

Fewer Studies of Athletic Performance at the 2013 ACSM Annual Meeting

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Featured Highlights with David Pyne: more thematic posters; poster and wireless quibbles; Exercise is Medicine; clinical decision making; critical power; resistance training; genetics for professionals; the human microbiome and sports performance; hypoxia reconstructed; fatigue; overtraining; nutrition. **Noteworthy Abstracts** with Will Hopkins: ACSM = ACEM; the usual problems with abstracts; my choice of promising strategies. **Acute Effects**: electrical muscle stimulation; warm-up for golf; stretching for runners and cyclists; an ice drink not for runners; cold-water immersion for recovery between semis and finals for runners; breathing and swimsuits for swimmers; aerodynamic pacing for team-pursuit cyclists; biomech shoes for cyclists; compression garments for baseball pitchers and cross-country skiers; holographic discs for endurance athletes? **Correlates of Performance**: Ironman phases; economy of Kenyan runners; endurance genes; cyclists' muscle transcriptome. **Nutrition and Drugs**: hydration but not hyperhydration for cyclists; beetroot?; bicarb and beta-alanine for rowers?; caffeine for everyone; melatonin not for endurance; paracetamol possibly but ibuprofen definitely not for endurance cyclists; blood transcriptome in the athlete's passport?; salbutamol for endurance? **Training**: specific for soccer, softball and baseball; vision for softball; video for divers; minimalist shoes for runners. KEYWORDS: anabolic, elite athletes, ergogenic aids, nutrition, overtraining, tests, training.

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Once again the report on the annual meeting of the American College of Sports Medicine, this year in Indianapolis, May 28 to June 1, is a joint effort by David Pyne and Will Hopkins. David attended the meeting and has provided first-hand accounts of keynote and other featured presentations, none of which have abstracts. Will did not attend the meeting but has summarized the abstracts for the slide and poster sessions. The ACSM [conference site](#) provides various links to information and abstracts for the meeting.

Featured Highlights with David Pyne

It was welcome back to Indianapolis, the headquarters city of the American College of Sports Medicine. The annual meeting is held here every few years and long-time attendees will recall the 2004 and 2008 meetings here. The main news in Indianapolis (and the whole US for that matter) this week was the severe

weather and tornado activity stretching from Texas to Illinois. Thankfully it only rained overnight in Indy and attendees were able to make full use of the walking trails around the nearby canal and river. There was plenty on offer as usual, and the highlights at this year's meeting included minimalist running shoes and running barefoot, many more sessions using the thematic poster format, and lots of abstracts (as usual) on nutritional supplements and ergogenic aids. The pre-conference program on the Tuesday seems to get bigger each year, the main sessions this year being Exercise is Medicine, a Gatorade pre-conference nutrition symposium in an engaging 3-minutes/3-slides format, and a career-development forum.

The format of the thematic poster sessions involved some initial informal viewing time and then moderator-lead discussion over 2 h. This format obviously provides for meaningful interaction and discussions, but I wonder how

many attendees were like me: a quick perusal of the posters then out the door before the moderated discussions got underway.

The free wireless internet at the convention center worked well in the lobby and foyer areas, but not in the lecture rooms—rather inconvenient, given the abstracts were available only online. Clearly the days of the big abstract book are numbered, as ipads and smart phones become more popular. Navigation down each aisle of the poster boards would also be easier with larger signage on both sides of the boards signaling the start of a new numbered section.

The opening session of this year's meeting was the JB Wolffe Lecture **Exercise is Medicine** presented by Scott Powers. Here Powers outlined some of the newer benefits of regular exercise, including browning of adipose tissue, reduction in cardiac reperfusion injury, reduction in chemotherapy for cancer. Proposed mechanisms around cardioprotection include vascular adaptations and intrinsic changes to cardiac myocytes. Recent research is highlighting the important role of mitochondrial antioxidants, particularly superoxide dismutase. While the focus here was on exercise in (clinical) medicine, this work also sheds light on oxidative stress and adaptive responses in athletes.

Of interest to readers of this journal was the session on **Clinical Decision Making** by Evert Verhagen, Steven Stovitz and Ian Shrier. Like a lot of sessions at the Annual Meeting, this session had more of a clinical focus on health, activity and illness rather than sports performance. Verhagen, an epidemiologist, outlined some emerging approaches quantifying benefit and harm to inform clinical decision making, and misconceptions around use of p-values. He outlined different forms of 'costs' including side effects of interventions, relative costs, logistics and comfort in prescribing interventions. Stovitz discussed the number-needed-to-treat approach and the subtleties of various kinds of risk. Shrier detailed his published work on return-to-play decisions involving models of shared decision making with clinicians, scientists, coaches and the patient/athlete.

A symposium on **Critical Power: Cardiovascular and Metabolic Determinants** highlighted the importance of oxygen kinetics and critical power in regulating exercise and sports performance. Andy Jones outlined some practical applications of manipulating oxygen kinet-

ics for enhancement of sports performance. For example Steve Ingham and colleagues at the English Institute of Sport have shown the benefits of prior high-intensity exercise as part of the warm-up for 800-m track events. A priming bout of 200-m fast running at 800-m race pace can be used approximately 15 min pre-race. This practice can reduce the slowing of running speed in the later stages of the race and was used at the London 2012 Olympics. Anni Vanhatalo summarized her research on changes in VO_2 kinetics and the power-time relationship in individual sports such as cycling and running. Both the critical power or velocity and the anaerobic work done above the critical power or velocity contribute to high-intensity performance. Philip Skiba presented an interesting approach to estimating anaerobic capacity during intermittent high-intensity exercise.

There was a good crowd in attendance at a symposium on **Synthesizing Resistance Training Research** featuring Brent Alvar, Mike Stone and John McCarthy. Alvar outlined some of the history of ACSM Position Stands on resistance training released in 1998, 2002, and 2009-11. The discipline of resistance training (or S&C—strength and conditioning) is gaining more academic credence with release of more scholarly research and some meta-analyses. Stone provided some practical examples of challenges for practitioners from his long involvement with elite athletes. McCarthy outlined current thinking on combining resistance with endurance training. He argued the key factor was the frequency of concurrent training—too many combined sessions can cause problems. Mechanisms of interference include reduced hypertrophy, reduced muscle glycogen and myofibrillar protein concentration, increased conversion of fast- to slow-twitch muscle fibers, interference to neural adaptations, and altered catabolic/anabolic hormone concentrations.

Genetics is now everywhere in medicine and sports science, and the latest word is that it will be possible for any individual to have their full genome sequenced for ~\$1,000 within the next two years. James Skinner gave an informative tutorial session on **Genetics for Professionals** looking back at the high profile HERITAGE study conducted from 1992-2004. From a sports performance perspective the key issue of how individuals respond differently to various train-

ing interventions can be investigated on a genetics basis. Skinner summarized his view that elite athlete performance (phenotype) is influenced by a well-structured training program and underlying genetic endowment (genotype). The hunt is on for the genes determining responders, non-responders, and adverse responders to training.

The genetic theme also featured strongly in a session on the **Human Microbiome and Sports Performance** presented by Larry Armstrong and Carol Torgan. The Human Microbiome Project involved 242 subjects and yielded some fascinating insights: there are approximately 10 times more microbes than cells, representing 1-3% of body mass, mainly in the gut. Heat stroke in athletes is due mainly to release of lipopolysaccharide from gram-negative bacteria in the gut producing endotoxemia, which causes failure of major organs. Factors influencing the microbiome include diet, hygiene, antibiotic use, the environment and physical factors related to exercise, such as altitude, heat and humidity, and over exertion. Future work will investigate the utility of bacterial biomarkers for identifying disease risk, overtraining, fatigue status, and predisposition to heat illness. It is possible this work might evolve to an athlete microbiological passport.

Altitude training always features strongly at the ACSM. This year Jerome Dempsey gave a provocative lecture entitled **Humans in Hypoxia—a Conspiracy of Maladaptation**. His thesis was that the research and sport community often only see the benefits of altitude training and ignore the costs, including sleep apnea, hypertension, peripheral vasodilatation limiting oxygen delivery to the brain and insulin resistance, all of which could negate positive physiological effects on performance.

Fatigue from the single muscle fiber to exercise performance was discussed in a symposium on **New Insights into Skeletal Muscle Fatigue**. Bruno Grassi neatly summarized research showing that fatigue in muscle is associated with increased fiber recruitment oxygen uptake. When additional fibers cannot be recruited and extra oxygen cannot be delivered, there is a reduction in force/power. Stephen Bailey reviewed the relevant research on nitrate supplementation showing that 2 x 70 ml shots of beetroot juice taken 2.5 h pre-exercise can yield enhancements of 0.4% in (individual)

exercise performance and 4.2% in YoYo intermittent recovery test (for team sports). More work is need on elite athletes. Our understanding of the mechanistic basis of performance enhancement continues to evolve from both human and animal studies. At present it appears that nitrate could work via mitochondrial function, regulation of excitation-contraction coupling, vascular control, and delivery of glucose.

The always impressive Randy Wilbur from the US Olympic Training Center chaired a current issue on **Overtraining: Research and Recommendations for Strength, Endurance and Team Sports**. Mike Stone used a series of case studies to highlight some of challenges and solutions in managing strength and power athletes. Long term development of younger athletes should follow the sequence of coordination training, power then maximal strength. Research in strength and power training is complicated by limited sample size and the fact that training is rarely in isolation of other factors. Preservation of ecological validity in strength research is critical which unfortunately limits the application of studies of lower level collegiate athletes. The long-held paradigm of the testosterone/cortisol ratio remains interesting but not conclusive in monitoring training responses. Bill Sands promoted the benefits of using a sports-specific clinical/practical approach for athlete assessment rather than traditional research designs and statistical significance in his talk on 20 y experience with elite athletes, primarily US gymnasts. Wilbur considered that *underperformance* is a much less threatening term for coaches and athletes than *overtraining*. His traffic light analogy for managing training loads, adaptations and underperformance would be understandable by every coach. A three-step process was suggested for an underperforming athlete: a comprehensive evaluation possibly including a blood test, health screen, nutrition review, functional movement screen, and biomechanical evaluation; then modification of training back towards an active training phase; and finally a conservative progressive return to full training and competition.

Finally, Louise Burke from the Australian Institute of Sport gave a very impressive president's lecture on **Sports Nutrition—Lessons from the Coalface** to wrap up the meeting. Her key messages centered on the idea that research

is important but the rules of engagement in sports performance are different to other non-sport research programs. Observational research designs and issues on ecological validity prevail in many cases over a more traditional randomized controlled approach. Burke contended that the athletes often know more than we do about the effects (positive and negative) of various dietary practices and nutritional interventions. Sports nutrition is a complex mosaic of factors and should not be reduced to a black and white (right or wrong; significant or non-significant) basis. Burke highlighted recent controversies on sports drinks and the benefits or otherwise of nutritional supplements that have adverse media exposure. Event nutrition is about finding the sweet spot for athletes by employing an individualized plan customized to the training or competition setting. She also reminded the audience that athletes have a brain as well as muscles and a stomach. Elegant mouth-rinse studies are yielding useful insights on the way body copes with variations in carbohydrate availability and temperature among other exercise challenges.

Noteworthy Abstracts with Will Hopkins

Having just taken more than a full week to review the ECSS conference, I was both relieved and disappointed to get through this report in about three full days. Although there were more abstracts in total than at ECSS (3049 vs 2452), far fewer were relevant to my focus on athletic performance, as you can see from the length of the two reports. ACSM is now ACEM: the American College of Exercise (is) Medicine.

Magnitude-based inference got a mention in six abstracts and reached the exalted status of acronym (MBI) in one of them, but most researchers still think that $p < 0.05$ and $p > 0.05$ are all ye know on earth and all ye need to know. Other complaints: sample sizes seem to be even smaller than last year, non-significance in grossly underpowered studies is still being misinterpreted as *no* effect, author-defined abbreviations are still rampant, and too many badly formatted or badly written abstracts are getting past the sponsoring fellows of the College and the review committee.

The highest point in the abstract for me was a thematic poster session on *training strategies and performance* [2256-2263], which had the

highest concentration of high-quality studies relevant to athletic performance that I have seen in any conference. These studies merited a slide session.

Here is my pick of the most novel or promising **performance-enhancing strategies**: aerodynamic prediction of the best [pacing strategy](#) for team-pursuit cyclists; [biomechanically adapted shoes](#) for cyclists; [compression garments](#) for baseball pitchers and cross-country skiers; [specific training](#) for soccer, softball and baseball players; [vision training](#) for softball players; [video training](#) for springboard divers; and [minimalist shoes](#) for runners.

Access the conference abstracts via [this link](#), which downloads the entire conference proceedings as a PDF (21 MB). Use the advanced search form (Ctrl-Shift-F) to find abstracts featured in this report via the number in brackets [...]. You will get several hits, but you can quickly home in on the right one. The abstracts are also freely available in the [May supplement](#) of *Medicine and Science in Sports and Exercise*, but the efficient way of searching for individual abstracts via the search form there no longer works.

Acute Effects

The developers claim that prior **electrical muscle stimulation** with the Compex "potentiates" performance, and if the authors have the effects the right way around, there was indeed the possibility of a 2.2% enhancement of a vertical jump and a 0.6% enhancement of a 40-m dash in a crossover with 14 Division I collegiate male **footballers** [2134]. But I wouldn't invest yet.

Warm-ups worked well for performance of a **golf** swing in this crossover of 26 highly proficient male golfers, but the authors didn't make it clear—and I was unable to figure out from the litany of p values—which combination of aerobic, **stretching** and specific activities was best [887].

A review of the effects of **stretching** on **running** speed came to the conclusion that "the majority of literature suggests that stretching has a detrimental effect on running speed, in particular static stretching. The results for dynamic stretching are contradictory, and there is insufficient evidence to make a conclusion... More studies are needed on longer distances" [2306].

So here's one: **dynamic stretching** for 15

min enhanced performance in a 5-km time trial by a large 2.2% in this crossover in 15 male **cross-country runners** [698].

Static stretching also improved performance and efficiency of 20 **cyclists** in a graded (incremental?) exercise test in this crossover study, but honestly, the effects are shown as F statistics and with up to 5 significant digits! When will they ever learn? [2172].

Precooling by drinking an ice slurry had a small *negative* effect (0.7%) on 5-km time in a crossover of 14 male and female **distance runners** [1753].

Cold-water immersion vs sitting at room temperature for 12 min for **recovery** between two 1500-m time trials in unstated ambient conditions mimicking a semi-final and a final produced a ~1% improvement in performance in this parallel-groups trial of 11+11 male and female **runners**. Aw, shucks, $p=0.052$, so it was only a "trend" [708]. In a similar crossover study of nine **endurance-trained males**, the design didn't quite simulate **recovery** between a semi and final, because the researchers added an extra "300-yard shuttle run to ensure fatigue" after the first of two 5-km **runs**. The second run was 10% slower with control recovery between the runs but only 2.6% slower with 15 min of **cold-water immersion** [2914]. It's surprising that such a large difference was not significant, so maybe cold-water immersion doesn't work for everyone. The study needs to be done with less fatigue in the second run.

Wow, put together the aerodynamic characteristics of the **team-pursuit cyclists** in the lead and drafting positions, along with what looks like the high-intensity power characteristics of the riders, and you can predict a medal-winning **pace strategy** in the Olympics [613].

Even **pace** is still the best strategy in a 4000-m **cycling** time trial (lasting ~5.5 min) in 19 "subjects", even though efficiency declines during the time trial [602, 603].

Eight **cyclists** who adapted to a "**biomechanically adapted shoe**" (1.5 mm of forefoot varus wedging, enhanced longitudinal arch support and a metatarsal button) achieved 2.1% higher mean power in a ~16-min time trial and 1.8% and 1.4% higher Wingate peak and mean power compared with control shoes in this double-blind crossover [2855]. The authors admitted they needed more subjects, but don't wait to try this yourself.

Twenty-one Division 1 female **swimmers** swam 1.8% slower in a 100-yd time trial when they took one **breath** every seven strokes instead of the usual 2-3 [540].

Male **swimmers** had to cover less of their skin with **swimsuits** compared with females at the London Olympics, with the result that the women swam relatively faster [1763].

Compression shirts decreased pain and improved speed of 60 pitches in a crossover of 15 young **baseball pitchers** [2167].

Lower-body **compression garments** seem to benefit roller-skiing economy in 7 female and 7 male **cross-country skiers**, but the abbreviations are too dense for me to decode [2262].

There has to be one delightfully impossible effect at every conference. The conclusion in this crossover study of 20 male road cyclists was that "energetically charged **holographic discs** significantly increased power output and exercise time to exhaustion and decreased perceived exertional pain in **endurance athletes**" [1624]. With no plausible mechanism, this effect has to be a Type-1 error.

Correlates of Performance

In the **Ironman triathlon**, the faster you cycle, the slower you run, apparently, but the abstract was so dense with confusing abbreviations that I gave up trying to figure out any practical application [709].

Kenyan run more **economically**, for reasons unclear [1754].

Hunters of **endurance genes** have bagged a few more trophies [2268, 2271], but some also got away [2272].

It's interesting, but I can't see any practical application of the finding that the resting muscle **transcriptome** predicts 40-km cycling time-trial performance about as well as ventilatory threshold does in 20 **cyclists** [701]. There are good reasons for finding measures at rest or in submaximal tests that track performance, but it's no good if you have to keep taking biopsies.

Nutrition and Drugs

Compared with ad-libitum drinking, prescribed **hydration** improves **cycling** performance in the heat [311].

If anything, **hyperhydration** had a negative effect when added to pre-cooling for **endurance cycling** performance in hot humid conditions [316].

Here's a study where they wasted 10 moder-

ately **trained males** by assigning them to a non-training group. The other 20 ended up in groups training hard on **cycle ergometers** for 6 wk with **beetroot** juice or placebo. There were some obvious benefits of beetroot on performance and economy, but the differences in the huge changes in each group were not significant (thanks to the large errors and/or individual responses) [2423]. My conclusion is that the beetroot worked, but these athletes weren't already highly trained. The evidence is piling up for at best no useful acute effect in such athletes (see the [ECSS report](#)), and I doubt if it will benefit training either.

Supplementation with sodium **bicarbonate** improved 200-m rowing time by only 0.3% in a crossover with 20 male **rowers** [2387]. The authors claimed a likely beneficial effect, but the smallest important change for rowers is only 0.3% (Smith and Hopkins, 2011), so it's only *possibly* beneficial.

Ten well-trained male **rowers** assigned to **beta-alanine** supplementation experienced a 1.6% enhancement in 2000-m performance time compared with 10 assigned to placebo. It's not entirely clear, but it looks like bicarbonate supplementation enhanced the placebo group by 0.8% and the beta-alanine group by 0.3% [2126].

Caffeine worked on various aspects of performance [1102, 1104-1107, 1112] even though some authors claimed otherwise! A crossover study of 14 male and 12 female Olympic-distance **triathletes** using actual competition times deserves special mention: 3.7% reduction in the swim time and 1.3% in the overall time [1109].

A 5-mg dose of **melatonin** consumed 15 min before a 40-km **cycle**-ergometer time trial had a negligible effect on performance compared with placebo in a crossover with 8 "**subjects**" [2395]. The effect when it's consumed the night before (for sleep with a time-zone shift) needs to be investigated.

Do pain killers affect endurance performance? In a crossover with only six **cyclists**, performance in a 10-mile time trial (~30 min) after an hour preload was 0.8% faster with acetaminophen (**paracetamol**) and 4.2% slower with **ibuprofen** compared with placebo [2396]. The smallest important effect on a cycling time trial without a preload is 0.3 (Hopkins et al., 2009) of the race-to-race variability of ~1%

(Paton and Hopkins, 2006), which comes to ~0.3%, so even if we double this threshold to adjust for amplifying effect of the preload, paracetamol is possibly beneficial and ibuprofen is most definitely harmful. The authors declared the effects trivial by invoking an inappropriate effect statistic (ω^2). My advice to any **endurance athletes** is to try paracetamol but don't touch ibuprofen before a race. Naturally, discuss with your physician first.

The **blood transcriptome** (testing for genes expressed in blood) looks set to become part of the athlete **biological passport** for detection of abuse of **erythropoietin** (EPO), judging by the outcomes in this trial of 39 endurance athletes [1757].

Here's an example of an underpowered and poorly reported but important study from a top research group. As a beta-agonist, **salbutamol** is a potential performance-enhancing substance with a permitted upper limit of dosing to allow asthmatic athletes to use it. So, what's the effect of dosing with 0.5 \times and 1 \times the upper limit? The crossover with only seven **runners** showed 1.8% and 1.7% enhancements respectively in a 5-km time trial compared with placebo, but "there was no significant difference" [2420]. Did they try averaging the effects for the two doses? What the authors concluded is unclear, because the Conclusions section shows the Results section verbatim, but I'll bet they took these results as evidence of no effect. Aren't they also evidence of a substantial effect?

The same group did a better job of reporting the effect of **salbutamol** on repeated sprints in a **soccer** simulation. But again, the sample size was only seven males and six females, so the changes in each group are all over the place, and non-significance in the Results inevitably became no effect in the Conclusion [2391]. When I averaged the effects in both sexes and doses, I got improvements in sprint mean time, sprint mean power (how measured in a run?) and sprint peak speed of 0.9%, 5.7% and 0.9%. So there could be something here. My conclusion is that someone needs to do the study with a decent sample size. Meantime don't be surprised if inhaler use increases amongst non-asthmatic athletes, especially endurance athletes.

Training

Compared with usual training, 7 wk of **soccer-specific power training** produced 1.4% to

2.9% more gains in performance tests and a 9.6% reduction in body fat in a randomized trial of 8+8 Division II female **soccer players** [2257].

An **injury-prevention program** consisting of "sport-specific endurance, sprint and jumping ability as well as strength/power of various muscle groups" halved injury incidence in 71 professional **soccer** players over four seasons [2258].

A 7-wk **sport-specific training** regimen that targeted the spine and trunk improved throwing velocity by a moderate 6% in a randomized controlled trial of 17 female **softball** and 29 male Division III collegiate **baseball** players [2259].

Six weeks of **vision training** produced what look like moderate improvements (assuming the data show SEs rather than SDs) in **softball** skill tests in a randomized controlled trial of 21 Division II female collegiate softball players [2170].

Augmenting **video** with information about takeoff height produced bigger gains in height in a 12-wk randomized controlled trial of 10 female and 10 male young teenage springboard **divers** learning new dives [2260].

Running economy was 1.2% higher with **minimalist shoes** (the Vibram FiveFingers) than with usual footwear in an acute crossover, and after 14 days of adaptation the benefit was 0.8% in 8 male and 6 female recreational athletes [684]. But the effects were not statistically significant, so you guessed it, "the minimal footwear did not provide an advantage". Economy was also better by 5.8% and 2.5% in **bare feet** and **minimalist shoes** compared with usual shoes in an acute study of eight well-trained female distance runners [1751]. Other things being equal, a 1% improvement in economy means a 1% improvement in running speed, which for a top runner is a moderate benefit. But there are likely to be individual differences in the response to switching to minimalist shoes, so you need to get a physiologist to test your adaptation via performance in multiple

repeated tests (e.g., incremental to peak speed). Chronic pain or injury could also be an issue for some individuals.

On the other hand, when 25 **runners** training at least 15 miles per week were randomized to a parallel-groups 10-wk training study with traditional vs **minimalist shoes**, the gains were greater with traditional shoes (8.2% vs 7.0%) [706]. The authors showed a p value of 0.20, so the difference of -1.2% represents a likely harmful effect for minimalist shoes when analyzed with magnitude-based inference. But the huge gains in economy were attributed to "more consistent training as a result of participation in this study", so maybe the group training with the minimalist shoes did relatively less training. I suggest we reserve judgment until there is proper control or adjustment for training, but meantime I'm making a cautious recommendation for minimalist shoes, and I declare no industry relationship!

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