

Zachary Aaron Graham, PhD

Research Health Science Specialist
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EDUCATION

- **August 2010 - May 2014**
 - **PhD:** Exercise Physiology-University of Kansas, Lawrence, KS
 - Advisor: Philip Gallagher, PhD
 - Dissertation Title: "The role of the focal adhesion following varying types of muscle loading"
- **August 2007 - July 2010:**
 - **MS:** Exercise Physiology-University of Kansas, Lawrence, KS
 - Advisor: Philip Gallagher, PhD
 - Thesis Title: "Integrin signaling at 2 h and 48 h post-eccentric exercise in heat treated rat skeletal muscle"
- **September 2002 - March 2007**
 - **BA:** Spanish-The Ohio State University, Columbus, OH
 - Graduated cum laude
- **August - December 2006**
 - **Certification in Hispanic Studies:** La Universidad de Granada, Granada, Spain

POSTDOCTORAL TRAINING

- **July 2014 - November 2018**
 - National Center for the Medical Consequences of Spinal Cord Injury, James J. Peters VA Medical Center, Bronx, NY; Department of Medicine, Icahn School of Medicine at Mt. Sinai, New York, NY
 - Mentor: Christopher Cardozo, MD
 - Research focused on mechanisms behind muscle atrophy following spinal cord injury

POSITIONS

- **8.19 - current:** Associate Scientist, UAB Center for Exercise Medicine, UAB
- **3.19 - current:** Research Health Science Specialist, Birmingham VAMC
- **3.19 - current:** Assistant Professor: Cell, Developmental and Integrative Biology, UAB
- **11.18 - 3.19:** Research Health Science Specialist, James J. Peters VAMC
- **9.18 - 3.19:** Assistant Professor: Department of Medicine, Icahn School of Medicine
- **7.14 - 9.18:** Postdoctoral Fellow: James J. Peters VAMC, Icahn School of Medicine
- **8.09 - 5.14:** GTA: Health, Sport and Exercise Sciences, University of Kansas

AWARDS

- **4.14** APS Minority Travel Fellowship for Experimental Biology
- **5.13** Department of HSES Outstanding Doctoral Student
- **10.12** APS Minority Travel Fellowship for Integrative Biology of Exercise
- **5.12** Stephen Horvath Minority Travel Award for ACSM National Conference:
- **6.04 & 05** Lotte Kaliski Foundation's Scholarship for Musically Gifted Students with Disabilities in the Sciences

FUNDING

Awarded

1. VA Rehabilitation Research and Development Career Development Award-2
1K2 RX002781-01A1
Dates: 10.1.18-9.30.23

Mechanisms and treatments of mitochondrial dysfunction in paralyzed skeletal muscle after SCI.

This proposal aims to investigate the roles of connexin hemichannels in causing mitochondrial dysfunction in paralyzed skeletal muscle after a moderate contusion SCI using skeletal muscle-specific Cre-Lox mice. Additional studies include testing the efficacy of the mitochondrial-targeting drug SS-31 in protecting mitochondria and muscle function using a mouse model of SCI.

\$955,012 over 5 years for 100% salary support and research funds.

Role: PI

CM: 12 months

PUBLICATIONS AND PRESENTATIONS

Published Manuscripts

16. **Zachary Graham**, Avigail Goldberger, Daniella Azulai, Rita De Gasperi, William Bauman, Christopher Cardozo, Joshua Yarrow. Contusion spinal cord injury upregulates p53 protein expression in rat soleus at multiple timepoints but not key senescence cytokines. *Physiological Reports* (Accepted, In press)

15. Joshua F. Yarrow, Hui Jean Kok, Ean G. Phillips,, Christine F. Conover, Jimmy Lee, Taylor E. Bassett, Kinley Buckley, Michael Reynolds, Russell Wnek, Dana M. Otzel, **Zachary Graham**, Christopher Cardozo, Prodip K. Bose, Stephen E. Borst, Fan Ye. Locomotor training with adjuvant testosterone promotes neuromuscular plasticity in rats after spinal cord injury. *J Neuroscience Research* (PubMed ID: [31797423](#))

14. **Zachary Graham**, Jacob Siedlik, Lauren Harlow, Karim Sahbani, William Bauman, Hesham Tawfeek and Christopher Cardozo. Key glycolytic metabolites in paralyzed skeletal muscle are altered 7 days after spinal cord injury in mice. *J Neurotrauma* (PubMed ID: [30869558](#))

13. **Zachary Graham**, Lauren Harlow, William Bauman, Christopher Cardozo. Alterations in mitochondrial fission, fusion and mitophagic protein expression in the gastrocnemius of mice after a sciatic nerve transection. *Muscle and Nerve*, 58; 592-599, 2018 (PubMed ID: [30028528](#))

12. Laura C. O'Brien, **Zachary Graham**, Qun Chen, Edward J. Lesnefsky, Christopher Cardozo, Ashraf Gorgey. Associations between adiponectin, body composition, metabolic profile, and mitochondria in individuals with chronic spinal cord injury. *Spinal Cord*, 56; 863-872, 2018 (PubMed ID: [29559683](#))

11. **Zachary Graham**, Rita de Gasperi, William Bauman, Christopher Cardozo. Recombinant myostatin reduces highly expressed microRNAs in differentiating C2C12 cells. *Biochemistry and Biophysics Reports*, 9; 273-280, 2017 (PubMed ID: [28691106](#))

10. Xin-Hua Liu, Lauren Harlow, **Zachary Graham**, William A. Bauman and Christopher Cardozo. Spinal cord injury leads to hyperoxidation and nitrosylation of skeletal muscle ryanodine receptor-1 associated with up regulation of NADH oxidase 4. *Journal of Neurotrauma*, 34; 2069-2074, 2017 (PubMed ID: [27998200](#))

9. Rita de Gasperi, **Zachary Graham**, Lauren Harlow, Weiping Qin, William Bauman, Christopher Cardozo. Studies of microRNA dysregulation in muscle paralyzed by spinal cord injury: downregulation of microRNAs that target myostatin signaling. *PLoS One*. 12; e0166189, 2016 (PubMed ID: [27907012](#))

8. Ashraf Gorgey, **Zachary Graham**, William A. Bauman, Christopher P. Cardozo, David R. Gater. Different training paradigms mediate various carbohydrate signaling pathways in the paralyzed and non-paralyzed muscle after spinal cord injury. *Journal of Spinal Cord Medicine*, 40; 439-448, 2017 (PubMed ID: [27735783](#))

7. **Zachary Graham**, Lauren Collier, Weiping Qin, Yuanzhen Peng, Juan Saéz, William Bauman, Christopher Cardozo. A soluble activin receptor IIB fails to prevent muscle atrophy in a mouse model of spinal cord injury. *Journal of Neurotrauma*, 15; 1128-35, 2016 (PubMed ID: [26529111](#))

6. **Zachary Graham**, Weiping Qin, Lauren Harlow, Nicholas H. Ross, William A. Bauman, Philip Gallagher, Christopher Cardozo. Focal adhesion kinase signaling is decreased 56 days following spinal cord injury in rat gastrocnemius. *Spinal Cord*, 54; 502-509, 2016. (PubMed ID: [26481700](#))

Curriculum Vitae

5. **Zachary Graham**, Chad Touchberry, Anishe Gupte, Greg Bomhoff, Paige Geiger and Phil Gallagher. Changes in alpha7beta1 integrin signaling in heat shocked rat soleus muscle. *Muscle and Nerve*, 51; 562-568, 2015 (PubMed ID: [2456997](#))
4. Phillip Vardiman, Nicole Moodie, Jacob Siedlik, Rebecca Kudrna, **Zachary Graham**, Philip M. Gallagher. Short-wave diathermy pretreatment and inflammatory myokine response after high-intensity eccentric exercise. *Journal of Athletic Training*, 50; 612-620, 2015 (PubMed ID: [25844857](#))
3. Phillip Vardiman, Jacob Siedlik, Trent Herda, William Hawkins, Michael Cooper, **Zachary Graham**, Jake Deckert, Philip Gallagher. Instrument-assisted soft tissue mobilization: effects on the properties of human plantar flexors. *International Journal of Sports Medicine*, 36; 197-203, 2015 (PubMed ID: [25347141](#))
2. Jacob Siedlik, Grant Harrison, Ronald Brigman, **Zachary Graham**, Joseph Weir, Philip Gallagher, Phillip Vardiman. Methods comparison: assessing agreement of physiological parameters obtained from exercise on two different cycle ergometers. *Journal of Strength and Conditioning Research*, 29; 1139-1145, 2015 (PubMed ID: [24263663](#))
1. Chad Touchberry, Anishe Gupte, Greg Bomhoff, **Zachary Graham**, Paige Geiger and Phil Gallagher. Acute heat stress alters skeletal muscle signaling responses following downhill running. *Cell Stress & Chaperones*, 17; 693-705, 2012 (PubMed ID: [22589083](#))

Published Reviews

4. Dibash Das, **Zachary Graham**, Christopher Cardozo. Myokine regulation of skeletal muscle physiology and metabolism. *Acta Physiologica*, ePub ahead of print (PubMed ID: [31442362](#))
3. Ashraf S. Gorgey, Oksana Witt,, Qun Chen, Edward Lesnfsky, Christopher Cardozo, **Zachary Graham**. Invited Review: Mitochondrial health and muscle plasticity after spinal cord injury. *Euro J App Physiol*, 58; 315-331, 2019 (PubMed ID: [30539302](#))
2. Christopher Cardozo and **Zachary Graham**. Muscle-bone interactions, movement in the field of mechanic-humoral coupling of muscle and bone. *Annals of the New York Academy of Sciences*, 1402; 10-17, 2017 (PubMed ID: [28763828](#))
1. **Zachary Graham**, Philip Gallagher, Christopher Cardozo. Focal adhesion kinase and its role in skeletal muscle. *Journal of Muscle Research and Cell Motility*, 36; 612-620, 2015 (PubMed ID: [26142360](#))

Manuscripts in Review

1. Ashraf Gorgey, **Zachary Graham**, Qun Chen, Jeannie Savas, Robert Adler, Edward Lesnfsky, Christopher Cardozo. Effects of testosterone with and without muscle hypertrophy on protein expression, fiber type distribution and mitochondrial health in humans with SCI. (Initial submission, *J Appl Physiol*)

Manuscripts in Preparation

1. **Zachary Graham**, Jennifer DeBerry, Christopher Cardozo, Marcas Bamman. A 50 kdyne contusion spinal cord injury with or without the drug SS-31 was not associated with major changes in muscle mass or gene expression 14 d after injury in 10 w old male mice. (In preparation)
2. Rita De Gasperi, Chengling Mo, **Zachary Graham**, Lauren Harlow, William Bauman, Marco Brotto, Christopher Cardozo. Numb is required for excitation-coupling in skeletal muscle. (In preparation)

Oral Presentations

4. Mechanisms and treatments of skeletal muscle dysfunction after paralysis. James J. Peters VAMC Research Day. May 14, 2018

Curriculum Vitae

3. Muscle-specific knockdown of Numb and Numb-like protein reduces in situ tetanic and twitch force production in mouse gastrocnemius muscle. 2 minute Data Blitz Presentation, University of Florida Myology Conference, Gainesville, FL, March 2017

2. A soluble activin receptor IIB fails to prevent muscle atrophy in a mouse model of spinal cord injury. American College of Sports Medicine National Congress, San Diego, CA, May 2015

1. Integrin Signaling in Heat Shocked Rat Soleus Muscle Following Eccentric Exercise. Central States American College of Sports Medicine Regional Conference, Overland Park, KS, October 2011

Published Abstracts/Poster Presentations

23. Xin-Hua Liu, Jiang Ping Pan, Lauren Harlow, **Zachary Graham**, Joshua Yarrow, Kenneth Cusi, William A. Bauman, and Christopher Cardozo. Spinal cord injury downregulated FGF21 signaling and is associated with dysregulation of metabolic gene expression in mouse liver and adipose tissue. Endocrine Society Annual Meeting. San Francisco, March 2020 (Accepted).

22. Abigail Goldberger, **Zachary Graham**, William Bauman, Joshua Yarrow, Christopher Cardozo. Stern College undergraduate research seminar. Stern College, 2018.

21. Lauren Harlow, Rite De Gasperi, **Zachary Graham**, William Bauman, Marco Brotto, Christopher Cardozo. The role of Numb and Numblike in tissue repair. FASEB Skeletal Muscle Satellite Cells and Regeneration. Steamboat Springs, CO, 2018.

20. **Zachary Graham**, Jacob Siedlik, Lauren Harlow, Hesham Tawfeek, William Bauman, Christopher Cardozo. Key glycolytic metabolites in paralyzed skeletal muscle are altered 7 days after spinal cord injury in mice. American College of Sports Medicine National Congress, Minneapolis, MN, May 2018

19. **Zachary Graham**, Rita De Gasperi, Lauren Harlow, William Bauman, Marco Brotto, Christopher Cardozo. Muscle-specific knockdown of Numb and Numb-like protein reduces in situ tetanic and twitch force production in mouse gastrocnemius muscle. University of Florida Myology Conference, Gainesville, FL, March 2017

18. Rita De Gasperi, **Zachary Graham**, Lauren Harlow, William Bauman, Marco Brotto, Christopher Cardozo. Localization of the adaptor protein Numb in the triad junction of skeletal muscle fibers. University of Florida Myology Conference, Gainesville, FL, March 2017

17. **Zachary Graham**, Rita De Gasperi, William Bauman, Christopher Cardozo. miR-145 targets the 3'UTR of Cited2 and is reduced by myostatin in C2C12 cells. Experimental Biology, San Diego, CA, April 2016

16. Xin-Hua Liu, **Zachary Graham**, Lauren Harlow, William Bauman, Christopher Cardozo. Overexpression of NADPH oxidase-4 is associated with increased skeletal muscle ryanodine receptor-1 oxidation/nitrosylation and dissociation from calstabin1 in spinal cord injured rats. Endocrinology, Boston, MA, April 2016

15. **Zachary Graham**, Rita de Gasperi, Lauren Harlow, Weiping Qin, William Bauman, Christopher Cardozo. Effects of nandrolone on the profile of dysregulated miRNAs in skeletal muscle paralyzed by spinal cord injury: identification of miR-145 as a regulator of Cited2. University of Florida Myology Conference, Gainesville, FL, January 2016

14. **Zachary Graham**, Chad Carroll, Tom Broderick, Philip Gallagher. Increases in protein expression of the alpha7beta1 integrin pathway following 8 weeks of acetaminophen administration in the rat soleus. Experimental Biology, San Diego, CA, April 2014

13. **Zachary Graham**, Phillip Vardiman, Jacob Siedlik, Jake Deckert, Philip Gallagher. The effect of instrument-assisted soft tissue manipulation on the alpha7beta1 integrin pathway. Experimental Biology, San Diego, CA, April 2014

12. **Zachary Graham**, Chad Carroll, Tom Broderick, Philip Gallagher. Acetaminophen has no effect on phosphorylated proteins downstream of integrins after 5 weeks of aerobic exercise training in rat soleus muscle. American College of Sports Medicine National Conference, Indianapolis, IN, May 2013

Curriculum Vitae

11. Andy C. Fry, David Wilson, Matt Andre, **Zachary Graham**, Patricia Dietz, Mike Lane. Combat-induced post-traumatic stress disorder results in blunted acute endocrine responses to heavy resistance training. National Strength and Conditioning Association National Conference, Las Vegas, NV, July 2013
10. Patricia Dietz, Andy C. Fry, Matt Andre, **Zachary Graham**, Mike Lane. Acute hormonal responses to super-slow or traditional resistance exercise in men: a pilot study. National Strength and Conditioning Association National Conference, Las Vegas, NV July 2013
9. **Zachary Graham**, Chad Touchberry, Paige Geiger, Anisha A. Gupte, Gregory L. Bomhoff and Phil Gallagher. Focal adhesion kinase expression in heat-shocked rat soleus muscle following eccentric exercise. American College of Sports Medicine National Conference, San Francisco, CA, May 2012
8. **Zachary Graham**, Chad Carroll, Tom Broderick, Philip Gallagher. Acetaminophen has no effect on integrin signaling following 5 weeks of treadmill exercise in rat soleus muscle. Integrative Biology of Exercise, Westminster, CO, October 2012
7. Trent J. Herda, Michael A. Cooper, Matthew J. Andre, Mike T. Lane, **Zachary Graham**, Philip M. Gallagher, Phillip Vardiman and Andrew C. Fry. Comparison of ground reaction forces derived from a force plate and motion capture system during body weight squats. National Strength and Conditioning Association National Conference, Providence, RI, July 2012
6. Matthew J. Andre, Andrew C. Fry, Michael T. Lane, **Zachary Graham**, Michael A. Cooper, Russell Emmons, Jake A. Deckert, Jessica L. Semaan, Justin J. Maresh, Patricia R. Dietz. Lower body strength and power are related to vertical jump power and sprint performance. National Strength and Conditioning Association National Conference, Providence, RI, July 2012
5. Mike T. Lane, Andrew C. Fry, Matthew J. Andre, **Zachary A. Graham**, Michael W. Hauber and Michael W. Aldright. Validation of a linear transducer for kinetic and kinematic assessment of the barbell squat. National Strength and Conditioning Association National Conference, Providence, RI July 2012
4. **Zachary Graham**, Chad Touchberry, Paige Geiger, Anisha A. Gupte, Gregory L. Bomhoff and Phil Gallagher. RhoA expression in heat-shocked rat skeletal muscle following eccentric exercise. American College of Sports Medicine National Conference, Denver, CO, May 2011
3. **Zachary Graham**, Chad Touchberry, Paige Geiger, Anisha A. Gupte, Gregory L. Bomhoff and Philip Gallagher. Integrin signaling in heat-shocked rat skeletal muscle following eccentric exercise. Integrative Physiology of Exercise, Miami, FL, October 2010
2. Nicole Moodie, Phil Vardiman, Rebecca Kudrna, **Zachary Graham**, Jeremy Bustamante and Phil Gallagher. Inflammatory cytokines and pain perception resulting from an eccentric exercise muscle damage protocol. American College of Sports Medicine National Conference, Baltimore, MD, May 2010.
1. **Zachary Graham**, Justin Fletcher, Ryan Wooderson, Ashley Fowles and Phil Gallagher. Differences in fatigue index, peak and mean power, and peak and mean lactate when comparing three different anaerobic max tests. Central States American College of Sports Medicine Regional Conference, Springfield, MO, October 2009

MENTEES

Research

Graduate

T32 Co-Translational Mentor

- Salvador Perez, Behavioral Psychology Module, UAB
- Devin Drummer, Cell and Molecular Physiology Module, UAB

Post-baccalaureate

- Daniella Azulai, Hunter College: Research Intern (Summer 2018-Winter 2019)

Undergraduate

- Adele Bloodworth, University of Georgia: Research Intern (Summer 2019)
- Abigail Goldberger, Stern College of Yeshiva University: Research Intern (Summer 2018)

Curriculum Vitae

- Jaclyn Wecht, Binghamton University: Research Intern (Winter 2016) - Current at the National Center for the Medical Consequences of SCI
- Nicolas Ross, UMass-Amherst: Research Intern (Summer 2015) - Current at NYU Dental

High School

- Juleberte Jean Pierre: Research Intern (Summer-Fall 2016)

Conference

- Jeremy Townsend (UCF): APS Porter Minority Travel Fellow for Experimental Biology, 2016

TEACHING EXPERIENCE

- December 2008-May 2014
Principle Instructor: Department of Health, Sport and Exercise Sciences, University of Kansas, Lawrence, KS.
 - Course: HSES 673-Fitness Techniques and Clinical Evaluations
- August 2009-May 2012
Principal Instructor: Department of Health, Sport and Exercise Sciences, University of Kansas, Lawrence, KS.
 - Course: HSES 108.2-Introduction to Weight Training
- August 2009-May 2012
Principal Instructor: Department of Health, Sport and Exercise Sciences, University of Kansas, Lawrence, KS.
 - Course: HSES 108.4-Physical Conditioning
- August 2010-May 2011
Principal Instructor: Department of Health, Sport and Exercise Sciences, University of Kansas, Lawrence, KS.
 - Course: HSES 269-Introduction to Exercise Science
- January 2011-May 2014
Teaching Assistant: Department of Health, Sport and Exercise Sciences, University of Kansas, Lawrence, KS.
 - Course: HSES 674-Exercise Biochemistry
- January 2013-May 2014
Teaching Assistant: Department of Health, Sport and Exercise Sciences, University of Kansas, Lawrence, KS.
 - Course: HSES 305-Methods of Strength Training and Conditioning
- August 2011-December 2013
Teaching Assistant: Department of Health, Sport and Exercise Sciences, University of Kansas, Lawrence, KS.
 - Course: HSES 369-Exercise Physiology
- August 2012-December 2013
Teaching Assistant: Department of Health, Sport and Exercise Sciences, University of Kansas, Lawrence, KS.
 - Course: HSES 369-Kinesiology

RESEARCH SKILLS

Wet Lab Skills

1. Cell culture
2. Site-directed mutagenesis
3. Sub-cloning and plasmid transfection
4. SDS-PAGE and Western immunoblotting
5. Quantitative real-time and traditional polymerase chain reaction
6. Luciferase, fluorogenic and ELISA assay experience
7. Immunofluorescence histochemistry
8. Hematoxylin and eosin histochemistry
9. Myosin ATPase histochemistry
10. Myosin heavy chain analysis with large format gels
11. Oxygen consumption analysis using the Seahorse Bioanalyzer

12. Isolated muscle fiber fluorescence assays
13. Cell and animal electroporation
14. Small muscle bundle high resolution oxygraph respiratory analysis

Animal Skills

1. Laminectomy and T9 spinal cord contusion and transection surgery in the mouse
2. Sciatic nerve transection in the mouse and rats
3. In situ lower limb physiology testing
4. Ex vivo muscle physiology testing
5. Hindlimb muscle harvest
6. Behavioral testing (Basso Mouse Scale, grip strength, Rotarod, open-field testing)
7. Post-operative care (bladder expression, subcutaneous injections)
8. Ear snip mouse genotyping

Exercise Physiology Skills

1. DEXA, hydrostatic weighing and caliper body composition testing and analysis
2. Blood pressure
3. Phlebotomy
4. ECG
5. Exercise risk stratification
6. Maximal and sub maximal aerobic and anaerobic exercise testing
7. Exercise prescription
8. Human skeletal muscle biopsy preparation, suction and wound care

SERVICE

Student Committee Member

- Margaret Bell (Dissertation, anticipated graduation in 2020)
- Devin Drummer (Dissertation, anticipated graduation in 2021)

Journal Reviewer

- Acta Physiologica (ad hoc): 1 Review
- AJP Cell (ad hoc): 1 Review
- AJP Reg, Int and Comp (ad hoc): 1 Review
- BioMed Research International (ad hoc): 1 Review
- J Appl Physiol (ad hoc): 1 Review
- J Neurotrauma (ad hoc): 1 Review
- J Trans Res (ad hoc): 1 Review
- Muscle and Nerve (ad hoc): 1 Review
- Physiology and Behavior (ad hoc) 1 Review

American Physiological Society

- April 2016-Experimental Biology Minority Travel Fellow Meeting Mentor

Birmingham VAMC

- November 2019-current Institutional Review Board Voting Member

James J. Peters VAMC

- February 2018-January 2019 Subcommittee for Research Safety
- October 2016-February 2018 Subcommittee for Research Safety (voting alternate)

University of Kansas, Lawrence, KS

- August 2010-May 2012 University of Kansas Radio Station (KJHK) DJ
- August 2011-May 2012 Assistant Music Director for KJHK
- August 2011-May 2012 Student Representative for Health, Sport and Exercise Sciences Faculty Meetings
- August 2009-May 2010 Student Representative for Health, Sport and Exercise Sciences Public Relations Committee
- August 2007-May 2008 National Politics Opinion Columnist for University of Kansas student newspaper

MEMBERSHIPS

- August 2011-current American Physiological Society
- August 2009-current American College of Sports Medicine
- August 2007-May 2014 Central States American College of Sports Medicine
- August 2010-May 2014 National Strength and Conditioning Association

LANGUAGES

- English-Native
- Spanish-Fluent