

# National Space Biomedical Research Institute Publications Musculoskeletal Alterations

## Articles

Adams, G. R., V. J. Caiozzo, and K. M. Baldwin. Skeletal muscle unweighting: spaceflight and ground-based models. *J Appl Physiol* 95(6):2185-2201, 2003.

Adams, G. R., V. J. Caiozzo, F. Haddad, and K. M. Baldwin. Cellular and molecular responses to increased skeletal muscle loading after irradiation. *Am J Physiol Cell Physiol* 283(4):C1182-C1195, 2002.

Adams, G. R., D. C. Cheng, F. Haddad, and K. M. Baldwin. Skeletal muscle hypertrophy in response to isometric, lengthening and shortening training bouts of equivalent duration. *J Appl Physiol* 96:1613-1618, 2004.

Adams, G. R., F. Haddad, and K. M. Baldwin. Time course of changes in markers of myogenesis in overloaded rat skeletal muscles. *J Appl Physiol* 87(5):1705-1712, 1999.

Adams GR, Haddad F, Bodell PW, Tran PD, Baldwin KM. Combined isometric, concentric and eccentric resistance exercise prevents unloading induced muscle atrophy in rats. *J Appl Physiol*. 2007 Nov;103(5):1644-54.

Akkus, O., F. Adar, and M. B. Schaffler. Age related changes in physicochemical properties of mineral crystals are related to impaired function of cortical bone. *Bone* 34:443-453, 2004.

Allen, M. R., and S. A. Bloomfield. Hindlimb unloading has a greater effect on cortical compared to cancellous bone in mature female rats. *J Appl Physiol* 94(2):642-650, 2003.

Allen MR, Hogan HA, Bloomfield SA. Differential bone and muscle recovery following hindlimb unloading in skeletally mature male rats. *J Musculoskelet Neuronal Interact*. 2006 Jul-Sep;6(3):217-25.

Arbogast, S., and M. B. Reid. Oxidant activity in skeletal muscle fibers is influenced by temperature, CO<sub>2</sub> level, and muscle-derived nitric oxide. *Am J Physiol Regul Integr Comp Physiol* 287(4):R698-705, 2004.

Arbogast S, Smith J, Matuszczak Y, Hardin B, Moylan J, Smith JD, Ware J, Kennedy AR, Reid MB. Bowman-Birk Inhibitor Concentrate prevents atrophy, weakness, and oxidative stress in soleus muscle of hindlimb-unloaded mice. *J Appl Physiol*. 2007 Mar;102(3):956-64.

Baek K, Barlow AA, Allen MR, Bloomfield SA. Food restriction and simulated microgravity: Effects on bone and serum leptin. *J Appl Physiol*. 2008 Apr;104(4):1086-93.

Baldwin, K. M., and F. Haddad. Effects of different activity and inactivity paradigms on myosin heavy chain expression in striated muscle: invited review. *J Appl Physiol* 90(1):345-357, 2001.

Baldwin, K. M., and F. Haddad. Skeletal muscle plasticity: cellular and molecular responses to altered physical activity paradigms. *Am J Phys Med Rehabil* 81(11 Suppl):S40-S51, 2002.

Barral, J. M., and H. F. Epstein. Protein machines and self-assembly in muscle organization. *Bioessays* 21(10):813-823, 1999.

Bateman, TA. Molecular therapies for disuse osteoporosis. *Gravit Space Biol* 17(2):83-89, 2004.

Beck, T., A. Looker, C. Ruff, H. Sievanen, and H. Wahner. Structural trends in the aging femoral neck and proximal shaft: analysis of NHANES III DXA data. *J Bone Min Res* 15(12):2297-2304, 2000.

Beers, D. R., B. K. Ho, L. Siklos, M. E. Alexianu, D. R. Mosier, A. H. Mohamed, Y. Otsuka, M. E. Kozovska, R. E. McAlhany, R. G. Smith, and S. H. Appel. Parvalbumin overexpression alters immune-mediated increases in intracellular calcium, and delays disease onset in a transgenic model of familial amyotrophic lateral sclerosis. *J Neurochem* 79(3):499-509, 2001.

Belaguli, N. S., J. L. Sepulveda, V. Nigam, F. Charron, M. Nemar, and R. J. Schwartz. Cardiac tissue enriched factors serum response factor and GATA-4 are mutual coregulators. *Mol Cell Biol* 20(20):7550-7558, 2000.

Bey, L., N. Akunuri, P. Zhao, E. P. Hoffman, D. G. Hamilton, and M. T. Hamilton. Patterns of global gene expression in rat skeletal muscle during unloading and low-intensity ambulatory activity. *Physiol Genomics* 13(2):157-167, 2003.

Bey, L., and M. T. Hamilton. Suppression of skeletal muscle lipoprotein lipase activity during physical inactivity: a molecular reason to maintain daily low-intensity activity. *J Physiol (London)* 551(Pt 2):673-682, 2003.

Bikle DD. Integrins, insulin like growth factors, and the skeletal response to load. *Osteoporos Int*. 2008 Mar 29; [Epub ahead of print]

Bloomfield, S. A. Cellular and molecular mechanisms for the bone response to mechanical loading. *Int J Sport Nutr Exerc Metab* 11(Suppl):128-136, 2001.

Bloomfield SA. Does altered blood flow to bone in microgravity impact on mechanotransduction? *J Musculoskelet Neuronal Interact*. 2006 Oct-Dec;6(4):324-6.

Bloomfield, S. A., M. R. Allen, H. A. Hogan, and M. D. Delp. Site- and compartment-specific changes in bone with hindlimb unloading in mature adult rats. *Bone* 31(1):149-157, 2002.

Bloomfield, S. A., H. A. Hogan, and M. D. Delp. Decreases in bone blood flow and bone material properties in aging Fischer-344 rats. *Clin Orthop* 396:248-257, 2002.

Caiozzo, V. J., C. Rose-Gottron, K. M. Baldwin, D. Cooper, G. Adams, J. Hicks, and A. Kreitenberg. Hemodynamic and metabolic responses to hypergravity on a human-powered centrifuge. *Aviat Space Environ Med* 75(2):101-108, 2004.

Cavanagh, P. R., A. A. Licata, and A. J. Rice. Exercise and pharmacological countermeasures for bone loss during long-duration space flight. *Gravit Space Biol* 18(2):39-58, 2005.

Chase, P. B., J. M. MacPherson, and T. L. Daniel. A spatially explicit nanomechanical model of the half-sarcomere: Myofilament compliance affects  $Ca^{2+}$ -activation. *Ann Biomed Eng* 32(11):1559-68, 2004.

Chen, J.-R., B. Chatterjee, R. Meyer, J. C. Yu, J. L. Borke, C. M. Isales, M. L. Kirby, C. W. Lo, and R. J. Bollag. Tbx2 represses expression of Connexin43 in osteoblastic-like cells. *Calcif Tissue Int* 74:561-573, 2004.

Clancy, J., H. Takeshima, S. L. Hamilton, and M. B. Reid. Contractile function is unaltered in diaphragm from mice lacking the calcium release channel isoform 3. *Am J Physiol* 277(4.2):R1205-R1209, 1999.

Colleran, P. N., M. K. Wilkerson, S. A. Bloomfield, L. J. Suva, R. T. Turner, and M. D. Delp. Alterations in skeletal perfusion with simulated microgravity: a possible mechanism for bone remodeling. *J Appl Physiol* 89(3):1046-1054, 2000.

Criswell, D. A., F. W. Booth, F. DeMayo, R. J. Schwartz, S. E. Gordon, and M. L. Fiorotto. Overexpression of IGF-I in skeletal muscle of transgenic mice does not prevent unloading-induced atrophy. *Am J Physiol Endocrinol Metab* 275(3.1):E373-E379, 1998.

Dacquin, R., R. A. Davey, C. Laplace, R. Levasseru, H. A. Morris, S. R. Goldring, S. Gebre-Medhim, D. L. Galson, J. D. Zaja, and G. Karsenty. Amylin inhibits bone resorption while the calcitonin receptor controls bone formation in vivo. *J Cell Biol* 164:509-14, 2004.

Dentel, J. N., S. G. Blanchard, D. P. Ankrapp, L. R. McCabe, and R. W. Wiseman. Inhibition of cross-bridge formation has no effect on contraction-associated phosphorylation of p38 MAPK in mouse skeletal muscle. *Am J Physiol Cell Physiol* 288(4):C824-30, 2005.

Deruisseau, K. C., R. A. Shanely, N. Akunuri, M. T. Hamilton, D. Van Gammeren, A. M. Zengeroglu, M. McKenzie, and S. K. Powers. Diaphragm unloading via controlled mechanical ventilation alters the gene expression profile. *Am J Respir Crit Care Med* 172(10):1267-75, 2005.

Di Maso, N. A., F. Haddad, M. Zeng, S. A. McCue, and K. M. Baldwin. Role of denervation in modulating Iib MHC gene expression in response to  $T_3$  plus unloading state. *J Appl Physiol* 88(2):682-689, 2000.

Ding, K. H., Q. Zhong, and C. M. Isales. Glucose-dependent insulinotropic peptide stimulates thymidine incorporation in endothelial cells: role of endothelin-1. *Am J Physiol Endocrinol Metab* 285(2):E390-E396, 2003.

Ding, K. H., Q. Zhong, J. Xu, and C. M. Isales. Glucose-dependent insulinotropic peptide: differential effects on hepatic artery vs. portal vein endothelial cells. *Am J Physiol Endocrinol Metab* 286:E773-E779, 2004.

Draghia-Akli, R., M. L. Fiorotto, L. A. Hill, P. B. Malone, D. R. Deaver, and R. J. Schwartz. Myogenic expression of an injectable protease resistant growth hormone-releasing hormone augments long-term pig growth. *Nature Biotechnol* 17(12):1179-1183, 1999.

Durham, W. J., Y. P. Li, E. Gerken, M. Farid, S. Arbogast, R. R. Wolfe, and M. B. Reid. Fatiguing exercise reduces DNA-binding activity of NF- $\kappa$ B in skeletal muscle nuclei. *J Appl Physiol* 97(5):1740-45, 2004.

Elefteriou, F., J. D. Ahn, S. Takeda, M. Starbuck, X. Yang, X. Liu, H. Kondo, W. G. Richards, T. W. Bannon, M. Noda, K. Clement, C. Vaisse, and G. Karsenty. Leptin regulation of bone resorption by the sympathetic nervous system and CART. *Nature* 434(7032):514-20, 2005.

Elefteriou, F., S. Takeda, K. Ebihara, J. Magre, N. Patano, C. A. Kim, Y. Ogawa, X. Liu, S. M. Ware, W. J. Craigen, J. J. Robert, C. Vinson, D. Nakao, J. Carpeau, and G. Karsenty. Serum leptin level is a regulator of bone mass. *Proc Nat. Acad Sci USA* 101:3258-63, 2004.

Elefteriou, F., S. Takeda, X. Liu, D. Armstrong, and G. Karsenty. Monosodium glutamate-sensitive hypothalamic neurons contribute to the control of bone mass. *Endocrinology* 144(9):3842-3847, 2003.

Farid, M., M. B. Reid, Y. P. Li, E. Gerken, and W. J. Durham. Effects of dietary curcumin or N-acetylcysteine on NF-kappaB activity and contractile performance in ambulatory and unloaded murine soleus. *Nutr Metab (Lond)* 2:20, 2005.

Ferreira LF, Reid MB. Muscle-derived ROS and thiol regulation in muscle fatigue. *J Appl Physiol*. 2008 Mar;104(3):853-60.

Finni, T., J. A. Hodgson, A. M. Lai, V. R. Edgerton, and S. Sinha. Mapping of movement in the isometrically contracting human soleus muscle reveals details of its structural and functional complexity. *J Appl Physiol* 95(5):2128-2133, 2003.

Finni, T., J. A. Hodgson, A. M. Lai, V. R. Edgerton, and S. Sinha. Muscle synergism during isometric plantarflexion in Achilles tendon rupture patients and in normal subjects revealed by velocity-encoded cine phase-contrast MRI. *Clin Biomech* 21(1):67-74, 2006.  
Finni, T., J. A. Hodgson, A. M. Lai, V. R. Edgerton, and S. Sinha. Nonuniform strain of human soleus aponeurosis-tendon complex during submaximal voluntary contractions in vivo. *J Appl Physiol* 95(2):829-837, 2003.

Garma T, Kobayashi C, Haddad F, Adams GR, Bodell PW, Baldwin KM. Similar acute molecular responses to equivalent volumes of isometric, lengthening or shortening mode resistance exercise. *J Appl Physiol*. 2007 Jan;102(1):135-43.

Giger, J. M., F. Haddad, A. X. Qin, and K. M. Baldwin. In vivo regulation of the  $\beta$ -myosin heavy chain gene in soleus muscle of suspended and weight-bearing rats. *Am J Physiol Cell Physiol* 278(6):C1153-C1161, 2000.

Gomes, M. D., S. H. Lecker, R. T. Jagoe, A. Navon, and A. L. Goldberg. Atrogin-1, a muscle-specific F-box protein highly expressed during muscle atrophy. *Proc Natl Acad Sci* 98(25):14440-14445, 2001.

Gooch, C. L., and D. R. Mosier. Stimulated single fiber electromyography in the mouse: techniques and normative data. *Muscle Nerve* 24(7):941-945, 2001.

Grill, M. A., M. A. Bales, A. N. Fought, K. C. Rosburg, S. J. Munger, and P. B. Antin. Tetracycline-inducible system for regulation of skeletal muscle-specific gene expression in transgenic mice. *Transgenic Res* 12(1):33-43, 2003.

Haddad, F., and G. R. Adams. Aging-sensitive cellular and molecular mechanisms associated with skeletal muscle hypertrophy. *J Appl Physiol* 100(4):1188-203, 2006.

Haddad, F., G. R. Adams, P. W. Bodell, and K. M. Baldwin. Isometric resistance exercise fails to counteract skeletal muscle atrophy processes during the initial stages of unloading. *J Appl Physiol* 100(2):433-41, 2006.

Haddad, F., K. M. Baldwin, and P. A. Tesch. Pretranslational markers of contractile protein expression in human skeletal muscle: Effect of limb unloading plus resistance exercise. *J Appl Physiol* 98(1):46-52, 2005.

Haddad, F., R. R. Roy, H. Zhong, V. R. Edgerton, and K. M. Baldwin. Atrophy responses to muscle inactivity. I. Cellular markers of protein deficits. *J Appl Physiol* 95(2):781-790, 2003.

Haddad, F., R. R. Roy, H. Zhong, V. R. Edgerton, and K. M. Baldwin. Atrophy responses to muscle inactivity. II. Molecular markers of protein deficits. *J Appl Physiol* 95(2):791-802, 2003.

Hamilton, M. T., D. G. Hamilton, and T. W. Zderic. Exercise physiology versus inactivity physiology: an essential concept for understanding lipoprotein lipase regulation. *Exerc Sport Sci Rev* 32(4):161-6, 2004.

Hamilton, S. A., M. J. Pecaut, D. S. Gridley, N. D. Travis, E. R. Bandstra, J. S. Willey, G. Nelson, and T. A. Bateman. A murine model for bone loss from therapeutic and space-relevant sources of radiation. *J Appl Physiol* 101:789-793, 2006.

Hamrick MW, Shi X, Zhang W, Pennington C, Thakore H, Haque M, Kang B, Isaacs CM, Fulzele S, Wenger KH. Loss of myostatin (GDF8) function increases osteogenic

differentiation of bone marrow-derived mesenchymal stem cells but the osteogenic effect is ablated with unloading. *Bone*. 2007 Jun;40(6):1544-53.

Hancock, C. R., J. J. Brault, R. W. Wiseman, R. L. Terjung and R. A. Meyer. <sup>31</sup>P-NMR observation of free ADP during fatiguing, repetitive contractions of murine skeletal muscle lacking AK1. *Am J Physiol Cell Physiol* 288(6):C1298-304, 2005.

Heinemeier KM, Olesen JL, Haddad F, Langberg H, Kjaer M, Baldwin KM, Schjerling P. Expression of collagen and related growth factors in rat tendon and skeletal muscle in response to specific contraction types. *J Physiol*. 2007 Aug 1;582(Pt 3):1303-16.

Heinemeier KM, Olesen JL, Schjerling P, Haddad F, Langberg H, Baldwin KM, Kjaer M. Short-term strength training and the expression of myostatin and IGF-I isoforms in rat muscle and -tendon: Differential effects of specific contraction types. *J Appl Physiol*. 2006 Oct 12.

Hirschfield, W., M. R. Moody, W. E. O'Brian, A. R. Gregg, R. M. Bryan, Jr., and M. B. Reid. Nitric oxide release and contractile properties of skeletal muscles from mice deficient in type III NOS. *Am J Physiol Regul Integr Comp Physiol* 278(1):R95-R100, 2000.

Hodgson, J. A., T. Finni, A. M. Lai, V. R. Edgerton, and S. Sinha. Influence of structure on the tissue dynamics of the human soleus muscle observed in MRI studies during isometric contractions. *J Morphol* 267(5):584-601, 2006.

Hunter, R. B., and S. C. Kandarian. Disruption of either the Nfkb1 or the Bcl3 gene inhibits skeletal muscle atrophy. *J Clin Invest* 114(10):1504-11, 2004.

Ingalls, C. P., G. L. Warren, and R. B. Armstrong. Intracellular Ca<sup>2+</sup> transients in mouse soleus muscle after hindlimb unloading and reloading. *J Appl Physiol* 87(1):386-390, 1999.

Jackman, R. W., and S. C. Kandarian. The molecular basis of skeletal muscle atrophy. *Am J Physiol Cell Physiol* 287:C834-C843, 2004.

Jagoe, R. T., S. H. Lecker, M. Gomes, and A. L. Goldberg. Patterns of gene expression in atrophying skeletal muscles: response to food deprivation. *FASEB J* 16(13):1697-1712, 2002.

Jin, S., M. Shimizu, A. Balasubramanyam, and H. F. Epstein. Myotonic dystrophy protein kinase (DMPK) induces actin cytoskeletal reorganization and apoptotic-like blebbing in lens cells. *Cell Motil Cytoskel* 45(2):133-148, 2000.

Jubrias SA, Vollestad NK, Gronka RK, Kushmerick MJ. Contraction-coupling efficiency of human first dorsal interosseous muscle. *J Physiol*. 2008 Apr 1;586(7):1993-2002.

Judex, S., R. Boyd, Y-X. Qin, L. Miller, R. Müller, and C. Rubin. Combining high-resolution microCT with material composition to define the quality of bone tissue. *Current Osteoporosis Reports* 1:11-19, 2003.

Judex, S., L. R. Donahue, and C. Rubin. Genetic predisposition to osteoporosis is paralleled by an enhanced sensitivity to signals anabolic to the skeleton. *FASEB J* 16(10):1280-1282, 2002.

Judex, S., S. Garman, M. Squire, B. Busa, L. R. Donahue, and C. T. Rubin. Genetically linked site-specificity of disuse osteoporosis. *J Bone Miner Res* 19:607-613, 2004.

Judex, S., R. Garman, M. Squire, L. R. Donahue, and C. Rubin. Genetically based influences on the site-specific regulation of trabecular and cortical bone morphology. *J Bone Miner Res* 19:600-606, 2004.

Judex, S., N. Zhong, M. E. Squire, K. Ye, L. R. Donahue, M. Hadjiargyrou, and C. T. Rubin. Mechanical modulation of molecular signals which regulate anabolic and catabolic activity in bone tissue. *J Cell Biochem* 94(5):982-94, 2005.

Judge AR, Koncarevic A, Hunter RB, Liou HC, Jackman RW, Kandarian SC. A role for I {kappa} B {alpha}, but not c-Rel, in skeletal muscle atrophy. *Am J Physiol Cell Physiol*. 2007 Jan;292(1):C372-82.

Kandarian, S. C., and E. J. Stevenson. Molecular events in skeletal muscle during disuse atrophy. *Exerc Sport Sci Rev* 30(3):111-116, 2002.

Kataoka A, Hemmer C, Chase PB. Computational simulation of hypertrophic cardiomyopathy mutations in troponin I: Influence of increased myofilament calcium sensitivity on isometric force, ATPase and [Ca(2+)](i). *J Biomech*. 2007;40(9):2044-52.

Kataoka A, Tanner BCW, Macpherson JM, Xu X, Wang Q, Regnier M, Daniel TL, Chase PB. Spatially explicit, nano-mechanical models of the muscle half-sarcomere: Implications for biomechanical tuning in atrophy and fatigue. *Acta Astronaut*. 2007 Jan;60(2):111-8.

Kisselev, A. F., A. Callard, and A. L. Goldberg. Importance of different active sites in protein breakdown by 26S proteasomes and efficacy of proteasome inhibition depends on the protein substrate. *J Biol Chem* 281:8582-90, 2006.

Koncarevic A, Jackman RW, Kandarian SC. The ubiquitin-protein ligase Nedd4 targets Notch1 in skeletal muscle and distinguishes the subset of atrophies caused by reduced muscle tension. *FASEB J*. 2007 Feb;21(2):427-37.

Kondrashov, V., S. J. Rothenberg, D. Chettle, and J. Zerwekh. Evaluation of potentially significant increase of lead in the blood during long-term bed rest and space flight. *Physiol Meas* 26(1):1-12, 2005.

Kushmerick, M. J., and K. E. Conley. Energetics of muscle contraction: the whole is less than the sum. *Biochem Soc Trans* 30(2):227-231, 2002.

Lambeth, M. J., and M. J. Kushmerick. A computational model for glycogenolysis in skeletal muscle. *Ann Biomed Eng* 30(6):808-827, 2002.

- Lawler, J. M., W. Song, and S. R. Demaree. Hindlimb unloading increases oxidative stress and disrupts antioxidant capacity in skeletal muscle. *Free Radic Biol Med* 35(1):9-16, 2003.
- Lecker, S. H., R. T. Jago, A. Gilbert, M. Gomes, V. Baracos, J. Bailey, S. R. Price, W. E. Mitch, and A. L. Goldberg. Multiple types of skeletal muscle atrophy involve a common program of changes in gene expression. *FASEB J* 18(1):39-51, 2004.
- Lecker, S. H., V. Solomon, S. R. Price, Y. T. Kwon, W. E. Mitch, and A. L. Goldberg. Ubiquitin conjugation by the N-end rule pathway and mRNAs for its components increase in muscles of diabetic rats. *J Clin Invest* 104(10):1411-1420, 1999.
- Lee, C. Y., X. Liu, C. L. Smith, X. Zhang, H. C. Hsu, D. Y. Wang, and Z. P. Luo. The combined regulation of estrogen and cyclic tension on fibroblast biosynthesis derived from anterior cruciate ligament. *Matrix Biology* 23:323-329, 2004.
- Lee, C. Y., C. L. Smith, X. Zhang, H. C. Hsu, D. Y. Wang, and Z. P. Luo. Tensile forces attenuate estrogen-stimulated collagen synthesis in the ACL. *Biochem Biophys Res Commun* 317:1221-1225, 2004.
- Lee, H. D., T. Finni, J. A. Hodgson, A. M. Lai, V. R. Edgerton, and S. Sinha. Soleus aponeurosis strain distribution following chronic unloading in humans-an in vivo MR phase-contrast study. *J Appl Physiol* 100(6):2004-11, 2006.
- Levasseur, R., R. Barrios, F. Eleftheriou, D. A. Glass II, M. W. Lieberman, and G. Karsenty. Reversible skeletal abnormalities in gamma-glutamyl transpeptidase-deficient mice. *Endocrinology* 144(7):2761-2764, 2003.
- Li, C. Y., K. J. Jepsen, R. J. Majeska, J. Zhang, R. Ni, B. D. Gelb, and M. B. Schaffler. Mice lacking cathepsin K maintain bone remodeling but develop bone fragility despite high bone mass. *J Bone Miner Res* 21(6):865-75, 2006.
- Li, C. Y., R. J. Majeska, D. M. Laudier, R. Mann, and M. B. Schaffler. High-dose risedronate treatment partially preserves cancellous bone mass and microarchitecture during long-term disuse. *Bone* 37(3):287-95, 2005.
- Li, C. Y., C. Price, K. Delisser, P. Nasser, D. Laudier, M. Clement, K. J. Jepsen, and M. B. Schaffler. Long-term disuse osteoporosis seems less sensitive to bisphosphonate treatment than other osteoporosis. *J Bone Miner Res* 20(1):117-24, 2005.
- Li, X., E. M. Eastman, R. J. Schwartz, and R. Draghia-Akli. Synthetic muscle promoters: activities exceeding naturally occurring regulatory sequences. *Nature Biotechnol* 17(12):241-245, 1999.
- Li, Y. P., C. M. Atkins, J. D. Sweatt, and M. B. Reid. Mitochondria mediate TNF $\alpha$ /NF- $\kappa$ B signaling in skeletal muscle myotubes. *Antiox Redox Signal* 1(1):97-104, 1999.

Li, Y. P., Y. Chen, J. John, J. Moylan, B. Jin, D. L. Mann, and M. B. Reid. TNF-alpha acts via p38 MAPK to stimulate expression of the ubiquitin ligase atrogin1/MAFbx in skeletal muscle. *FASEB J* 19(3):362-70, 2005.

Li, Y. P., Y. Chen, A. Li, and M. B. Reid. Hydrogen peroxide stimulates ubiquitin-conjugating activity and expression of genes for specific E2 and E3 proteins in skeletal muscle myotubes. *Am J Physiol Cell Physiol*. 285(4):C806-C812, 2003.

Li, Y. P., S. H. Lecker, Y. Chen, I. D. Waddell, A. L. Goldberg, and M. B. Reid. TNF-alpha increases ubiquitin-conjugating activity in skeletal muscle by up-regulating UbcH2/E220k. *FASEB J* 17(9):1048-1057, 2003.

Liu, F., I. Ortiz, A. Hutagalung, C. C. Bauer, R. G. Cook and H. F. Epstein. Differential assembly of alpha- and gamma-filagenins into thick filaments of distinct lengths is developmentally regulated in *Caenorhabditis elegans*. *J Cell Sci* 113(Pt 2):4001-4012, 2000.

Lloyd SA, Travis ND, Lu T, Bateman TA. Development of a low dose antiresorptive drug regimen reveals synergistic suppression of bone formation when coupled with disuse. *J Appl Physiol*. 2008 Mar;104(3):729-38.

Lotinun, S., G. L. Evans, R. T. Turner, and M. J. Oursler. Deletion of membrane-bound steel factor results in osteopenia in mice. *J Bone Miner Res* 20(4):644-52, 2005.

Lotinun, S., J. D. Sibonga, and R. T. Turner. Triazolopyrimidine (trapidil), a platelet-derived growth factor antagonist, inhibits parathyroid bone disease in an animal model for chronic hyperparathyroidism. *Endocrinology* 144(5):2000-2007, 2003.

Lotinun, S., K. C. Westerlind, A. M. Kennedy, and R. T. Turner. Comparative effects of long-term continuous release of 16alpha-hydroxyestrone and 17beta-estradiol on bone, uterus, and serum cholesterol in ovariectomized adult rats. *Bone* 33(1):124-131, 2003.

Lublinsky S, Ozcivici E, Judex S. An automated algorithm to detect the trabecular-cortical bone interface in micro-computed tomographic images. *Calcif Tissue Int*. 2007 Oct;81(4):285-93.

Matuszczak, Y., S. Arbogast, and M. B. Reid. Allopurinol mitigates muscle contractile dysfunction caused by hindlimb unloading in mice. *Aviat Space Environ Med* 75(7):581-588, 2004.

Matuszczak, Y., M. Farid, J. Jones, S. Lansdowne, M. A. Smith, A. A. Taylor, and M. B. Reid. Effects of N-acetylcysteine on glutathione oxidation and fatigue during handgrip exercise. *Muscle Nerve* 32(5):633-638, 2005.

McCall, G. E., D. L. Allen, F. Haddad, and K. M. Baldwin. Transcriptional regulation of IGF-I expression in skeletal muscle. *Am J Physiol Cell Physiol* 285(4):C831-C839, 2003.

- McCurdy, M. R., P. N. Collieran, J. M. Muller-Delp, and M. D. Delp. Effects of fiber composition and hindlimb unloading on the vasodilator properties of skeletal muscle arterioles. *J Appl Physiol* 89(1):398-405, 2000.
- McNamara, L. M., P. J. Prendergast, and M. B. Schaffler. Bone tissue material properties are altered during osteoporosis. *J Musculoskelet Neuronal Interact* 5(4):342-3, 2005.
- Midura RJ, Su X, Androjna C. A simulated weightlessness state diminishes cortical bone healing responses. *J Musculoskelet Neuronal Interact*. 2006 Oct-Dec;6(4):327-8.
- Mohamed, H. A., D. R. Mosier, L. L. Zou, L. Siklos, M. E. Alexianu, J. I. Engelhardt, D. R. Beers, W. D. Le, and S. H. Appel. Immunoglobulin Fc gamma receptor promotes immunoglobulin uptake, immunoglobulin-mediated calcium increase, and neurotransmitter release in motor neurons. *J Neurosci Res* 69(1):110-116, 2002.
- Moore, C. P., J. Z. Zhang, and S. L. Hamilton. A role for cysteine 3635 of RyR1 in redox modulation and calmodulin binding. *J Biol Chem* 274(52):36831-36834, 1999.
- Mosier, D. R., L. Siklós, and S. H. Appel. Resistance of extraocular motoneuron terminals to effects of amyotrophic lateral sclerosis sera. *Neurology* 54(1):252-255, 2000.
- Narayanan, R., M. R. Allen, D. Gaddy, S. A. Bloomfield, C. L. Smith, and N. L. Weigel. Differential skeletal responses of hindlimb unloaded rats on vitamin D-deficient diet to 1,25-dihydroxyvitamin D<sub>3</sub> and its analog, seocalcitol (EB1089). *Bone* 35:134-143, 2004.
- Narayanan, R., V. A. Sepulveda, M. Falzon, and N. L. Weigel. The functional consequences of cross talk between the vitamin D receptor and ERK signaling pathways are cell specific. *J Biol Chem* 279(45):47298-310, 2004.
- Narayanan, R., C. L. Smith, and N. L. Weigel. Vector-averaged gravity-induced changes in cell signaling and vitamin D receptor activity in MG-63 cells are reversed by a 1,25-(OH)(2)D(3) analog, EB1089. *Bone* 31(3):381-388, 2002.
- Oden, Z. M., D. M. Selvitelli, and M. L. Bouxsein. Effect of local density changes on the failure load of the proximal femur. *J Orthop Res* 17(5):661-667, 1999.
- Olesen, J. L., K. M. Heinemeier, F. Haddad, H. Langberg, A. Flyvbjerg, M. Kjaer, and K. M. Baldwin. Expression of insulin-like growth factor I, insulin-like growth factor binding proteins, and collagen mRNA in mechanically loaded plantaris tendon. *J Appl Physiol* 101(1):183-8, 2006.
- Olszak, I. T., M. C. Poznansky, R. H. Evans, D. Olson, C. Kos, M. R. Pollak, E. M. Brown, and D. T. Scadden. Extracellular calcium elicits a chemokinetic response from monocytes in vitro and in vivo. *J Clin Invest* 105(9):1299-1305, 2000.
- Ontiveros, C., R. Irwin, R. W. Wiseman, and L. R. McCabe. Hypoxia suppresses runx2 independent of modeled microgravity. *J Cell Physiol* 200(2):169-76, 2004.

Pi, W., Z. Yang, J. Wang, L. Ruan, X. Yu, J. Ling, S. Krantz, C. Isales, S. J. Conway, S. Lin, and D. Tuan. The LTR enhancer of ERV-9 human endogenous retrovirus is active in oocytes and progenitor cells in transgenic zebrafish and humans. *Proc Natl Acad Sci U S A* 101(3):805-810, 2004.

Reid MB. Free radicals and muscle fatigue: Of ROS, canaries, and the IOC. *Free Radic Biol Med*. 2008 Jan 15;44(2):169-79. Epub 2007 Mar 12.

Reid, M. Response of the ubiquitin-proteasome pathway to changes in muscle activity. *Am J Physiol Regul Integr Comp Physiol* 288(6): R1423-31, 2005

Roman, B. B., R. A. Meyer, and R. W. Wiseman. Phosphocreatine kinetics at the onset of contractions in skeletal muscle of MM creatine kinase knockout mice. *Am J Physiol Cell Physiol* 283(6):C1776-C1783, 2002.

Rubin, C., S. Judex, and Y. X. Qin. Low-level mechanical signals and their potential as a non-pharmacological intervention for osteoporosis. *Age Ageing* 35 Suppl 2:ii32-ii36, 2006.

Rubin, C. T, D. W. Sommerfeldt, S. Judex, and Y. X. Qin. Inhibition of osteopenia by low magnitude, high frequency mechanical stimuli. *Drug Discov Today* 6(16):848-858, 2001.

Rubin, C. T., G. Xu, and S. Judex. The anabolic activity of bone tissue, suppressed by disuse, is normalized by brief exposure to extremely low magnitude mechanical stimuli. *FASEB J* 15(12): 2225-2229, 2001.

Sacheck JM, Hyatt JP, Raffaello A, Jagoe RT, Roy RR, Edgerton VR, Lecker SH, Goldberg AL. Rapid disuse and denervation atrophy involve transcriptional changes similar to those of muscle wasting during systemic diseases. *FASEB J*. 2007 Jan;21(1):140-55.

Sacheck, J. M., A. Ohtsuka, S. C. McLary, and A. L. Goldberg. IGF-I stimulates muscle growth by suppressing protein breakdown and expression of atrophy-related ubiquitin ligases, atrogin-1 and MuRF1. *Am J Physiol Endocrinol Metab* 287(4):E591-601, 2004.

Sandri M, Lin J, Handschin C, Yang W, Arany ZP, Lecker SH, Goldberg AL, Spiegelman BM. PGC-1 $\alpha$  protects skeletal muscle from atrophy by suppressing FoxO3 action and atrophy-specific gene transcription. *Proc Natl Acad Sci*. 2006 Oct 31;103(44):16260-5.

Sandri, M., C. Sandri, A. Gilbert, C. Skurk, E. Calabria, A. Picard, K. Walsh, S. Schiaffino, S. H. Lecker, and A. L. Goldberg. Foxo transcription factors induce the atrophy-related ubiquitin ligase atrogin-1 and cause skeletal muscle atrophy. *Cell* 117(3):399-412, 2004.

Schoffstall, B., A. Kataoka, A. Clark, and P. B. Chase. Effects of rapamycin on cardiac and skeletal muscle contraction and crossbridge cycling. *J Pharmacol Exp Ther* 312(1):12-8, 2005.

Shackelford, L. C., A. D. LeBlanc, T. B. Driscoll, H. J. Evans, N. J. Rianon, S. M. Smith, E. Spector, D. L. Feeback, and D. Lai. Resistance exercise as a countermeasure to disuse-induced bone loss. *J Appl Physiol* 97:119-29, 2004.

Shapiro JR. Microgravity and drug effects on bone. *J Musculoskelet Neuronal Interact.* 2006 Oct-Dec;6(4):322-3.

Shapiro J. R., and V. Schneider. Countermeasure development: future research targets. *J Gravit Physiol* 7(2):1-4, 2000.

Shimizu, M., W. Wang, E. T. Walch, P. W. Dunne, and H. F. Epstein. Rac-1 and Raf-1 kinases, components of distinct signaling pathways, activate myotonic dystrophy protein kinase. *FEBS Lett* 475(3):273-277, 2000.

Sibonga, J. D., M. Zhang, G. L. Evans, K. C. Westerlind, J. M. Cavolina, E. Morey-Holton, and R. T. Turner. Effects of spaceflight and simulated weightlessness on longitudinal bone growth. *Bone* 27(4):535-540, 2000.

Sinha, S., J. A. Hodgson, T. Finni, A. M. Lai, J. Grinstead, and V. R. Edgerton. Muscle kinematics during isometric contraction: Development of phase contrast and spin tag techniques to study healthy and atrophied muscles. *J Magn Reson Imaging* 20(6): 1008-19, 2004.

Smith, M. A., and M. B. Reid. Redox modulation of contractile function in respiratory and limb skeletal muscle. *Respir Physiol Neurobiol* 151(2-3):229-41, 2006.

Solomon, V., S. H. Lecker, and A. L. Goldberg. The N-end rule pathway catalyzes a major fraction of the protein degradation in skeletal muscle. *J Biol Chem* 273(39):25216-25222, 1998.

Solomon, V., V. Baracos, P. Sarraf, and A. L. Goldberg. Rates of ubiquitin conjugation increase when muscles atrophy, largely through activation of the N-end rule pathway. *Proc Natl Acad Sci* 95(21):12602-12607, 1998.

Squire, M., L. R. Donahue, C. Rubin, and S. Judex. Genetic variations that regulate bone morphology in the male mouse skeleton do not define its susceptibility to mechanical unloading. *Bone* 35(6):1353-60, 2004.

Stevenson, E. J., P. G. Giresi, A. Koncarevic, and S. C. Kandarian. Global analysis of gene expression patterns during disuse atrophy in rat skeletal muscle. *J Physiol* 551(Pt 1):33-48, 2003.

Stevenson, E. J., A. Koncarevic, P. G. Giresi, R. W. Jackman, and S. C. Kandarian. Transcriptional profile of a myotube starvation model of atrophy. *J Appl Physiol* 98(4):1396-406, 2005.

Takeda, S., F. Eleftheriou, R. Levasseur, X. Liu, D. Armstrong, P. Ducy, and G. Karsenty. Leptin regulates bone formation via the sympathetic nervous system. *Cell* 111(3):305-317, 2002.

Turner, R. T. Mechanical signaling in the development of postmenopausal osteoporosis. *Lupus* 8(5):388-392, 1999.

Turner, R. T. Invited review: what do we know about the effects of spaceflight on bone? *J Appl Physiol* 89(2):840-847, 2000.

Turner, R. T., A. Maran, S. Lotinun, T. Hefferan, G. L. Evans, M. Zhang, and J. D. Sibonga. Animal models for osteoporosis. *Rev Endocr Metab Disord* 2(1):117-127, 2001.

Wang, L., Y. Wang, Y. Han, S. C. Henderson, R. J. Majeska, S. Weinbaum, and M. B. Schaffler. In situ measurement of solute transport in the bone lacunar-canalicular system. *Proc Natl Acad Sci* 102(33):11911-6, 2005.

Warren, G. L., J. L. Stallone, M. R. Allen, and S. A. Bloomfield. Functional recovery of the plantarflexor muscle group after hindlimb unloading in the rat. *Eur J Appl Physiol* 93(1-2):130-8, 2004.

Xiang Y, Yingling VR, Malique R, Chao Yang Li, Schaffler MB, Raphan T. Comparative assessment of bone mass and structure using texture-based and histomorphometric analyses. *Bone*. 2007 Feb;40(2):544-52.

Yamaguchi, T., N. Chattopadhyay, O. Kifor, and E. M. Brown. Extracellular calcium ( $\text{Ca}^{2+}_o$ )-sensing receptor in a mouse bone marrow-derived stromal cell line (ST2): potential mediator of the actions of  $\text{Ca}^{2+}_o$  on the function of ST2 cells. *Endocrinology* 139(8):3561-3568, 1998.

Yamaguchi, T., N. Chattopadhyay, O. Kifor, R. Butters Jr., T. Sugimoto, and E. Brown. Mouse osteoblastic cell line (MC3T3-E1) expresses extracellular calcium ( $\text{Ca}^{2+}_o$ )-sensing receptor and its agonists stimulate chemotaxis and proliferation of MC3T3-E1 cells. *J Bone Miner Res* 13(10):1530-1538, 1998.

Yamaguchi, T., N. Chattopadhyay, O. Kifor, C. Ye, P. M. Vassilev, J. L. Sanders, and E. M. Brown. Expression of extracellular calcium ( $\text{Ca}^{2+}$ )-sensing receptor (CaR) in human osteoblastic MG-63 cell line. *Am J Physiol (Cell Physiol)* 280(2):C382-C393, 2001.

Yamaguchi, T., O. Kifor, N. Chattopadhyay, M. Bai, and E. M. Brown. Extracellular calcium ( $\text{Ca}^{2+}$ )-sensing receptor in a mouse monocyte-macrophage cell line (J774): potential mediator of the actions of  $\text{Ca}^{2+}_o$  on the function of J774 cells. *J Bone Miner Res* 13(9):1390-1397, 1998.

Yamaguchi, T., O. Kifor, N. Chattopadhyay, and E. M. Brown. Expression of extracellular calcium ( $\text{Ca}^{2+}$ )-sensing receptor in the clonal osteoblast-like cell lines, UMR-106 and SAOS-2. *Biochem Biophys Res Commun* 243(3):753-757, 1998.

Yamaguchi, T., I. Olozak, N. Chattopadhyay, R. R. Butters, O. Kifor, D. T. Scadden, and E. M. Brown. Expression of extracellular calcium ( $\text{Ca}^{2+}$ )-sensing receptor in human peripheral blood monocytes. *Biochem Biophys Res Commun* 246(2):501-506, 1998.

Yamaguchi, T., C. Ye, N. Chattopadhyay, J. L. Sanders, P. Vassilev, and E. M. Brown. Enhanced expression of extracellular calcium sensing receptor in monocyte-differentiated versus undifferentiated HL-60 cells: potential role in regulation of a nonselective cation channel. *Calcif Tissue Int* 66(5):375-382, 2000.

Yang Y, Baker MJ, Graf SC, Larson JK, Caiozzo VJ. Hypergravity resistance exercise: The use of artificial gravity as potential countermeasure to microgravity. *J Appl Physiol*. 2007 Nov;103(5):1879-87.

Yang Y, Kaplan A, Pierre M, Adams G, Cavanagh P, Takahashi C, Kreitenberg A, Hicks J, Keyak J, Caiozzo V. Space cycle: A human-powered centrifuge that can be used for hypergravity resistance training. *Aviat Space Environ Med*. 2007 Jan;78(1):2-9.

Ye, C. P., T. Yamaguchi, N. Chattopadhyay, J. L. Sanders, P. M. Vassilev, and E. M. Brown. Extracellular calcium-sensing-receptor (CaR)-mediated opening of an outward  $\text{K}^+$  channel in murine MC3T3-E1 osteoblastic cells: evidence for expression of a functional CaR. *Bone* 27(1):21-27, 2000.

Yingling VR, Xiang Y, Raphan T, Schaffler MB, Koser K, Malique R. The effect of a short-term delay of puberty on trabecular bone mass and structure in female rats: A texture-based and histomorphometric analysis. *Bone* 2007 Feb;40(2):544-52.

Yuan YY, Kostenuik PJ, Ominsky MS, Morony S, Adamu S, Simionescu DT, Basalyga DM, Asuncion FJ, Bateman TA. Skeletal deterioration induced by RANKL infusion: A model for high-turnover bone disease. *Osteoporos Int*. 2008 May;19(5):625-35.

Zderic, T. W., and M. T. Hamilton. Physical inactivity amplifies the sensitivity of skeletal muscle to the lipid-induced downregulation of lipoprotein lipase activity. *J Appl Physiol* 100(1):249-57, 2006.

Zerwekh, J. E. Nutrition and renal stone disease in space. *Nutrition* 18(10):857-863, 2002.

Zhao J, Brault JJ, Schild A, Cao P, Sandri M, Schiaffino S, Lecker SH, Goldberg AL. FoxO3 coordinately activates protein degradation by the autophagic/lysosomal and proteasomal pathways in atrophying muscle cells. *Cell Metab*. 2007 Dec;6(6):472-83.

Zhao J, Brault JJ, Schild A, Goldberg AL. Coordinate activation of autophagy and the proteasome pathway by FoxO transcription factor. *Autophagy*. 2008 May-Jun;4(3):378-80.

Zhong, N., R. A. Garman, M. E. Squire, L. R. Donahue, C. T. Rubin, M. Hadjiargyrou, and S. Judex. Gene expression patterns in bone after 4 days of hind-limb unloading in two inbred strains of mice. *Aviat Space Environ Med* 76(6):530-5, 2005.

Zhong, Q., K. H. Ding, A. L. Mulloy, R. J. Bollag, and C. M. Isales. Glucose-dependent insulinotropic peptide stimulates proliferation and TGF-beta release from MG-63 cells. *Peptides* 24(4):611-616, 2003.

Zhong, Q., S. Sridhar, L. Ruan, K. H. Ding, D. Xie, K. Insogna, B. Kang, J. Xu, R. J. Bollag, and C. M. Isales. Multiple melanocortin receptors are expressed in bone cells. *Bone* 36(5):820-31, 2005.