

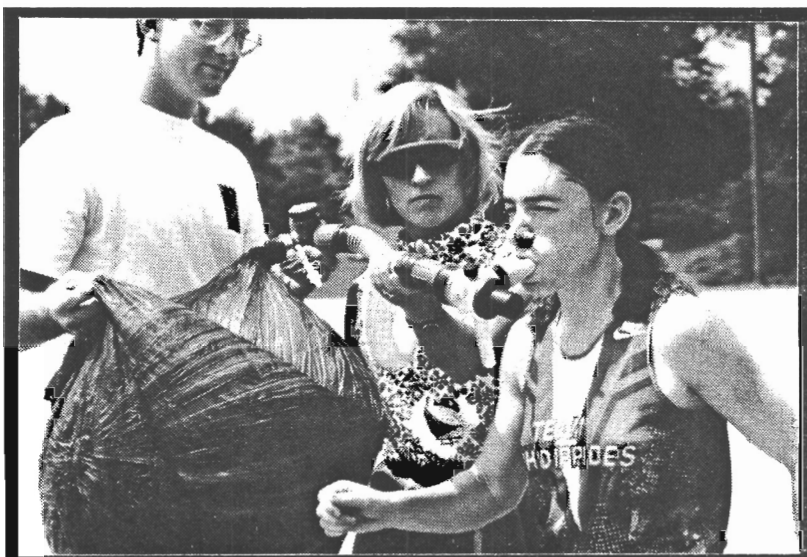
*For Immediate Release*  
*July 30, 1992*

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## PROLONGED EXERCISE IN HOT, HUMID CONDITIONS: FEMALE ATHLETES MAY HAVE AN EDGE OVER THEIR MALE COUNTERPARTS

If you're a woman and you like to run long distances, a Georgia Institute of Technology researcher has some good news for you. Highly trained female athletes may have an advantage over their male counterparts when exercising in hot, humid weather, according to research conducted by Dr. Mindy Millard-Stafford, associate professor in the Department of Health and Performance Sciences.

Millard-Stafford's study of fluid replacement among athletes drinking a carbohydrate-electrolyte "sports drink" shows that highly trained male and female runners matched by age and fitness status register some



*Dr. Mindy Millard-Stafford measures oxygen consumption of a runner. (Color Slides/B&W Prints Available)*

significantly different physiological responses during prolonged running in the heat. Women stay cooler and maintain higher blood volume than men, despite similar levels of dehydration, she said.

More follow-up studies are needed to determine the exact causes of the gender differences, Millard-Stafford noted -- but research in this area could influence recommendations on the concentrations and formula-

tions of carbohydrate-electrolyte sports drinks athletes consume during exercise. In 1990, she completed research that showed such drinks are more effective than water for boosting performance while preventing dehydration, overheating and fatigue among endurance athletes.

"We really wanted to test out whether optimal fluid

**-OVER-**

### **FOR MORE INFORMATION:**

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replacement strategies would be different for men and women, because it hadn't been documented," Millard-Stafford said. "We wanted to focus on highly trained distance runners, particularly with the Olympics coming here in 1996."

The researchers matched six female and six male runners similar in age, amount of training and aerobic capacity. All of the subjects regularly ran more than 85 kilometers (52.7 miles) per week.

The runners consumed 400 milliliters (12 ounces) of a carbohydrate-electrolyte beverage containing two percent fructose and five percent glucose polymer with electrolytes such as sodium, chloride and potassium before they ran. They then consumed about 250 additional milliliters (7.5 ounces) every five kilometers during the run. Although the subjects ran on different days in late summer, they always ran in the mornings under similar weather conditions and followed specific dietary and practice guidelines before the runs.

Researchers drew blood samples from the runners before the run, at 20 kilometers (12.4 miles) and 40 kilometers (24.8 miles) and after a 30-minute recovery period. They analyzed levels of blood glucose, sodium and potassium, as well as other variables including core body temperature, heart rate, sweat loss and energy expenditures.

The researchers found no statistically significant gender differences in sweat rates relative to body surface areas, or in levels of dehydration, blood pressure or types of fuel burned. However:

- Male runners lost more blood plasma volume than female runners. Plasma is the watery portion of the blood -- having less of it means less blood is circulating, the heart is pumping faster, and some tissues may lack proper amounts of oxygen.

- Male runners also registered lower levels of blood electrolytes such as sodium and potassium than females did. The researchers had expected the men to have more concentrated blood, and thus higher particle levels, because they lost more fluid than the women did.

Hormonal gender differences might explain these results, Millard-Stafford said. Five of the six female runners had, by chance, passed the ovulation stage of their monthly menstrual cycles when they ran. This meant that they may

have had higher levels of the hormone aldosterone, which regulates the body's salt and water balance. The more aldosterone present, the more sodium the body retains. Sodium attracts water -- so the more sodium in the body, the more water is retained, as well.

- The researchers also found that the women's body temperatures were cooler than the men's by about 0.7 degrees Celsius at the end of the race. Thirty minutes after the race, the women were cooler by an even greater amount -- 1.1 degrees Celsius. They were returning to baseline metabolism rates more quickly, Millard-Stafford said. This difference might be explained by the fact that the men ran slightly faster during the last five kilometers of the race than the women did, she said.

Another potential explanation for the Georgia Tech findings has been documented in other experiments by other researchers -- that women may not sweat as much as men do, but they do it more efficiently, getting more cooling for the amount of sweat lost.

Millard-Stafford would like to secure funding to continue the gender difference studies, expanding the measurements taken to include hormonal data. Her work is some of the latest that refutes previously held ideas that women's participation in endurance competition should be limited.

Women were not allowed to run marathon races in the Olympics until 1984 -- that year a female runner staggered across the finish line in the Los Angeles Coliseum, obviously suffering from heat stroke, Millard-Stafford noted.

"That event may have perpetuated the idea among the lay public that maybe women shouldn't be in this event," she said. "We felt very strongly that women would perform similarly to men if the male and female runners were matched properly, based on age, training and aerobic capacity."

Millard-Stafford presented her research May 29, 1992 at the annual meeting of the American College of Sports Medicine. It was supported in part by a National Institutes of Health Biomedical Research Support Grant.

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