

Calen P. Ryan

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Areas of specialization and current research interests

Evolution, Health, Tradeoffs, Reproduction, Aging, Development, Epigenetic Processes (DNA methylation, Non-coding RNAs), Short-tandem repeats, Transposable elements, Inheritance, Statistics, Reproducibility, R programming language, Evolutionary Medicine

Education

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| 2020 | Ph.D., Anthropology <i>Tradeoffs between reproduction and aging in the human epigenome</i> Advisor: Christopher W. Kuzawa | Northwestern University |
| 2018 | M.A., Anthropology | Northwestern University |
| 2013 | M.Sc., Biological Sciences | Simon Fraser University |
| 2010 | B.Sc.(Hons.), Zoology | University of Manitoba |

Professional Appointments

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| 2021 | Postdoctoral Researcher | Northwestern University Department of Anthropology |
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Active Research Funding

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| 2018-2020 | National Science Foundation (BA-DDRIG) Quantifying the costs of human reproduction using the 'Epigenetic Clock' Role: Co-Principal Investigator | Northwestern University US\$31,205.00 |
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Publications

Peer-reviewed articles

- 2020** Shirazi, T.N., Hastings, W.J., Rosinger, A.Y. **Ryan, C.P.** Parity predicts biological age acceleration in post-menopausal, but not pre-menopausal, women. *Scientific Reports*. 10(1):20522
- 2020** **Ryan, C.P.** Epigenetic clocks: Theory and application in Human Biology. *American Journal of Human Biology*. e23488
- 2020** **Ryan, C.P.** and Kuzawa, C.K. Germline epigenetic inheritance: Challenges and opportunities for linking human paternal experience with offspring biology and health. *Evolutionary Anthropology*. 1–21.
- 2020** Kuzawa, C.K., Bechayda, S.A., Borja, J.R.B., Carba, D.B., Duazo, P.L., Eisenberg, D.T.A., Georgiev, A.V., Gettler, L.T., Lee, N.R., Quinn, E.A., Rosenbaum, S., Rutherford, J., **Ryan, C.P.**, McDade, T.W. Evolutionary life history theory as an organizing framework for cohort studies: Insights from the Cebu Longitudinal Health and Nutrition Survey. *Annals of Human Biology*. 47(2): 94-105.
- 2019** **Ryan, C.P.** Tandem Repeat Disorders. *Evolution, Medicine, and Public Health*. 1:17-17.
- 2019** McDade, T.W., **Ryan, C.P.**, Jones M.J., Hoke, M.K., Borja, J., Miller, G.E., Kuzawa C.W., Kobor M.S. Epigenetic signatures of socioeconomic status during development and early adulthood - *American Journal of Physical Anthropology*. 169(1):3-11.
- 2018** **Ryan, C.P.**, Hayes, M.G., Lee, N.R., McDade, T.W., Jones M.J., Kobor M.S., Kuzawa C.W., Eisenberg D.T.A. Reproduction predicts shorter telomeres and epigenetic age acceleration among young adult women. *Scientific Reports*. 8(1): 11100.
- 2017** Georgiev, A.V., **Ryan, C.P.**, Borja, J.B., Kuzawa, C.W. Does growth during early postnatal “minipuberty” predict adult second-to-fourth digit ratio (2D:4D)? Evidence from Cebu, The Philippines. *American Journal of Human Biology*. 23(7): e23047.
- 2017** McDade, T.W., **Ryan, C.P.**, Jones, M.J., MacIsaac, J.L., Morin, A.M., Meyer, J.M., Borja, J.B., Miller, G.E., Kobor, M.S., Kuzawa, C.W. Social and physical environments early in development predict DNA methylation of inflammatory genes in young adulthood. *Proceedings of the National Academy of Sciences of the United States of America*. 114: 7611-7616.
- 2017** Georgiev, A.V., **Ryan, C.P.**, Gettler, L.T., McDade, T.W., Kuzawa, C.W. Second-to-fourth digit ratio (2D:4D) is unrelated to measures of somatic reproductive effort among young men from Cebu, The Philippines. *American Journal of Physical Anthropology*. 163(3):437–445.
- 2017** **Ryan, C.P.**, Georgiev, A.V., Bechayda, S.A., McDade, T.W., Gettler, L.T., Eisenberg, D.T.A., Rzhetskaya, M., Hayes, M.G., Kuzawa, C.W. Androgen receptor polyglutamine repeat length (AR-CAGn) modulates the effect of testosterone on androgen- dependent somatic traits in Filipino young adult men. *American Journal of Physical Anthropology*. 163(2): 317–327.
- 2017** Bairos-Novak, K.R., **Ryan, C.P.**, Freeman, A.R., Anderson, W.G., Hare, J.F. Like mother, like daughter: heritability of female Richardson’s ground squirrel (*Urocitellus richardsonii*) cortisol stress responses. *Current Zoology*. zox014. doi: 10.1093/cz/zox014

- 2017 Gettler, L.T., **Ryan, C.P.**, Eisenberg, D.T.A., Rzhetskaya, M., Hayes, M.G., Feranil AB, Bechayda SA, Kuzawa, C.W. The role of testosterone in coordinating male life history strategies: The moderating effects of the androgen receptor CAG repeat polymorphism. *Hormones and Behavior*. 87: 164-175.
- 2017 **Ryan, C.P.**, McDade, T.W., Gettler, L.T., Eisenberg, D.T.A., Rzhetskaya, M., Hayes, M.G., Kuzawa, C.W. Androgen receptor CAG repeat polymorphism and hypothalamic-pituitary-gonadal function in Filipino young adult males. *American Journal of Human Biology*. 29(1): e22897
- 2016 **Ryan, C.P.**, Brownlie, J.C., and Whyard, S. Hsp90 and physiological stress are linked to autonomous transposon mobility in nematodes. *Genome Biology and Evolution*. 8 (12): 3794:3805. DOI: 10.1093/gbe/evw284
- 2015 **Ryan, C.P.**, Dawson, A.S., Sharp, P.J. and Williams, T.D. Uncoupling clutch size, prolactin, and luteinizing hormone using experimental egg removal. *General and Comparative Endocrinology*. 213: 1-8.
- 2014 **Ryan, C.P.**, Anderson, W.G., and Hare, J.F. Maternal gestational cortisol and testosterone are associated with trade offs in offspring sex and number in a free-living rodent (*Urocyon richardsonii*). *PLoS One*. 9 (10): e111052.
- 2014 Clary, D., Skyner, L.J., **Ryan, C.P.**, Gardiner, L.E., Anderson, W.G., and Hare, J.F. Shyness boldness, but not exploration, predicts glucocorticoid stress response in Richardson's ground squirrels (*Urocyon richardsonii*). *Ethology*. 120: 1101-1109.
- 2014 Hare, J.F., **Ryan, C.P.**, Enright, C., Gardiner, L.E., Skyner, L.J., and Anderson, W.G., Validation of a radioimmunoassay-based fecal corticosteroid assay for Richardson's ground squirrels (*Urocyon richardsonii*) and behavioural correlates of stress. *Current Zoology*. 60 (5): 591-601
- 2014 **Ryan, C.P.**, Dawson, A.S., Sharp, P.J. and Williams, T.D. Circulating breeding and pre-breeding prolactin and LH are not associated clutch size in the Zebra Finch (*Taeniopygia guttata*) *General and Comparative Endocrinology*. 202: 26-34.
- 2013 **Ryan, C.P.**, and Crespi, B.J. Androgen receptor polyglutamine repeat tract length: models of selection and disease susceptibility. *Evolutionary Applications*. 6:180-196.
- 2013 Singh, A.D., Wong, S., **Ryan, C.P.**, Whyard, S. Oral delivery of double-stranded RNA in larvae of the yellow fever mosquito, *Aedes aegypti*; implications for pest mosquito control. *Journal of Insect Science*. 13.69.
- 2012 **Ryan, C.P.**, Anderson, W.G., Gardiner, L.E. and Hare, J.F. Stress-induced sex ratios in ground squirrels: support for a mechanistic hypothesis. *Behavioral Ecology*. 23:160-167
- 2010 Anderson, W.G., Dasiewicz, P.J., Liba, S., **Ryan, C.P.**, Taylor, J.R., Grosell, M., and Weihrauch, D. Gastro-intestinal handling of water and solutes in three species of elasmobranch fish, the white-spotted bamboo shark, *Chiloscyllium plagiosum*, little skate, *Leucoraja erinacea*, and the clear-nose skate *Raja eglanteria*. *Comparative Biochemistry and Physiology. Part A, Molecular and Integrative Physiology*. 155: 493-502.

Book chapters and other publications

- 2017** **Ryan, C.P.** Simple Sequence Repeats. In Vonk, J. and Shackelford, T.K. (eds.) *Encyclopedia of Animal Cognition and Behavior*. Springer International Publishing.

Professional presentations with published abstracts

Podium Presentations

- 2020** **Ryan, C.P.**, Jones, M.J., Borja, J.B., McDade, T.W., Kuzawa, C.W. Testing for costs of reproduction using a new ‘epigenetic clock’ of all-cause mortality in a cohort of young women in the Philippines. Human Biology Association 45th Annual Meeting, Los Angeles, California, U.S.A. (Conference cancelled due to COVID-19)
- 2019** **Ryan, C.P.**, Kuzawa, C.W. Germline epigenetic inheritance: Challenges and opportunities of linking paternal experience with offspring biology and health. American Association of Physical Anthropologists and American Association of Anthropological Genetics, 44nd Annual Meeting, Cleveland, Ohio, U.S.A
- 2018** **Ryan, C.P.**, Edgar, R.D., Jones, M.J., Kobor, M.S., Borja, J.B., McDade, T.W., and Kuzawa C.W. Genome-wide DNA-methylation varies with reproductive status and supports costs of reproduction in a cohort of young Filipino women. International Society for Evolution, Medicine, and Public Health, 4th Annual Meeting, Park City, Utah, U.S.A.
- 2018** Kim, A.W., **Ryan, C.P.**, Bechayda, S.A, McDade, T.W., Kuzawa, C.W. Early life social experiences as predictors of depression in Cebu, Philippines: Investigating the mediating roles of the HPA axis and DNA methylation. Developmental Origins of Disease: Biocultural and Evolutionary Insights from Working with Vulnerable Human and Non-Human Populations. 46th Annual Meeting of the Canadian Association for Physical Anthropology. London, Ontario, Canada.
- 2018** Kim, A.W., **Ryan, C.P.**, Borja, J., McDade, T.W., Kuzawa, C.W. Early life social experiences as predictors of depression in Cebu, Philippines: Investigating the mediating roles of the HPA axis and DNA methylation. 43rd Annual Meeting of the Human Biology Association. Austin, Texas, U.S.A.
- 2017** **Ryan, C.P.**, Jones, M.J., MacIsaac, J.L., Morin, A., Borja, J.B., Kobor, M.S., Kuzawa, C.W., McDade, T.W. Epigenetic pathways of intergenerational phenotypic inertia in birth weight: Evidence from mothers in Cebu, Philippines. American Association of Physical Anthropologists and American Association of Anthropological Genetics, 42nd Annual Meeting, New Orleans, Louisiana, U.S.A.
- 2017** Eisenberg, D.T.A., Hayes, M.G., McDade, T.W., **Ryan, C.P.**, Georgiev, A.V., Jones, M.J., Kobor, M.S., Kuzawa, C.W., Costs of reproduction assessed via telomere length and epigenetic age measures of biological senescence in young adult women from Cebu, the Philippines. American Association of Physical Anthropologists, 86th Annual Meeting, April 22nd, New Orleans, Louisiana, U.S.A.
- 2016** **Ryan, C.P.**, Georgiev, A.V., McDade, T.W., Gettler L.T., Eisenberg, D.T.A., Hayes, M.G., Kuzawa, C.W. Variation in the androgen receptor modulates the relationship between

testosterone and sexually dimorphic traits in adult males. Human Biology Association, 41st Annual Meeting, April 13-14, Atlanta, Georgia, U.S.A.

- 2016** McDade, T.W., **Ryan, C.P.**, Fried, R., Jones M., Kobor, M., Kuzawa, C.K. Early origins of inflammation: Does DNA methylation mediate the association between nutritional and microbial environments in infancy and the regulation of inflammation in young adulthood? Human Biology Association, 41st Annual Meeting, April 13-14, Atlanta, Georgia, U.S.A.
- 2016** Georgiev, A.V., **Ryan, C.P.**, Gettler L.T., McDade, T.W., Kuzawa, C.W. Prenatal androgen exposure (2D:4D) and its relationship to early growth and adult reproductive effort in men from Cebu, The Philippines. American Association of Physical Anthropologists, 85st Annual Meeting, April 12-16, Atlanta, Georgia, U.S.A.
- 2016** Bairos-Novak, K.R., Anderson, W.G., Freeman, A.R., **Ryan, C.P.**, Hare, J.F. Like mother, like matriline: quantification and inheritance of Richardson's ground squirrel (*Urocitellus richardsonii*) stress responses. Prairie University Biology Symposium, Lethbridge, AB, Canada.
- 2013** **Ryan, C.P.**, Dawson, A.S., Sharp, P.J. and Williams, T.D. Hormone-trait relationships for experimentally enlarged clutches continue to challenge the prolactin-based model for clutch-size determination. Society for Integrative and Comparative Biology, Annual meeting and exhibition, Jan. 3-7, San Francisco, California, U.S.A.
- 2012** **Ryan, C.P.**, Dawson, A.S., Sharp, P.J. and Williams, T.D. Testing the prolactin-based mechanism for avian clutch-size determination in captive Zebra finches: Individual variability in hormone-trait relationships. North American Ornithological Conference, August 15-18, Vancouver, British-Columbia, Canada
- 2012** **Ryan, C.P.**, Dawson, A.S., Sharp, P.J. and Williams, T.D. Experimental evidence for a role of prolactin in modulating avian clutch-size. Society for Integrative and Comparative Biology, Annual meeting and exhibition Jan. 3-7, Charleston, South Carolina, U.S.A.
- 2011** **Ryan, C.P.**, Anderson, W.G., and Hare, J.F. Glucocorticoids, litter size optimization and sex allocation in *Urocitellus richardsonii*. Society for Integrative and Comparative Biology, Annual meeting and exhibition, Jan. 3-8, Salt Lake City, Utah, U.S.A.
- 2010** **Ryan, C.P.**, Anderson, W.G., and Hare, J.F. Struggling mothers, strong sons: optimization and adaptive sex allocation in Richardson's ground squirrels (*Spermophilus richardsonii*). Annual meeting for the Canadian Society of Zoologists, May 17-21, Vancouver, British Columbia, Canada

Poster Presentations

- 2020** **Ryan, C.P.**, Lin, D.S., Kobor, M.S., McDade, T.W., Kuzawa, C.W. DNA methylation measurements using dried blood spots on the Illumina EPIC array yield high quality data comparable to whole blood measured using the 450k array. American Association of Physical Anthropologists, 45th Annual Meeting, Los Angeles, California, U.S.A. (Conference cancelled due to COVID-19)
- 2018** **Ryan, C.P.**, Edgar, R.D., Jones, M.J., Kobor, M.S., Borja, J.B., McDade, T.W., Kuzawa, C.W. Genome-wide DNA-methylation in pregnancy and breastfeeding mark a 'landscape

of adaptive immunity' and novel biological networks. Human Biology Association, 43rd Annual Meeting, Austin, Texas, U.S.A.

Selected Media Coverage

Pregnancy and Cellular Aging: [USA Today](#), [NBC Healthline](#), [ABC News](#), [Daily Mail](#), [The Sun](#), [Scientias](#), [CBS Chicago](#), [US News and World Report](#)

Socioeconomic Status, Early Life Environments and DNA Methylation: [BBC-Russia](#), [Smithsonian Magazine](#), [US News and World Report](#), [European Scientist](#), [Chicago Tribune](#)

Honors and Awards

External

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| 2016- | NSERC Postgraduate Scholarship | Northwestern University |
| 2018 | Natural Sciences and Engineering Research Council of Canada (NSERC) | |
| 2016 | Alexander Graham Bell Canada Graduate Scholarship NSERC <i>Declined - ineligible outside Canada</i> | Northwestern University |
| 2011 | Michael Smith Foreign Study Supplement NSERC - <i>Research conducted at The Roslin Institute, University of Edinburgh, UK</i> | Simon Fraser University |
| 2010- 2011 | Alexander Graham Bell Canada Graduate Scholarship NSERC | Simon Fraser University |
| 2009 | IDP Student Mobility Scholarship IDP Education, Australia | University of Wollongong |
| 2008 | Undergraduate Summer Research Award NSERC | University of Manitoba |
| 2008 | W.B. Scott Scholarship in Ichthyology | Huntsman Marine Science Centre |
| 2007 | Undergraduate Summer Research Award NSERC | University of Manitoba |

Internal

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| 2010- 2011 | Provost Prize of Distinction Dean of Graduate Studies | Simon Fraser University |
| 2010 | Harold E. Welch Award Faculty of Science <i>Awarded for highest academic standing in B.Sc. Honours degree program</i> | University of Manitoba |
| 2010 | David Ian Mackenzie Medal Department of Zoology <i>Awarded for highest academic standing in Zoology degree program</i> | University of Manitoba |
| 2009- 2010 | UMSU Scholarship for Excellence in Academic Achievement University of Manitoba Students Union | University of Manitoba |
| 2006- 2007 | UMSU Scholarship for Excellence in Academic Achievement University of Manitoba Students Union | University of Manitoba |
| 2006- 2007 | Isbister Scholarship Manitoba Scholarship and Bursary Initiative <i>Awarded to 10 University 1 students attaining highest academic standing</i> | University of Manitoba |

Invited Talks

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| 2019 | Evolution in Medicine, Human Reproduction, and Health. 22nd annual Britton C. and Lucille McCabe Lecture, Springfield College, Springfield, Massachusetts, USA. April 11th, 2019. |
| 2019 | Using whole genome DNA methylation to study the costs of reproduction in a cohort of young Filipino women. Department of Biochemistry and Medical Genetics, University of Manitoba, Winnipeg, Manitoba. January 24th, 2019. |
| 2013 | Evolution and Disease in the Human Androgen Receptor. Department of Biological Sciences Seminar Series, University of Manitoba, Winnipeg, Manitoba. November 29th, 2013. |

Research Fellowships and Grants

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| 2019 | Data Science Development Grant Research Assistant Data Science for the Social Sciences Initiative | Northwestern University |
| 2018 | Le Cron Foster and Friends of Anthropology Research Grant | Northwestern university |
| 2018 | Leadership Coaching Program Northwestern Center for Leadership and McCormick School of Engineering and Applied Science | Northwestern University |
| 2018 | Computational Essentials for Social Scientists Data Science for the Social Sciences Initiative | Northwestern University |
| 2018 | Intensive in Computational Evolutionary Medicine Evolutionary Medicine Summer Institute (EMSI) | Duke University |
| 2015- 2016 | Graduate Research Assistant Institute for Policy Research | Northwestern University |
| 2012 | Dean of Graduate Studies Fellowship | Simon Fraser University |
| 2011 | Dean of Graduate Studies Fellowship | Simon Fraser University |

Campus/Departmental Talks

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| 2017 | Epigenetic Change as Biological ‘Memory’: Potential Pathways for Lifecourse Health Determinants in the Philippines. Department of Anthropology Graduate Student Colloquium | Northwestern University |
| 2011 | Endocrine control of clutch-size determination in <i>Taeniopygia guttata</i> - Linnaeusborg Centre for Life Sciences | Groningen University |
| 2011 | Physiological orchestration of life history traits: Why do mechanisms matter? | Centre for Ecology and Hydrology, U.K. |

Teaching

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| 2018-2020 | Virtual Science Mentor Mentor Matching Program | Illinois Science and Technology Institute |
| 2019 | Assistant Lecturer/Teaching Assistant Evolutionary Medicine | Northwestern University |
| 2019 | Workshop Assistant Intro to R, R for Stata Users | Northwestern University Research Computing Services |
| 2018 | Teaching Assistant: Human Population Biology | Northwestern University |
| 2017 | Guest Lecturer: Epigenetic Processes in Health and Evolution Evolution of Life Histories | Northwestern University |
| 2016 | Teaching Assistant/Guest Lecturer: Genomic Imprinting Evolutionary Medicine | Northwestern University |
| 2012 | Guest Lecturer: Endocrine Control of Life History Traits, States, and Trade-offs Endocrinology | Simon Fraser University |
| 2008 | Lab Demonstrator Principles and Themes in Biology | University of Manitoba |
| 2006-2009 | Tutor Biological Diversity, Function and Interactions Cell Biology | University of Manitoba, Disability Services |

Technical Training

Computational and Analytic Skills

Languages:

R (proficient), Python (basic), SQL (basic), Git/Github (basic), Bash (Linux) (basic), Perl (basic), L^AT_EX, (basic)

Statistical Methods:

Descriptive statistics and data visualization, linear regression, linear mixed-effects models, generalized linear and generalized linear mixed-effects models, principle component analysis, power calculations, model diagnostics, Monte Carlo simulations, high-throughput epigenome-wide association studies (EWAS). Empirical Bayes, model selection (information theoretic approaches, lasso, ridge, elastic net regression), regression trees, random forests, other methods for statistical learning.

Other Tools:

ErmineJ (Functional Enrichment); Cytoscape (Network Construction); ENSEMBL genome database and genome browser; PyMol (Molecular modeling); Epigenetic Age estimation methods

Professional Activities

Ad-hoc Peer-Reviewer

Scientific Reports, Journal of Evolutionary Medicine and Public Health, American Journal of Human Biology, Behavioral Ecology, Behavioral Ecology and Sociobiology, Bioessays, Current Zoology, Diabetes Metabolism Research and Reviews, Evolution, Medicine, and Public Health, Frontiers in Zoology, The Israeli Science Foundation, Journal of Mammology, Molecular Biology Reports, Oncotarget

Volunteering and Outreach

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| 2018-2020 | Virtual Science Project Mentor to Illinois High School Students Mentor Matching Program | Illinois Science and Technology Institute, Illinois |
| 2019-2020 | Meeting Co-organizer Northwestern R User Group | Northwestern University Evanston, Illinois |
| 2015-2016 | Meeting Planner and Timekeeper: Anthropology Graduate Student Association (AGSA) | Northwestern University, Evanston, Illinois |
| 2012-2013 | Biology Tutor: Introductory Biology | Native Education Centre Vancouver, Canada |
| 2005 | Note-Taker Disability Services (now Student Accessibility Services) | University of Manitoba, Winnipeg, Canada |

Language Skills

English ●●●●●

French ●●●○○

Spanish ●●○○○

Portuguese ●○○○○

Professional Memberships and Affiliations (Active)

American Association of Anthropological Genetics
American Association of Physical Anthropologists
Human Biology Association
International Society for Evolution, Medicine, and Public Health