



# Women's Health Research

**T**he National Primate Research Center, University of Wisconsin-Madison, houses about 1,400 monkeys. The reproductive physiology and endocrinology of rhesus and cynomolgous macaques is almost identical to that of women. Marmosets exhibit several differences in regulation of reproduction that provide novel insights into human processes.

Following are studies related to women's health involving the center and its monkeys.

## REPRODUCTIVE HEALTH

### Maternal-fetal health

**Thaddeus Golos**, OB/GYN, uses the nonhuman primate model to study major areas of economic and societal cost pertaining to women's health. Research topics include fertility and infertility, maternal-fetal viral transmission, recurrent pregnancy loss, and fetal growth and well-being. Studies also involve the genetic control of early embryonic development, the placental regulation of maternal immunology and metabolism, and the fetal basis of adult disease.

Another goal is to integrate basic research in primate embryo development and pregnancy with assisted reproductive technologies and gene therapy approaches in the nonhuman primate. This will have broad applicability for model development in pregnancy and immunology, vaccine development, and research in primate genetics, development, aging, and behavior.

Primate Center researchers and affiliates are also concerned with placental function in women with diabetes or alcoholism.

### Polycystic ovary syndrome

Polycystic ovary syndrome (PCOS) affects one out of every 15 women. It is marked by infertility and miscarriage, and is frequently associated with diabetes. Other symptoms may include excess body hair and excess abdominal fat.

Rhesus monkeys are an excellent model for this disorder. **David Abbott**, OB/GYN, is collaborating with **Daniel Dumesic** at the Mayo Clinic to reveal the causes of polycystic ovary syndrome in rhesus

monkeys and women. This research team has shown the interrelatedness between symptoms that were previously considered unrelated, as well as revealing for the first time the fetal origins of this disorder and the possibility of a preventive cure.

### Endometriosis

Endometriosis causes painful abdominal inflammation and can impair reproductive function. The disease is common, but remains difficult to diagnose and treat. **Joseph Kennitz** has collaborated with the Marshfield Clinic through the UW-Madison Institution for Clinical and Translational Research to advance the study and treatment of endometriosis. **Stephen Kennedy** at Oxford University has identified monkeys at risk for endometriosis and is studying the disease's genetic components to improve its diagnosis and treatment in women.

### AIDS

Although HIV infection rates for men in the U.S. are declining, the infection rate for women is rising dramatically. AIDS is the leading cause of death in African American women between 24 and 44. Mother-to-infant transmission of the virus is also on the rise. **David O'Connor**, who directs the WNPRC's Research Services Division, along with Primate Center scientists **Eva Rakasz**, **Tom Friedrich**, and **David Watkins** at the University of Miami are working on developing potential vaccines and new treatments against HIV. These include ways to harness the power of elite controller genes, ways to prevent the transmission of HIV from mother to infant, and the use of topical microbicides aimed toward preventing heterosexual transmission of HIV.

### NEUROENDOCRINE RESEARCH

Many diseases or disorders are common to both sexes but occur more frequently in one sex or the other. At the onset of puberty, steroid hormones increase and substantial changes in the brain's neurotransmitters occur. Because the ovarian hormone estrogen is critical to maintain healthy



*Rhesus monkeys (Macaca mulatta), with peanuts they have stuffed into their cheek pouches.*

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neuronal function, understanding the mechanism of puberty and the role of steroids in neuronal function provides important insight into behaviors that occur differently between the sexes.

**Ei Terasawa**, Pediatrics, studies the neuroendocrine mechanisms controlling puberty and also how diet relates to puberty. She has recently discovered how excess calories early in life can spur early puberty in girls.

Terasawa and **Brian Kenealy, Ph.D.**, also recently discovered that the brain, not just the ovaries, can directly produce estrogen, and in large, rapid surges. This fundamentally changes the way we look at the brain's role in reproduction, hormonal control, behavior and disease.

## SENIOR HEALTH

### Osteoporosis

**David Abbott, Ricki Colman** and **Wendy Saltzman** have studied bone metabolism in female marmosets.

Socially dominant marmosets are reproductively active and have normal levels of estrogen. Subordinate marmosets, on the other hand, exhibit suppressed reproductive function and have low estrogen levels. Their low estrogen should put them at risk for osteoporosis, but these marmoset females do not suffer from accompanying bone loss as do human females with low estrogen. Research is aimed at uncovering the mechanisms preventing bone loss in these monkeys.



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*Common marmoset  
(Callithrix jacchus)*

### Glaucoma

**Paul Kaufman**, Ophthalmology and Visual Sciences, is developing new compounds to enhance aqueous outflow from the eye and treat glaucoma, which afflicts about 3 million women and men in the United States. The rhesus monkey is an invaluable model for studying glaucoma, the second most common cause of irreversible vision loss among Americans and the most common among African Americans. Researchers are focusing on novel compounds and gene therapeutic strategies to enhance fluid drainage from the eye. They are also studying compounds to protect retinal ganglion cells and their axons from pressure-induced damage.

## Aging and nutrition

WNPRC research on calorie-restricted rhesus monkeys revealed how the restricted animals were generally healthier than the controls. The restricted monkeys showed better glucoregulation and lower incidence of diabetes. They showed favorable changes in plasma lipids and less risk for cardiovascular disease. They also had less incidence of osteoarthritis. (2009 photo by J. Miller.)



The studies were led by **Richard Weindruch** at the Institute on Aging, and **Ricki Colman** at the Primate Center. They and others are investigating diseases of aging and the normal aging process with the aim of understanding, treating and preventing age-related diseases.

Weindruch, Colman, **Joseph Kennnitz** and others have learned a great deal about the biological mechanisms that control food intake and energy expenditure. They have found aging, calorie-restricted rhesus monkeys to be excellent models for studying obesity, diabetes, hypertension, coronary heart disease, osteoarthritis, neural function, menopause, endometriosis and other conditions and disorders.

Kennnitz also manages the Aging Primate Database, an internet resource for scientists around the world to use in their studies on aging in nonhuman primates.

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