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## Race to the Swift? Not Necessarily

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Ian Waldie/Getty Images

Vasileios Zambelis, a Greek marathon runner, practicing for the 2004 Summer Olympics in Athens. Competitors and trainers looking toward Beijing in 2008 are anticipating and planning for grueling heat, humidity and air pollution.

INDIANAPOLIS — Steve Spence arrived in Tokyo on an August day in 1991 to run a world championship marathon. He knew right away that it would be bad.

The city was hot and humid and the air so polluted, Mr. Spence said, that he felt as though he could not take a full breath. His adviser, David Martin, an exercise physiologist, agreed. They were, Dr. Martin said, “the most challenging conditions that have ever been reported for world championships.”

But Mr. Spence, who is now the head cross-country coach at Shippensburg University in Pennsylvania, had trained long and hard for the race, the International Association of Athletics Federations’ World Championships. He had run so much that a five-minute-per-mile pace “felt like a jog,” he said. But his training had been so exhausting that he had to sleep 10 hours a night and nap 2 hours every afternoon. And his schedule, running 140 miles a week, was so onerous that he needed 5,000 calories a day to sustain himself.

“I got sick of eating,” he said.

Even so, he and Dr. Martin, who is a professor at Georgia State University, planned his training by trial and error, Mr. Spence recalled. “We just kind of muddled our way through,” he said.


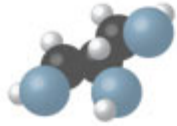




Times have changed. Armed with new knowledge of how to survive a grueling race in heat, humidity and pollution, trainers and coaches say they are already starting to plan for two races that may be as bad as Mr. Spence’s — the World Championships in Osaka, Japan, in 2007, and the Olympics in Beijing in 2008.

It is so early that the athletes for the races have not even been selected. But exercise physiologists and trainers are planning every detail, from a mile-by-mile examination of the routes to the use of a chemical that can prevent dehydration to methods for coping with the extreme air pollution in China.

Each tip, each special preparation, might take only 1 percent or so off a runner’s time, but that can mean the difference between fame and defeat.

**Marathon running turns out to be a science, and physiologists are starting to crack its secrets.**

**Punishing Conditions** Vasileios Zambelis, a Greek marathon runner, practicing for the 2004 Summer Olympics in Athens. Competitors and trainers looking toward Beijing in 2008 are anticipating and planning for grueling heat, humidity and air pollution.

 <p><b>HEAT AND HUMIDITY</b></p> <p><b>PROBLEM</b> Sweat does not evaporate easily in humid conditions, so the body compensates by producing more sweat, which can lead to dehydration.</p>  <p><b>SOLUTION</b> Drinking a mixture of water and glycerin, a viscous sugar alcohol, could help runners maintain hydration without causing excessive urination.</p>	 <p><b>POLLUTION</b></p> <p><b>PROBLEM</b> Polluted air can inflame and constrict air passages and set off exercise-induced asthma attacks.</p>  <p><b>SOLUTION</b> Inhalers are banned except for medically documented asthma, so runners with asthma must submit their medical tests well in advance.</p>	 <p><b>FATIGUE AND ENERGY LOSS</b></p> <p><b>PROBLEM</b> Eating fewer, larger meals can cause energy levels to fluctuate drastically throughout the day.</p>  <p><b>SOLUTION</b> Changing eating patterns to balance calories across the full day can significantly increase both power and performance.</p>
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And that includes psychological preparation, says Gloria Balague, who directs sports psychology services at the Sports Medicine Center and Human Performance Lab at the University of Illinois at Chicago.

“You can’t just hope to have a good day,” Dr. Balague said.

Mr. Spence’s experience shows how preparation and planning — even without the advances of the last decade — can determine who wins a race. At 6 a.m. on race day in Tokyo, the temperature was already in the 70’s and humidity was high. Mr. Spence knew he could not keep up his usual pace in those conditions, so his strategy was to run slower than usual and hope his training would pull him through, allowing him to speed up at the end while the faster runners faded.

The gun went off, and the other runners quickly pulled ahead.

“You begin to wonder, ‘Where am I?’ ” Mr. Spence recalled. “The leaders are so far ahead of me that I’ll never catch up.” Would they really wilt and fall behind on the 26-mile course?

They did, and so did many others: 40 percent of the runners never finished. Mr. Spence came in third, 40 seconds behind the winner, with an average pace of 5 minutes 11 seconds per mile. He went down in sports history as one of the few American marathoners to win a medal in a world championship.

“Was I the third most fit person in that race? Absolutely not,” Mr. Spence said. “Was I the third most talented? Absolutely not.” What made the difference, he said, was his training and strategy.



Shannon Stapleton/Reuters

When it is humid, sweat does not easily evaporate.

When it is humid, sweat does not easily evaporate, so the body sweats even more. Blood volume drops, and the body has to make a choice: divert blood to the skin for cooling or divert it to the muscles for performance. It sends blood to the skin.

The result is predictable, Dr. Martin said. With less blood going to the muscles, the runner slows down or stops. The challenge, then, is to find the fastest pace that can be maintained for 26 miles. Go too fast and you may collapse before the race is over. Go a little slower than you have to and you may lose the race.

“You’re on the horns of a dilemma,” Dr. Martin said.

Of course, he added, runners should not use lotions, including sunblock, because they add a barrier to the evaporation of sweat. He said that while it seemed logical to drink as much water as possible before the race — and runners try it — “it doesn’t work.” The reason, he explained, is that drinking a lot of water increases blood volume and the body responds by getting rid of it, in urine.

“What you need to do is to increase your total body fluids another way,” Dr. Martin said.

He added that the legal, safe way to do it is through glycerin loading. The technique exploits the unusual properties of glycerin, a thick, gooey sugar alcohol that is sold in drugstores as a lubricant. Each molecule of glycerin absorbs three molecules of water. During a race, the body uses the glycerin for energy. And every time the body metabolizes a molecule of glycerin, “it unleashes three molecules of water,” Dr. Martin said.

The result, he said, is that “you have a water bank account.”

Now, with plenty of time to prepare for the races in Osaka and Beijing, USA Track & Field sponsored a small meeting for coaches, distance runners and trainers on getting to the medals podium. Mr. Spence told how he prevailed in Tokyo; exercise physiologists shared research results; and coaches of the champion American Olympic marathoners Meb Keflezighi and Deena Kastor revealed their athletes’ preparations.

It was not the typical scientific meeting. At least half the people in the room wore runners’ watches on their wrists and running shoes on their feet. The meeting adjourned for 2½ hours in the late afternoon so the participants could go for a run and eat dinner. And it seemed that no training tip was too minor to be of interest.

The overwhelming challenge, the group agreed, was to run well in high heat and humidity. Dr. Martin, analyzing performance records for men, calculated that the optimum temperature for a fast marathon was about 54 degrees. Running times, he said, slow by one minute or more with every seven degrees above that, because it becomes more difficult for the body to cool itself.



Top, Reinhard Krause/Reuters; Randall L. Wilber/United States Olympic Committee

Air pollution, like that in Beijing, top, can bring on exercise-induced asthma. Runners took breathing tests before the 2004 Olympics in Athens to identify any adverse reactions to the air there.

Glycerin loading, he added, should be reserved for races of a half marathon or longer, when runners are competing in intense heat for at least an hour and a half. Ten days before the Tokyo world championships, Dr. Martin told Steve Spence to try glycerin loading.

“He told me it would help with hydration,” Mr. Spence said. “I asked a lot of questions. I was very skeptical because I didn’t want to mess with anything. But they assured me it wouldn’t cause any problems.”

He tried it in training, and used it in the race. “I definitely think it helped me,” Mr. Spence said.

Two American men, Steve Taylor and Brad Hudson, chose not to use glycerin in the Tokyo marathon, Dr. Martin said. Mr. Hudson did not finish the race, and Mr. Taylor “finished miserably,” coming in 26th, Dr. Martin said.

Mr. Spence used glycerin again in the 1992 Olympics in Barcelona, where he finished 12th. So did the other two American men in the marathon, Ed Eyestone, who finished 13th, and Bob Kempainen who finished 17th. One American woman, Cathy O’Brien, used it and finished 10th, Dr. Martin said.

But the glycerin trick is not widely known, and that is just what Dr. Martin wants. He and his colleagues studied it in the early 1990’s, testing it on athletes and asking, he said, “if it did any harm and whether they could finish a 20-mile run in hot weather and feel great.”

Wanting credit, the researchers published their work. But not wanting to advertise it to the world’s marathon runners, they published it in a Swiss triathlon journal, *Der Laufer*, written in German.

Food is another issue. A change in eating patterns can markedly improve performance, said Dan Benardot, a sports nutritionist at Georgia State. But getting athletes to change their eating habits is another story.

In analyzing athletes’ diets, Dr. Benardot and Dr. Martin found that the diets of some, like Ms. Kastor and Mr. Keflezighi, were nearly perfect, “astounding,” Dr. Benardot said.

But, he said, “most of the athletes have really severe energy deficits at different times of the day.”

They “don’t eat enough, and they don’t drink enough,” Dr. Benardot said. “Their backup plan is to take supplements,” which, he added, are not particularly useful.

The typical pattern for athletes, Dr. Benardot found, is to eat a tiny breakfast, snack throughout the day and then, “at the end of the day, oh, my God, they make up for it with a big meal.”

What would happen, he and Dr. Martin asked, if athletes parceled out their calories more evenly? In a recent study, they recruited 60 college athletes. Thirty were told to eat three high-carbohydrate energy bars a day, in midmorning, midafternoon and after dinner. The others got packets of a sweet powder to mix with water and drink three times a day. The athletes thought the study was comparing liquid to solid snacks. In fact, the powder contained no calories, and each energy bar had 250 calories.

**The challenge in the Beijing Olympics: to run well in high heat and humidity.**

No one gained or lost weight; those eating the energy bars unconsciously adapted to the extra calories by eating less at other times. But the athletes who ate the energy bars lost nearly 2 percent of their body fat, a statistically significant change, and greatly improved their performance on a 30-second test of anaerobic power and endurance.

“It’s a test from hell,” Dr. Benardot said.

He said the athletes were so competitive that they pushed themselves to exhaustion. “We had the world cross-country cycling champion on his knees,” Dr. Benardot said.

The test puts athletes on a bicycle connected to a computer. The computer adds 7 percent of the athlete’s body weight as resistance, and then the athlete sprints as hard as he or she can for 30 seconds. Five minutes later, the athlete does it again.

Not only did those eating the energy bars do better on the test, they also said they did not feel hungry and that they felt more vigorous, Dr. Benardot said. And, to his astonishment, the changes occurred in just two weeks.

“After the study was over, those who had the bars kept coming to us saying: ‘Do you have any more of those bars? What was in them, really?’ ” Dr. Benardot said. “Some of them thought it was illegal.”

A month after the study ended, those athletes were back to their old eating habits, and their body composition and performance on the anaerobic test were back where they had been before the study. “It was incredible,” Dr. Benardot said. “They went right back to their baseline levels.”

Even if the distance runners in the Beijing Olympics eat perfectly, though, they are going to face the problem of air pollution.

In March, Randy Wilber, an exercise physiologist with the United States Olympic Committee, went to Beijing to measure the air quality at training and competition sites.

“I walked around the city for over a week,” he said.

The air was not good. It had high levels of carbon monoxide, which significantly decreases the amount of oxygen that blood can carry. Added to that were high levels of ground-level ozone, nitrogen dioxide, sulfur dioxide and particulate matter, all of which can inflame and constrict the air passages in the lungs and set off asthma attacks even in people who have never had them.

“When you add in heat and humidity, with the heat index you can expect a sensation, a feeling of 90 to 95 degrees when you are outside,” Dr. Wilber said. “With prolonged exposure and moderate physical activity, you will be on the borderline between caution and extreme caution.”

The physical activity the athletes will be doing could hardly be described as moderate, however.

Parts of the 26-mile course are particularly dirty. “If any of you have driven through the steel mill district of Gary, Ind., that’s what it reminded me of,” Dr. Wilber told the meeting participants.

Air pollution can bring on exercise-induced asthma, even in athletes who never knew they were susceptible, Dr. Wilber said. But the runners cannot simply show up at the race and whip out an inhaler.

The drug they inhale, a beta-2 agonist, is considered a banned performance enhancer. If it shows up in a urine test, the athlete is disqualified unless he or she has medically documented asthma.

Since 2002, the World Anti-Doping Agency has said athletes must submit their medical tests well in advance of Olympic competitions. No longer will a doctor’s note be enough; an independent panel of medical experts will determine whether the athletes have asthma severe enough to warrant medication.

Dr. Wilber wants to pretest Olympic athletes in Beijing, something he did for several athletes competing in the 2004 Olympics in Athens. One or two years before the Olympics, the athletes will be going to Beijing for other competitions, Dr. Wilber said, and those events would be a perfect time to test them.

To show how important it is to find out about asthma ahead of time, Dr. Wilber described an athlete who was competing in track and field and had no idea he had asthma until he tried exercising at the Athens Olympics.

“He tested positive for exercise-induced asthma, and we gave him the meds right there,” Dr. Wilber said. “A few days later, he won a silver medal.”

Dr. Wilber also has another plan up his sleeve to help athletes — including those without asthma — compete while breathing Beijing’s polluted air. But he prefers not to reveal it to the outside world.

“There’s a fine line amongst all of us internationally,” he said. “They’re not going to tell us everything they’re doing. and I’m not going to tell them everything we’re doing.”

“That’s medals for us,” he said. “not them.”

**Correction: July 31, 2006**

*An article in Science Times on July 18 about new training techniques for marathon runners in the Olympics and other games included an incorrect reference from an exercise researcher to a legal tactic called glycerin loading, which takes advantage of glycerin’s ability to absorb water from the body and gradually release it during a race. The technique was used by three American men in the 1992 Olympics at Barcelona, as the article noted; it was not used by an American woman, Cathy O’Brien.*