



## GENDER DIFFERENCE IN CARDIOVASCULAR RESPONSES TO EXERCISE

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### Abstract

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There are physical and physiological gender differences in humans. The most consistent gender difference in cardiovascular responses to endurance or “dynamic” exercise (e.g., running, jogging, cycling, walking, etc.) is the lower stroke volume of women and the smaller increase in stroke volume from rest to exercise. Gender-specific differences in cardiac size/mass and blood volume may be responsible for the smaller stroke volume at rest and during exercise, as well as the lower peak oxygen uptake ( $VO_{2peak}$ ) in women than men of similar age. At the same absolute workload, both gender and physical fitness affect the heart rate response to exercise. Specifically, the increase in heart rate during exercise is the greatest in unfit women and smallest in fit men. However at the same relative workload (e.g., the percentage of  $VO_{2peak}$ ), the heart rate response is similar between men and women, as well as between fit and unfit individuals. At peak exercise effort, heart rate, blood pressure and arteriovenous oxygen difference are not significantly different between genders. Normal aging is associated with a decline in  $VO_{2peak}$ , while the rate of decline appears to be similar between men and women. The age-related decreases in stroke volume, heart rate and arteriovenous oxygen difference across the body at peak exercise contribute importantly to the decline in  $VO_{2peak}$  in the elderly. Regardless of age, gender and physical fitness, there is a constant relationship between the increase in  $VO_2$  and the corresponding increase in cardiac output (stroke volume  $\times$  heart rate) during exercise; in general, about 5-6 liters of cardiac output are required for every liter of oxygen uptake above rest. Taken together, gender does not affect cardiovascular responses to exercise and the age-related decline in exercise capacity in humans.

**Keywords:** sex, exercise capacity, physical fitness, aging

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Education

1989, She received M.D. in the field of medicine at Suzhou University School of Medicine, Suzhou, Jiangsu Province, P. R. China

1995, She received M. M.Sc. in the field of neurology at Suzhou University School of Medicine, Suzhou, Jiangsu Province, P. R. China

2001, she received Ph.D. in the field of autonomic neuroscience at Nagoya University School of Medicine, Nagoya, Aichi Prefecture, Japan

2001-2004, She worked as post-doctoral fellow in the field of autonomic neural control at the Institute for Exercise and Environmental Medicine, Texas Health Presbyterian Hospital Dallas, Texas, USA

Professional Experience

2004-2006, Instructor, Cardiology Division, Internal Medicine, the University of Texas Southwestern Medical Center

2016-2012, Assistant Professor, Cardiology Division, Internal Medicine, the University of Texas Southwestern Medical Center

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Honors and Awards

1993, Chou's Medical Research Award of Mr. Wen-xuan Chou's Foundation, Suzhou University Graduate School of Medicine, Suzhou, P. R. China

1994, Xu's Medical Research Award of Mrs. Xiang Xu's Foundation, Suzhou University Graduate School of Medicine, Suzhou, P. R. China

1995, The Outstanding Graduate Student Award, Suzhou University Graduate School of Medicine, Suzhou, P. R. China

1997-2001, The Japanese Government (Monbushou) Scholarship, Monbushou, Japanese Government, Japan

2001, The Japanese Foundation for Aging and Health, Japanese Government, Japan

2004, DAVID H.P. STREETEN American Autonomic Society Travel Award, The American Autonomic Society

2012, The 2012 Shih-Chun Wang Young Investigator Award, The American Physiological Society

2015, NASA JSC Group Achievement Award to Sex and Gender Report Team for outstanding contributions to the "Impact of Sex and Gender on Adaptation to Spaceflight" Report, NASA Lyndon B. Johnson Space Center