Olympic Games: Have we reached a plateau in terms of speed?

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The world-record pace for the marathon continues to improve for both men and women. For men, the record pace for the marathon is now about as fast as the record pace for the 10,000-meter run just after World War II. Today, champion athletes are running more than four times farther at speeds of well under five minutes per mile.

How can this be? Are humans simply built better or is there something else behind the mind-blowing speeds on the racetrack?

Michael Joyner, M.D., an anesthesiologist at Mayo Clinic whose research interests extend to exercise science, says that a combination of factors are leading to new world records in track and field and other sports. He attributes the improved records, not necessarily to genetics, but to training harder and longer, improved medical care and the fact that people from throughout the world now participate.

In studying the world records of sporting events like the marathon, the mile and 10,000- and 5,000-meter races throughout the last 125 years, Dr. Joyner says there are key primary factors at play. Prior to World War I, athletes didn't train every day. They trained three to four times per week out of concern they would "overtrain" or become stale. By the 1920s, athletes were training more often and by the 1950s, especially in Eastern Europe, athletes were training daily for hours at a time.

By the 1960s, more people from other countries were involved in competition than ever before. Up until then, most champion athletes

came from European countries, the U.S., Australia and Canada. Since then, however, athletes from the developing world have been able to participate. Since the 1960s, some of the most successful athletes have come from the East African countries of Ethiopia and Kenya.

"So we've gone from maybe one-fifth or one-sixth of the world's population participating to where we now have a huge pool of people in the Olympic Games," Dr. Joyner says.

Does this mean we've reached a plateau in terms of speed?

"At some level we've reached a physiological plateau. In general, the champions of today don't have dramatically better treadmill times as compared to elite athletes of earlier generations. What I think we are seeing is a small effect due to better racetracks, shoes and improved sports medicine. And, people are participating longer, so you have more competitive depth which leads to better races and races designed to set world records," Dr. Joyner says.

The Physiology of Performance

In endurance sports such as running a marathon, there are three physiological determinants of performance: maximal oxygen uptake (also called VO2 max), lactate threshold and running economy (sometimes called running efficiency).

Maximal oxygen uptake is the maximum capacity for oxygen consumption by the body during peak performance. It is also a measure of aerobic fitness. Generally, the higher the VO2 max during peak performance, the better the cardiac output - which means the heart is bigger.

In a treadmill test of two young men - one, an athlete, and the other, not -

the athletic male generally has a VO2 max value of between 70 and 85 milliliters (ml) of oxygen per kilogram per minute, as compared to 45 in the sedentary male, Dr. Joyner says.

What fraction of your VO2 max you use over a period of time can depend on your lactate threshold, which is considered a marker of maximum steady-state performance for athletes in endurance events.

"The lactate threshold is highly related to how people perform in an event like the 10,000-meter race, marathons or a bicycle time trial. The physiology and biochemistry behind it is complex and controversial, but it's a good marker of when the regulatory and physiological control systems of the body are in balance," Dr. Joyner says.

Old Wives' Tales - The Lactate Threshold

Intense exercise causes lactic acid levels to build up faster than the body can metabolize it. For athletes, this can be good because in the process of generating lactic acid, energy for muscle is also being generated. However, Dr. Joyner says, there are some misperceptions about lactate levels. Specifically:

-- Lactate is not synonymous with muscle hypoxia: "The first misperception is that somehow people don't have enough oxygen when they are making lactic acid. That certainly can be true because lactic acid can come from a lack of oxygen, but under most circumstances the athletes have plenty of oxygen and there is plenty of oxygen in the muscle."

-- Lactate is gone from the muscle in the 15 to 30 minutes after exercise and does not make you sore: "The second misnomer is that lactic acid hangs around in your muscle for long periods of time. You may hear things like this individual is sore or not performing as well today because

they have a lot of lactic acid in their muscle from yesterday's event. Well, you can have very high levels of lactic acid in muscle, but it's gone 15 to 30 minutes after exercise - so lactic acid doesn't hang around a long time."

-- Breathing oxygen on the sidelines does not help enhance lactate levels: "Breathing oxygen on the sidelines really doesn't help - there's no evidence that it works."

Running Economy

How well your muscles use oxygen and how well they can metabolize glucose without producing a lot of lactic acid in the skeletal muscle (which can contribute to fatigue) are both important for performance, Dr. Joyner says. However, how much speed you can generate at the lactate threshold is also important. This is known as running efficiency or running economy. Runners with good running economy, for example, can generate more speed per given oxygen uptake. The legendary Olympic champion Frank Shorter had outstanding running economy and this likely contributed to his success. Lance Armstrong also showed marked improvements in his efficiency when he returned to bicycle racing after beating cancer and that clearly helped him win the Tour de France seven times.

Most world-class athletes have a high VO2 max or, as Dr. Joyner says, "They all have big engines and high lactate thresholds because they've been training hard for a long time. Their muscles have adapted to run very fast without releasing a lot of lactic acid.

"In cycling for example, when Lance Armstrong came back from cancer, he became much more efficient - he could generate more power per given oxygen update. That is the same as a runner being able to generate more speed per given power. When you look at this small pool of elite

athletes of runners, cyclists and rowers, all of them have a high VO2, all have a large engine and all of them have skeletal muscles that are designed not to produce a lot of lactic acid. So the question then becomes who is the most efficient," Dr. Joyner says.

The Aging Athlete

At 41 years old, nine-time Olympic medalist Darra Torres will be one of the oldest female Olympians at the 2008 Summer Olympic Games. It is not unheard of for a professional athlete to complete into his or her 40s, but it's unusual. Torres, a swimmer who specializes in sprints, depends more on muscle power and technique, not necessarily aerobic capacity.

Torres is not the first to compete into her 40s. Carlos Lopes was in his late 30s when he won the Olympic marathon in 1984. Jack Foster of New Zealand was in his 40s and he placed highly in the marathon in the 1972 and 1976 Olympic Games.

How can some athletes continue to compete into their late 30s and early 40s?

"Your VO2 max typically starts to decline in your 30s, but a highly trained athlete can delay that decline until they are in their later 30s or even early 40s. An average sedentary person loses about 10 percent per decade starting at about age 30, but for someone who is able to continue to train very hard into their 40s and 50s, they only lose about half that much - primarily due to the fact they continue to train hard," Dr. Joyner says.

The older athlete is redefining what normal aging is and what's possible for people who are middle age or older."

It's Cultural, Not Genetic

"Nobody becomes a great athlete without prolonged intense training," Dr. Joyner says. "As scientists search for genes and the determinants of performance, they keep drawing a blank. There have been no major gene discoveries saying that this gene really confers championship status or the potential for championship status of one person."

Sports are complex behaviors for biologists, he says. Many genes contribute to performance, but it isn't likely that one individual would have the right combination of all genes that would give you a natural competitive edge, he says.

"It can be very deceptive to say that since the Kenyans, and perhaps Ethiopians, are dominating distance running, it must be genetic. In fact there have been periods of time when other cultures have dominated distance running. Before World War II, the Finns dominated distance running. After World War II, the Eastern Europeans dominated distance running. They were just as dominant as the Kenyans are now," Dr. Joyner says.

Dr. Joyner points to cultural influences in sports. "I think what the Kenyans and Ethiopians have shown is the value of altitude training. They are physically active their entire lives, they live at high altitude, they run to and from school, they play soccer after school - all at high altitude (6,000 to 8,000 feet). There are not a lot of economic opportunities, so there is a tremendous incentive for people to run and train hard," he says.

"So what the Kenyans have added is altitude training, hard training and large numbers of highly motivated people, but their physiological data is not dramatically different from other people. I think you can make the same argument for the Eastern Europeans after World War II. If you

were a pretty good athlete, the government offered you and your family incentives to train in an otherwise bleak economic landscape," Dr. Joyner says.

Doping

"One of the sad things in last 30 to 40 years of sport has been the emergence of the pharmacological arms race, or doping," Dr. Joyner says.

Creating reliable tests for these illegal compounds has been difficult. Several recent studies show that testing in humans for both steroids and erythropoietin (EPO), a hormone that induces red blood cell production, is very difficult. In testing for EPO, for example, a study suggests the tests are ineffective unless administered shortly after having taken EPO, because EPO doesn't have a long life in the body. But EPO's effects can last for months.

Another study suggests that it is very difficult to detect the use of some steroids through urine tests in some ethnic groups.

"Researchers have started to test the tests and have raised questions about the accuracy of the existing tests. They've shown that if you don't do the test soon after people take the drug, it may be very difficult to detect (especially if EPO is take in low doses)," Dr. Joyner says.

The Bottom Line: Keep Moving

"Remember, while it's fun to watch sports and while we will all be tempted to sit in front of the TV to watch the Olympics. The really important thing is to get out and move. One hundred and fifty minutes of physical activity a week is really the most powerful medicine anybody

can prescribe. No matter what your level of fitness - even if it's just walking - try to be as physically active as you possibly can because that's the way to be a healthy old person and get more out of life," Dr. Joyner says.

Source: Mayo Clinic