prematurely moving their chest forward (Judge & Young, 2011), thus undermining the translation of force along the kinetic chain in an efficient proximal to distal manner. This technical error decreases throwing distances; this is related to early deceleration of the throwing shoulder which in turn decelerates and thus delays acceleration of the implement at the release point (Judge & Bellar, 2012). Use of a heavy wrist wrap exerts a compressive force that augments the natural passive stiffness of the muscles that cross any joint (Currier & Nelson, 1992), and this may help to prevent technical errors by providing added stability to the wrist joint as it undergoes high force/high velocity stresses during the shot put throw. Research on the effects of a heavy wrist wrap on the biomechanics of throwing the shot put is needed to more fully explain the exact mechanism underlying its beneficial effects on sports performance.

Based upon the material properties of the wrist wraps, the light wrist wrap exerted smaller compressive forces at the wrist than the heavy wrist wrap. Differences in wrist extension during the shot put throws between the wrist wrap conditions may plausibly explain why the light wrist wrap condition did not provide any beneficial effects on shot put performance. Research on the impact of wrist wraps on the biomechanics of throwing the shot put would be needed to support or refute this plausible explanation for the differences in throwing performance seen between the two wrist wrap conditions.

Similar to previous research on taping and sports-related movements (Abián-Vicén et al., 2008; Nunes et al., 2013; Quackenbush et al.,

2008), the light wrist wrap condition did not result in a boost to sports performance in the present study. However, the derived likelihoods suggested a dose-response relationship existed for the wrist wrap conditions on maximum throwing distance: the likely beneficial effects of the heavy wrist wrap condition was 68.9%, whereas the likely beneficial effects of the light wrist wrap condition was only 12.3%.

Moreover, the athletes increased their maximum throwing distance by 1.3%, albeit not statistically significant, when wearing the heavy wrist wrap as compared to the light wrist wrap, but clearly meaningful from a competitive perspective when viewed in light of Hopkins' work (Hopkins, 2005). The derived likelihood that the heavy wrist wrap condition provided an additive beneficial effect on shot put performance was 33.5%, as compared to the light wrist wrap condition. The wrist wraps compared in the present study included one of the lightest available and one of the heaviest available on the retail market. The heaviest available wrist wraps used in this study were a brand that is typically worn by athletes competing in the shot put event.

The athletes in the current study may have perceived the compression force exerted by the heavy wrist wrap on the wrist joint as a prophylactic measure. Further research using sport psychometric measures would help shed light on their perceptions of how wrist wraps may aid performance. Similarly, comparison of the passive and dynamic range of motions among the three wrist wrap conditions would help to address any perceived prophylactic benefit of the heavy wrist wrap, as this would help to explain the extent that the compression of the wrist wraps augmented the natural passive stiffness of the muscles crossing the wrist joint. However, Verhagen et al. (2001) cautioned that restricted range of motion does not necessarily increase joint protection. For example, Harman and Frykman (1990) reported that knee wraps worn during powerlifting, back squat exercise at 80% of one-repetition maximum, actually altered the biomechanics of the movement as compared to the no knee wrap condition and increased injury potential to the knee joint and

JOHN GIUSTINA

World record holder Randy Barnes, with wrapped wrist.

lower-body musculature (Harman & Frykman, 1990) .

One potential limitation of this study was the use of the standing shot put technique. Shot put athletes use two different techniques during competition: the glide or the rotational. However, all athletes in this sample regularly practiced the standing shot put technique regardless of the technique that they used in competition. Future research will need to address the effects of wrist wraps on throwing performance when athletes use the glide and rotational shot put techniques. Future research also needs to compare the effects of the different wrist wraps on the biomechanics of throwing the shot put to better address mechanisms underlying performance improvements. Passive and dynamic range of motion of the wrist joint while athletes are wearing the different wrist wraps should also be compared in future studies. Further study should also be done on women throwers, as there is literature noting that the sexes often exhibit differences in joint flexibility measures, suggesting that women throwers may experience difference performance characteristics when wearing wrist wraps when compared to their male counterparts.

It may be argued that the sample size was inadequate in the present study. Using nQuery Advisor (version 6.01), post-hoc analysis of our maximum throwing distance data indicated that sample size of 74 athletes would be necessary to detect differences in means across three levels of the repeated measure factor characterized by our small effect at the 0.05 significance level and the 80% power level. Similarly, our secondary analysis would have required a sample size of 60 athletes to detect the 1.3% difference in means between the heavy and light wrist conditions at the 0.05 significance level and the 80% power level.

However, the precision of estimation, rather than the null hypothesis, more readily translates to testing the practical importance of performance enhancing strategies when small effects impact competitive outcomes (Batterham & Hopkins, 2006; Hopkins, 2005; Hopkins, 2007). Using the methods of Hopkins (2006) for estimating sample size for magnitude-based inferences and our data for maximum throwing distance between the heavy and light wrist conditions, the estimated sample size was 19 athletes. Given the competitive skill-level of our athletes, our sample size and sampling frame were deemed to be adequate and representative of NCAA Division I shot put athletes.

CONCLUSIONS

The beneficial effect of the heavy wrist wrap on maximum throwing distance among 18 male Division I shot put athletes was deemed the primary evidence supporting enhancement of competitive sports performance. This ergogenic effect has not been previously documented in the scientific literature. The use of power lifting style wrist wrap is advisable for the shot put athlete to enhance sports performance.

PRACTICAL APPLICATION

The use of power lifting style wrist wrap by collegiate track & field athletes increased the maximum throwing distance of the shot put. Meaningful differences in sports performance that provide a competitive advantage are often observed at very small overall percentages, typically one to two percent. Statistical approaches that measure the likelihoods of true effects being beneficial or substantially positive, negligible or trivial, and harmful or substantially negative may be appropriate to understand performance enhancing strategies used by athletes in competitive sport settings.

THE USE OF POWER LIFTING STYLE WRIST WRAP IS ADVISABLE FOR THE SHOT PUT ATHLETE TO ENHANCE SPORTS PERFORMANCE

In summary, the heavy wrist wrap provided a smallest worthwhile difference to shot put throwing performance. This likely occurred through the augmentation of the natural passive stiffness afforded by the many muscles that cross the wrist joint. This in turn affects the kinetic chain in a positive fashion, as it relates to controlling the degrees of freedom in the upper extremity during the shot put throw.

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Corresponding Author:

Lawrence W. Judge, Ph.D, CSCS*D
School of PE, Sport and Exercise Science, Ball State University
Muncie, IN 47306 USA
lwjudge@bsu.edu

USATF HIGH PEFORMANCE PLAN:

OVERVIEW OF NEW SPORT SCIENCE INITIATIVES—DISTANCE EVENTS

Track Coach 206 contained the first article by Dr. Chapman regarding USATF's new science intiatives. This article continues the discussion focusing on altitude training for distance running.

BY ROBERT F. CHAPMAN, PHD,
ASSOCIATE DIRECTOR OF SPORT SCIENCE & MEDICINE USA TRACK & FIELD

At the beginning of each quadrennium, USA Track & Field presents a copy of a four-year High Performance Plan to the U.S. Olympic Committee for their consideration and support. As part of the 2013—2016 USATF High Performance Plan, five new sports science initiatives (broadly referred to below as the Initiatives), were introduced and outlined. Each of these proposed Initiatives are believed to carry the potential of a positive impact in medal production in 2016—either by increasing medal wins in event areas where the USA was lacking in 2012, or by defending medal winning event areas from 2012.

As a continuing contribution to Track Coach, *we will outline and update progress on these Initiatives, as well as additional aspects of the USATF High Performance Plan. It is hoped that this will allow the USATF community of coaches and supporters to have an understanding and an appreciation of the steps being taken by USATF and the USOC to utilize sport science and medicine resources to optimize performance and medal attainment. This report will give the rationale behind and initial outcomes from our second Initiative, which focuses on the distance events.*

2013-2016 SPORT SCIENCE INITIATIVE #2 —OPTIMIZATION OF ALTITUDE TRAINING IN THE DISTANCE EVENTS

At the 2012 Olympic Games, Team USA distance runners put forth a very impressive group performance. While only two medals were won (Manzano, 1500m silver, age 28; Rupp 10,000m silver, age 26), a remarkable **10 additional middle distance and distance athletes finished in the top 8 of their respective events.** These 4th through 8th place finishers at London represent a large and noteworthy cohort on the cusp of medal attainment, with 7 of the 10 athletes aged 29 or younger. **For these 10 athletes, on average they needed just a 0.52% improvement in performance (range 0.02 to 1.22%) to equal the time of the bronze medalist.**

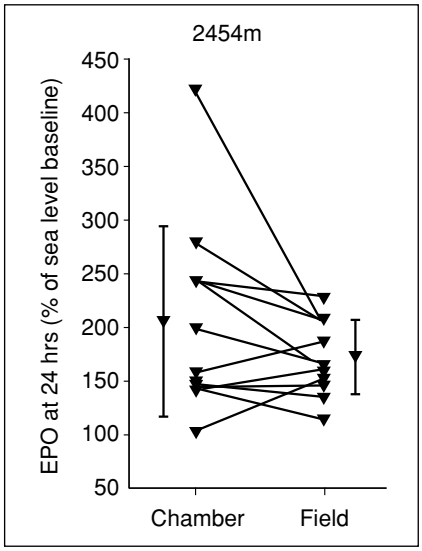
For comparison, consider that the

coefficient of variation within elite track & field athletes in the distance events has been calculated at 1.1% (Hopkins, WG. Competitive performance of elite track and field athletes: variability and smallest worthwhile enhancements. *Sportscience,* 2005). With the needed performance improvement to medal for the group being half of the typical coefficient of variation, we feel that a focus of scientific resources to our distance runners has the potential for a strong return on investment from a medal attainment standpoint in 2016.

Of the mechanisms available to obtain a fraction of a percent improvement in performance in the distance events, *properly executed* altitude training holds by far the most potential. The reason we note the term *properly executed,* is that the athlete and coach have a number of variables to consider when completing an altitude camp, such as:

- how high to live
- the best altitude for training
- how to best modify training at altitude
- how long to stay at altitude
- how to adjust dietary factors such as iron supplementation
- when is the optimal time to return to sea level prior to a major competition

Because the physiological and performance responses to these variables show substantial individual variability, **getting these variables optimally prescribed for each person becomes a medal impacting factor.** To help illustrate this concept, the graph above depicts the individual and mean ± standard deviation erythropoietin (EPO) response of a group of distance runners to 24 hours in a chamber or in the field



at 2454m (8000ft). Note the wide individual range of responses, from no change to a 425% increase in EPO levels. As EPO is the hormone responsible for stimulating production of red blood cells by the body, the magnitude and duration of the EPO response is critical to gaining a positive, performance enhancing response from altitude training.

These EPO response data may suggest that the athlete should simply live as high as possible to make as much EPO as possible. However, the data on race performance changes at sea level from pre- to post-altitude training camp (Chapman, et al. Defining the "dose" of altitude training. *Journal of Applied Physiology,* 2014) show that this is not the case. Athletes who lived at 1780m (6000ft) effectively lived "too low" to maximize performance enhancement after altitude training, while the athletes who lived at 2800m (9000ft) lived "too high" where the myriad of negative factors associated with altitude exposure mitigated performance enhancement.

These differing EPO and performance responses show the crucial importance of getting the living altitude properly determined for each individual athlete, as the average magnitude of the difference in performance response between sub-optimal and optimal altitude living altitudes (~2%) is *four times* the average performance difference needed for our ten athletes in the 4th through 8th place cohort from London to equal the bronze medal performance (~0.5%).

USATF's High Performance planning meetings on this topic included the very best altitude physiologists and distance coaches in the country. Based on the recommendations of this group, USATF has implemented the following programs:

- Establishment of a station for measuring total hemoglobin mass (a key variable that determines the hematological response to altitude training) in Flagstaff, Arizona, as well as development of a partnership with U.S. Ski and Snowboard to utilize their total hemoglobin mass testing station in Park City, Utah.

- Support of USATF Tier athletes for altitude training camps where they agree to get tested to determine their individual hematological response to altitude.

- Provide coaches and athletes with individual prescriptions for key altitude training variables, based on their measured response to altitude.

Between December 2014 and June 2015 alone, a total of 74 elite U.S. distance runners were tested at the beginning and end of altitude training camps in Flagstaff and Park City as part of the Distance Initia-

tive. Individual recommendations from these outcomes have been utilized by many coaches and athletes to help optimize their training response. For example, this testing has helped determine who has a strong hematological response to living at 7000ft and who may need to live slightly higher to get an adequate response. Similarly, for athletes who demonstrate a strong hematological response to altitude, simply knowing the magnitude of their response enables them to plan for additional altitude training stints at key times.

Finally, outcomes from our 2015 testing show that not all athletes are utilizing known best-practice principles as they complete altitude training camps, which mitigates our ability to prescribe individual modifications. For example, in a cohort of 47 athletes who were tested in Flagstaff from January to April 2015, 25 athletes did not have their serum ferritin measured in the 2-4 weeks prior to departure for altitude. Ferritin is a vitally important measure for athletes completing an altitude training camp, as it serves as a marker of bone marrow iron storage. Athletes with low ferritin levels (< 20 ng/ml in women and < 30 ng/ml in men) tend to show no increases in total hemoglobin mass, even after a four-week altitude training camp, despite making adequate amounts of erythropoietin (the hormone responsible for signaling red blood cell production in the bone marrow). Therefore, getting ferritin stores to normal levels prior to an altitude camp is of extreme importance.

For the 26 athletes who had normal ferritin levels prior to January-April 2015 altitude training in Flagstaff, the average increase in total hemoglobin mass was 3.9 ± 2.1%, which is right at the typical response of 4.2 ± 2.2% seen after 4 weeks at 7000ft. For the athletes whose ferritin was measured on arrival in Flagstaff and found to be low, their average increase in total hemoglobin mass was just 0.6 ± 2.3%. Therefore, despite our efforts to help "optimize" the altitude training prescription for our elite athletes, we still need to work and ensure that the fundamental best-practice principles are being followed.

In future editions of *Track Coach*, we will continue to share excerpts and outcomes of the Sport Science Initiatives of the USATF High Performance Plan, with a specific highlight on Initiative focused on the horizontal jumps.

USATF COACHING EDUCATION

LEVEL 1 SCHOOLS

2015

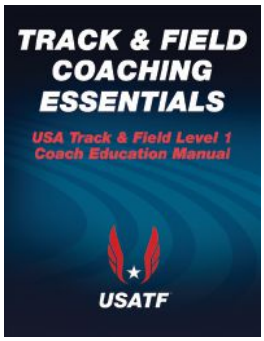
Nov. 6-8	Westminster College – Salt Lake City, UT
Nov. 14-15	Tennessee State University – Nashville, TN
Nov. 14-15	Cardinal Stritch University – Milwaukee, WI
Nov. 20-22	Johnson & Wales University – Denver, CO
Nov. 20-22	Life University – Marietta, GA
Nov. 27-29	UNLV – Las Vegas, NV
Nov. 28-29	USATF Missouri Valley Association Offices – Kansas City, MO
Dec. 4-6	IMG Academy – Bradenton, FL
Dec. 11-13	Houston Baptist University – Houston, TX
Dec. 18-20	Public School 9 – New York, NY
Dec. 18-20	Westerville South High School – Westerville, OH
Dec.19-20	Sacramento City College – Sacramento, CA

2016

Jan. 2-3	Florida Atlantic University – Boca Raton, FL
Jan. 8-10	Coastal Carolina University – Myrtle Beach, SC
Jan. 16-17	Chabot College – Hayward, CA
Feb. 6-7	Alhambra High School – Phoenix, AZ
Feb. 19-21	University of Portland – Portland, OR
Feb. 19-21	Christian Brothers College High School – St. Louis, MO
Mar. 5-6	Brown & Dorsett Foundation – New Orleans, LA

COACHING EDUCATION

USATF



NEW RECERTIFICATION GUIDELINES FOR USATF LEVEL 1 COACHES

As of January 1, 2015, the Coaching Education Committee has implemented a recertification component for the Level 1 curriculum. Recertification for Level 1 coaches will now be required on a 4-year cycle.

PURPOSE

To introduce new training techniques, and provide the latest materials to enhance the knowledge of Level 1 coaches. As of January 1, 2015, a new textbook and updated curriculum was introduced into all Level 1 schools.

QUALIFYING PERIOD

Certification will be renewable every four years to match the Olympic cycle. To open the new recertification, a “grandfather clause” will be offered from January 1, 2013 through December 31, 2020. This is a special offer to open the recertification guidelines. A Level 1 coach who fails to recertify through the 2020 Olympic quadrennium as of December 31, 2016 will be removed from the USATF coach certification database.

RECERTIFICATION GUIDELINES

To retain a Level 1 certification that is recognized by various educational organizations, including NCACE, USOC, a coach who received their Level 1 certification prior to January 1, 2013, and has not obtained an USATF Level 2 Certification must meet the new recertification guidelines. There are two options for coaches to renew his/her status as a USATF Certified Coach. **Click here** for full explanation of guidelines and how to begin your Recertification.

WHAT THE NEW RECERTIFICATION PROVIDES:

- Second Edition Level 1 textbook (updated content that includes graphics, skill pictures, updates from USATF master coaches)
- Updated school curriculum content, delivered by certified instructors
- USADA modules to provide coaches with best practices for Anti-doping information
- New online exam
- Recertification through December 31, 2020.

START TODAY TO BE AN USATF CERTIFIED COACH!!!!

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Welcome to the NEW USATF Campus!

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USATF has joined the United States Olympic Committee (USOC) to implement the SafeSport program. The goal of SafeSport is to provide a safe environment in our sport at all levels, but particularly for athletes who are ages 18 and under. The SafeSport program includes athlete protection policies, guidelines, codes of conduct, a background screening program, education and training, and a reporting process for any SafeSport concerns within our sport.

As a member of the Coaches Registry, you are required to complete the USOC SafeSport Training Course, as well as your annual background screen (or bi-annual if you are not a USATF Youth Coach). SafeSport becomes a requirement of the Coaches Registry on January 1, 2016.

To complete the SafeSport course, click here.

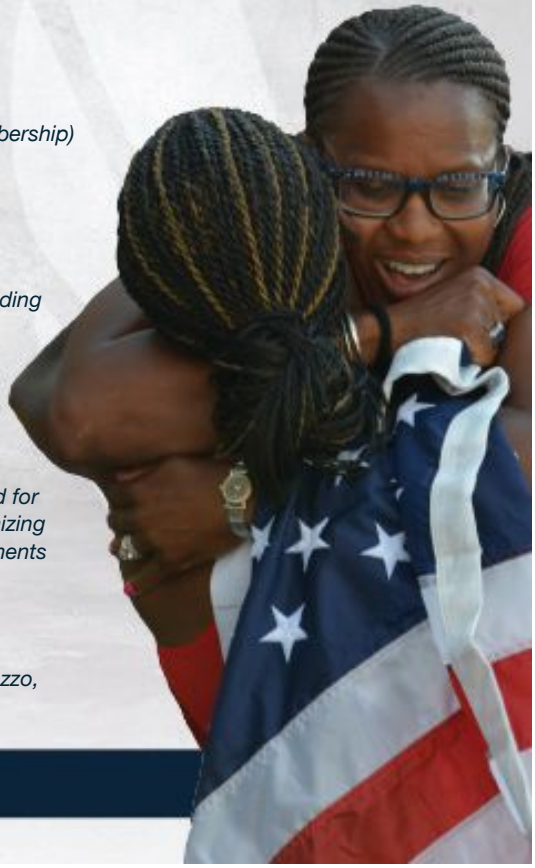
2015 USATF YOUTH SPECIALIZATION CLINIC

HOUSTON, TEXAS
DECEMBER 2, 2015
1:00-5:00 P.M.
HYATT REGENCY

WHO: *All coaches interested in preparing youth athletes for success*

COST: *Free for USATF members*
Not a USATF member: $30 (includes the purchase of a USATF membership)

12:30 p.m. - 1:00 p.m.	***Check-in for pre-registered coaches***
1:00 p.m.	***Welcome and Introductions***
1:10 p.m. - 2:00 p.m.	***Pediatric Physiology:*** *The importance of understanding growth and development in the youth athlete* *Presenter: Dr. Christine Brooks*
2:15 p.m. - 3:00 p.m.	***Training Loads and Progression for the Youth Athlete to Avoid Overuse Injuries*** *Presenter: Dr. Robert Chapman*
3:15 p.m. - 4:00 p.m.	***The Positive Coaching Model:*** *A model developed for coaching and enhancing communication skills, recognizing learning styles, and creating positive learning environments for youth athletes and teams* *Presenter: Dr. Rick McGuire*
4:15 p.m. - 5:00 p.m.	***Youth Coaches Panel*** *Presenters: Keith Combs, Carmen Jackson, Jerry Palazzo, and Lisa Morgan*



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