BIOGRAPHICAL SKETCH

Junior Trainer

NAME: Colman, Ricki Jean

eRA COMMONS USER NAME (credential, e.g., agency login): rcolman

POSITION TITLE: Assistant Professor, Senior Scientist

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Washington University, St. Louis, MO	B.A.	05/1991	Biology, Anthropology
Washington University, St. Louis, MO	M.A.	05/1993	Biological Anthropology
University of Wisconsin, Madison, WI	M.S.	05/1998	Biological Anthropology
University of Wisconsin, Madison, WI	Ph.D.	12/1998	Biological Anthropology
WI National Primate Research Center, Madison, WI	Postdoc	01/2001	Primate Aging

A. Personal Statement

My laboratory utilizes nonhuman primate models to explore the impact of nutrition and metabolism on health across the aging continuum. To date the bulk of my research has focused on later life time points and the ability of caloric restriction to modulate the aging process, I have more recently begun to explore the impact of nutrition on early life growth and development. Caloric restriction offers a powerful way to explore mechanisms of aging because it is the only environmental intervention that repeatedly and strongly increases maximum life span and delays aging in a diverse array of experimental organisms. The inverse linear relationship between caloric intake and lifespan extension in rodents suggests a role for factors involved in the regulation of energy metabolism in the mechanisms of caloric restriction. Alterations in energy metabolism are observed in multiple species on caloric restriction, including humans. Therefore, the driving hypothesis behind my work is that caloric restriction induces an altered state of energy metabolism that promotes health and longevity. While my caloric restriction and aging research has been primarily in the macaque model, my work on nutrition and development utilizes a small New World primate model – the common marmoset. Given the links in the literature between unhealthy diet and depressive symptoms, and the increasing frequency of adolescent depression, along with the growing concern with childhood metabolic disturbances and poor diet, I felt compelled to ask the question: Does altering the fat composition and quantity in an otherwise healthy diet impact social and behavioral endpoints indicative of depression in humans, and what roles do changes in reproductive hormones in adolescence and altered metabolic profile play in this relationship? To address this question, I am testing the hypothesis that increasing levels of unsaturated fats consumed in the form of healthy snacks improves problem solving and learning, social interactions, activity levels and reward processing in adolescent marmosets whereas increasing the amount of saturated fats produces a negative effect on these areas.

1. **Colman RJ**, Anderson RM, Johnson SC, Kastman EK, Kosmatka KJ, Beasley TM, Allison DB, Cruzen C, Simmons HA, Kemnitz JW, Weindruch R. Caloric restriction delays disease onset and mortality in rhesus monkeys. *Science*. 325:201-204, 2009. PMC2812811.
2. **Colman RJ**, Beasley TM, Kemnitz JW, Johnson SC, Weindruch R, Anderson RM. Caloric restriction reduces age-related and all-cause mortality in rhesus monkeys. *Nature Commun*. 5:3557, 2014. doi:10.1038/ncomms4557. PMC3988801.
3. Mattison JA*, **Colman RJ***, Beasley TM, Allison DB, Kemnitz JW, Roth GS, Ingram DK, Weindruch R, deCabo R, Anderson RM. Caloric restriction improves health and survival of rhesus monkeys. *Nature Commun.* 8:14063, 2017. doi:10.1038/ncomms14063. PMC5247583. *Joint first authors

B. Positions and Honors

1989-1991 **Undergraduate Teaching Assistant**, Washington University, Dept. of Anthropology
1992-1993 **Teaching Assistant**, Washington University, Dept. of Anthropology
1994-1998 **Research Assistant**, Univ. of WI, Wisconsin National Primate Research Center

1998-2001 **Research Associate**, Univ. of WI, Wisconsin National Primate Research Center
2001-2005 **Assistant Scientist**, Univ. of WI, Wisconsin National Primate Research Center
2002-present **Affiliate Member**, Univ. of WI, Institute on Aging
2002-present **Unit Leader**, Aged Rhesus Monkey Resource, Wisconsin National Primate Research Center
2006-2011 **Advisor**, Behavioral Management Unit, Wisconsin National Primate Research Center
2006-present **Core Leader**, Aging and Metabolism, Wisconsin National Primate Research Center
2006-2010 **Associate Scientist**, Univ. of WI, Wisconsin National Primate Research Center
2010-present **Senior Scientist**, Univ. of WI, Wisconsin National Primate Research Center
2012-2015 **Chair**, Graduate School Animal Care and Use Committee, University of Wisconsin
2013-2015 **Vice-Chair,** All Campus Animal Planning and Advisory Committee, University of Wisconsin
2014 **Co-Chair,** Energy Metabolism & Chronic Dis., Wisconsin National Primate Research Center
2015-present **Chair,** Energy Metabolism & Chronic Dis., Wisconsin National Primate Research Center
2015 **Permanent Principal Investigator Status Award**, University of Wisconsin
2016-present **Co-Chair**, LSVC Animal Care and Use Committee, University of Wisconsin
2016 **Fellowship Status Award**, Gerontological Society of America
2017-present **Assistant Professor**, Cell & Regenerative Biology, University of Wisconsin
2018 **Vilas Faculty Early Career Investigator Award**, University of Wisconsin

C. Contribution to Science

My early publications aimed to validate methods for the assessment of body composition in rhesus monkeys. At the time, dual-energy x-ray absorptiometry equipment was newly developed and generally only being used clinically for the evaluation of bone mass and density. We adapted this equipment, working closely with the manufacturer, to measure total body and regional body composition in rhesus monkeys. The development of these noninvasive techniques for both the measurement and analysis of body composition allowed for relatively easy and cost-effective methods for the longitudinal assessment of body composition. Following this developmental phase, we utilized these techniques to evaluate the effects of long-term, adult-onset caloric restriction on body composition in rhesus monkeys. Through this work we have shown that caloric restriction prevented age-related increases in both total body and abdominal body fat that are normally seen in rhesus monkeys. We additionally utilized our large collection of information on rhesus monkeys to establish reference body composition for this species, important information that was lacking in the literature. I was fully responsible for all work associated with these publications from study design to data collection and interpretation to manuscript development.

a. **Colman RJ**, Hudson JC, Barden HS, Kemnitz JW. A comparison of dual-energy x-ray absorptiometry and somatometrics for determining body fat in rhesus monkeys. *Obes. Res.* 7:90-96, 1999.
b. **Colman RJ**, Roecker EB, Ramsey JJ, Kemnitz JW. The effect of dietary restriction on body composition in adult male and female rhesus macaques. *Aging* 10:83-92, 1998.
c. **Colman RJ**, Ramsey JJ, Roecker EB, Havighurst T, Hudson JC, Kemnitz JW. Body fat distribution with long-term dietary restriction in adult male rhesus macaques. *J. Gerontol.* 54A:B283-290, 1999.
d. Raman A, **Colman RJ**, Cheng Y, Kemnitz JW, Baum ST, Weindruch R, Schoeller DA. Reference body composition in adult rhesus monkeys: glucoregulatory and anthropometric indices. *J. Gerontol.* 60A(12):1518-1524, 2005.

Taking advantage of my work in developing noninvasive methods of soft tissue assessment described above, we began to pursue the development of total body and regional bone mass and density assessments in rhesus monkeys. Once developed, we used these techniques to then establish patterns of bone loss with advancing age and changes in reproductive hormone levels showing that rhesus monkeys closely mimic the human condition, therefore furthering the utility of rhesus monkeys for the study of human clinical diseases such as osteoporosis. Given the understanding we had then developed in this model, we were then able to tackle a question of great interest in the calorie restriction community, does calorie restriction have a negative effect on skeletal health? We were able to show that while rhesus monkeys on calorie restriction had lower bone mass, this mass was appropriate for their smaller body size proving that calorie restriction was not negatively impacting skeletal health. I collaborated on the initial work with a clinical colleague and then had full responsibility for the following three publications including study design, data collection and interpretation and manuscript development.

a. Champ JE, Binkley N, Havighurst T, **Colman RJ**, Kemnitz JW, Roecker EB. The effect of advancing age on bone mineral content of the female rhesus monkey. *Bone* 19:485-492, 1996.
b. **Colman RJ**, Lane MA, Binkley N, Wegner FH, Kemnitz JW. The skeletal effects of aging in male rhesus macaques. *Bone:* 24:17-23. 1999.
c. **Colman RJ**, Binkley N, Lane MA, Abbott DH, Kemnitz JW. Skeletal effects of aging and menopausal status in female rhesus macaques. *J. Clin. Endocrinol. Metabol.* 84:4144-4148, 1999.
d. **Colman RJ**, Beasley TM, Allison DB, Weindruch R. Skeletal effects of long-term caloric restriction in rhesus monkeys. *AGE*. 34(5):1133-1143, 2012. PMCID: PMC3448987.

Sarcopenia, the loss of muscle mass with advancing age, is a serious clinical concern leading to increased morbidity and mortality. We know that people begin losing muscle mass at relatively young ages, but the mechanism behind this loss and ways to prevent sarcopenia are not well developed. The lack of an appropriate rodent model of sarcopenia greatly hinders this work. We therefore, established a rhesus monkey model of sarcopenia establishing first that rhesus monkeys, like humans, experience sarcopenia and determining the age at which this occurs. We then showed that calorie restriction was able to delay the onset of sarcopenia in rhesus monkeys and more recently we have focused on the mechanisms behind this beneficial effect of calorie restriction on muscle mass centering on a potential mechanism related to alterations in energy metabolism. Our most recent work incorporates measures of sarcopenia in the development of the rhesus monkey as a frailty model and shows the ability of caloric restriction to delay or prevent frailty. I designed and performed the initial experiments developing the techniques and validating the model and showing the effects of calorie restriction and the development and testing of the frailty model. The mechanism work is performed in collaboration with cellular biology colleagues with my full input and participation in study design, data collection and interpretation and manuscript preparation.

a. **Colman RJ**, McKiernan SH, Aiken JM, Weindruch R. Muscle mass loss in rhesus monkeys: age of onset. *Exp. Gerontol.* 40(7):573-581, 2005.
b. **Colman RJ**, Beasley TM, Allison DB, Weindruch R. Attenuation of sarcopenia by dietary restriction in rhesus monkeys. *J. Gerontol. A Biol. Sci. Med. Sci.* 63(6):556-559, 2008. PMCID: PMC2812805.
c. Pugh TD, Conklin MW, Evans TD, Polewski MA, Barbian HJ, Pass R, Anderson BD, **Colman RJ**, Eliceiri KW, Keely PJ, Weindruch R, Beasley MT, Anderson RM. A shift in energy metabolism anticipates the onset of sarcopenia in rhesus monkeys. *Aging Cell* 12(4):672-681, 2013. PMCID: PMC3714309.
d. Yamada Y, Kemnitz JW, Weindruch R, Anderson RM, Schoeller DA, **Colman RJ**. Caloric restriction and healthy lifespan: frail phenotype of non-human primates in the Wisconsin National Primate Research Center caloric restriction study. *J Gerontol Biol Sci*. doi:10.1093/gerona/glx059. epub ahead of print.

Working with neuroscience collaborators, we began investigations into the important question of the effects of calorie restriction on brain structure and function. This work was designed to address a crucial question regarding any effects, either positive or negative, of long-term, adult-onset calorie restriction in a primate model. This work involved noninvasive imaging in addition to evaluations of cognitive function, motor function, physical activity and glucoregulatory function along with other covariates of interest. Ex vivo determinations were also performed. I had full responsibility for all live animal portions of this work including study design and data collection and interpretation for cognitive and motor function, physical activity and glucoregulatory function along with all sample collection, and was fully involved in all design, data interpretation and manuscript preparation.

a. Willette AA, Bendlin BB, **Colman RJ**, Kastman EK, Field AS, Alexander AL, Sridharan A, Allison DB, Anderson R, Voytko ML, Kemnitz JW, Weindruch RH, Johnson SC. Calorie restriction reduces the influence of glucoregulatory dysfunction on regional brain volume in aged rhesus monkeys. *Diabetes* 61(5):1036-1042, 2012. PMCID: PMC3331743.
b. Sridharan A, Willette AA, Bendlin BB, Alexander AL, Coe CL, Voytko ML, **Colman RJ**, Kemnitz JW, Weindruch RH, Johnson SC. Brain volumetric and microstructural correlates of executive and motor performance in aged rhesus monkeys. *Front. Aging Neurosci*. 4(Article 31):1-19, 2012. PMCID: PMC3492760.
c. Sridharan A, Pehar M, Salamat MS, Pugh TD, Bendlin BB, Willette AA, Anderson RM, Kemnitz JW, **Colman RJ**, Weindruch RH, Puglielli L, Johnson SC. Calorie restriction attenuates astrogliosis but not amyloid plaque load in aged rhesus macaques: a preliminary quantitative imaging study. *Brain Res.* 1508:1-8, 2013. PMCID: PMC3652278.

d. Sridharan A, Bendlin BB, Gallagher C, Oh JM, Willette AA, Alexander AL, Kemnitz JW, **Colman RJ**, Weindruch RH, Johnson SC. Effect of age and calorie restriction on corpus callosal integrity in rhesus macaques: A fiber tractography study. *Neurosci Lett*. 569:38-42, 2014. PMCID: PMC4105191

I have more recently begun to translate my work into the common marmoset model. The desire has long existed within the research community for a small nonhuman primate model of glucoregulatory function. The common marmoset has generated much interest due in large part to their unique social structure. However, development of a common marmoset model of glucoregulatory function was severely limited by the lack of a validated insulin assay. Working with Dr. Ziegler, we finally succeeded in validating an insulin assay several years ago. This has led the way to increased utility of this relatively short-lived nonhuman primate for many areas of biomedical research. I was fully involved in all aspects of this work including study design, data interpretation and manuscript preparation.

a. Ziegler TE, Sosa ME, Peterson LJ, **Colman RJ**. Using snacks high in fat and protein to improve glucoregulatory function in adolescent male marmosets (Callithrix jacchus). *J Am Assoc Lab Anim Sci.* 52(6):756-762, 2013. PMCID: PMC3838610.
b. Ziegler TE, Sosa ME, **Colman RJ**. Fathering style influences health outcome in common marmoset (*Callithrix jacchus*) offspring. PLoS One. 12(9):e0185695, 2017. doi:10.1371/journal.pone.0185695. PMCID:PMC5619809.
c. Kraynak M*, **Colman RJ***, Flowers MT, Abbott DH, Levine JE. Ovarian estradiol supports sexual behavior but not energy homeostasis in female marmoset monkeys. *Int J Obesity*. 2018 Jul 18. doi:10.1038/s41366-018-0156-4 [Epub ahead of print]. PMCID in progress. *Joint first authors
d. Saltzman W, Abbott DH, Binkley N, **Colman RJ**. Maintenance of bone mass despite estrogen depletion in female common marmoset monkeys (Callithrix jacchus). Am J Primatol. 2018 Aug 14 14:e22905. doi:10.1002/ajp.22905. [Epub ahead of print].

Complete List of Published Work in MyBibliography:
http://www.ncbi.nlm.nih.gov/sites/myncbi/ricki.colman.1/collections/47287059/public/

D. Additional Information: Research Support and/or Scholastic Performance

Ongoing Research Support

NIH R01 AG040178 Colman (PI) 6/01/2016 – 5/31/2021
Caloric restriction and aging in rhesus monkeys.
This project explores the possibility that long-term dietary restriction retards aging processes in a nonhuman primate species. I have full responsibility for the design, oversight and performance of this study.
Role: Principal Investigator

NIH P51 OD011106 Mallick (PI) 5/01/2017 – 4/30/2022
Primate research center support
This base-operating grant for the Primate Center includes funds for Resource Development in Nonhuman Primate Aging and an Aging and Metabolism Core Laboratory, both led by me.
Role: Co-Investigator, Working Group Chair

NIH R01 HD083001 Ikonomidou (PI) 1/01/2016 – 12/31/2021
Hypothermia to prevent neurotoxic side effects of pediatric drugs.
This study is designed to determine whether hypothermia can protect the nonhuman primate brain from histological, behavioral and neurocognitive toxicity of common drugs used for anesthesia, prolonged sedation or antiepileptic therapy in human neonates and infants. I have responsibility for the cognitive testing portions of this study and will work with the PI on data analysis and reporting.
Role: Co-Investigator

NIH R24 OD020347 Colman, Power, Tardif (PI) 4/01/2016 – 3/31/2020
Research to improve and standardize marmoset nutrition and dietary husbandry.
This study will identify critical features of a standardized basic diet for captive common marmosets; determine links between diet, gut microbiome, and disease; and establish standards for healthy weights, body condition, and biomarkers of metabolic function. I have responsibility for the design, oversight and performance of this study.

Role: Principal Investigator

NIH R01 HD086057 Colman, Ziegler (PI) 7/01/2016 – 6/30/2021
Dietary fat ratio's influence on adolescent depression: A nonhuman primate model.
This grant examines the role of balanced fatty acids in promoting healthy brain development for cognition, the reward system and social behaviors from childhood through to adulthood in the common marmoset. I have full responsibility for the design, oversight and performance of this study.
Role: Principal Investigator

Mayo Clinic Research Grant Colman (PI) 7/18/2016 – 12/31/2019
Effect of senescent cell clearance on aging and metabolic phenotypes in monkeys.
This project examined the efficacy of novel treatments in killing senescent cells and therefore ameliorating age-related diseases. I have responsibility for oversight and performance of all portions of this project.
Role: Principal Investigator

Selected Completed Research Support

NIH R56 AG047358 Colman, Anderson (PI) 10/01/2015 – 8/31/2017
Skeletal muscle aging in rhesus monkeys.
This study utilizes rhesus monkeys, a highly translatable aging model, to elucidate the basis for sarcopenia onset and progression. I have full responsibility for the design, oversight, and performance of this study.
Role: Principal Investigator

NIH R01 AG043125 Johnson (PI) 8/01/2012 – 7/31/2016
The Effect of Caloric Restriction on Brain Aging
This project examines the effects of long-term caloric restriction on brain aging. I have responsibility for all animal-related portions of this project including design, data collection, analysis, reporting, and budgeting.
Role: Co-Investigator

NIH R01 AG038746 Jones (PI), Colman (PI, subcontract) 6/01/2015 – 5/31/2016
A metabolic model of aging in the common marmoset.
The goal of this subcontract is to perform follow-up metabolic testing on marmosets transferred to the WNPRC from the New England Primate Center colony. I have full responsibility for all aspects of this work.
Role: Principal Investigator, subcontract

NIH R01 HL102472 Colman (PI, subcontract) 4/01/2013 – 3/31/2015
Intrinsic Vascular Smooth Muscle Cell Stiffness
This grant, based at the New Jersey School of Medicine and Dentistry (PI: Stephen Vatner) contained a subcontract to WNPRC for evaluation of vascular smooth muscle cell stiffness in rhesus macaques.
Role: Principal Investigator, subcontract

Mayo Clinic Research Grant Colman (PI) 8/01/2014 – 7/31/2015
Effect of senescent cell clearance on aging and metabolic phenotypes in monkeys.
This project examined the efficacy of novel treatments in killing senescent cells and therefore ameliorating age-related diseases. I had responsibility for oversight and performance of all portions of this project.
Role: Principal Investigator

NIH P01 AG11915 Weindruch (PI) 5/01/2006 – 1/31/2013
Dietary Restriction and Aging in Rhesus Monkeys
This ongoing Program Project explores the possibility that dietary restriction retards aging processes in a nonhuman primate species. I was a Core Leader and Co-Investigator on this project.
Role: Core Leader, Co-Investigator

NIH HHSN263200800026C Kemnitz (PI) 9/01/2008 – 9/29/2013
Development and Maintenance of a Non-human Primate Tissue Bank
This award provides for a central repository of tissues from non-human primates, especially those of advanced age. I was responsible for scientific oversight of this project.
Role: Co-Investigator