MON-0285

Exercise increases UCP1 expression but decreases trabecular bone acquisition in mice during cold exposure and at thermoneutrality

Amy Robbins*, Christina Tom, Rebecca Tutino, Miranda Cosman, Taylor Spencer, Cleo Moursi, Rachel Hurwitz, Maureen Devlin

University of Michigan, United States

Chronic cold exposure induces bone loss via increased sympathetic outflow to osteoblast beta-adrenergic receptors. Brown adipose tissue (BAT) can protect against such bone loss by inducing nonshivering thermogenesis (NST) and increasing body temperature, thereby reducing sympathetic tone. Exercise reportedly stimulates BAT, suggesting exercise during cold stress could have osteoprotective effects by increasing NST. To test this hypothesis, wildtype C57BL/6J male mice were housed at 26C (thermoneutrality), 22C (standard housing temperature), and 16C (moderate cold stress) from 3-6 wks of age with food and water ad libitum. Half of the mice at each temperature were housed with running wheels (ex ercise, EX) and half without (control, CON). Outcomes at 6 wks of age included body mass, food intake, leptin, uncoupling protein (UCP1) expression in BAT, whole body bone mineral density (BMD, g/cm2) and percent body fat (%) via PIXImus, and cortical and trabecular bone architecture at the midshaft and distal femur via μCT. Results indicate that body mass, BMD, and percent fat did not differ in response to temperature or exercise, but mice at 16C ate more compared to mice at 22C or 26C. Serum leptin was lower in EX vs. CON mice at 16C and 22C but not 26C. Exercise led to lower trabecular bone volume fraction (BV/TV), connectivity density (Conn. D), and trabecular number (Tb.N) vs. controls at 16C and 26C (BV/TV -28% and -28%, Tb.N -7% and -8%, Conn.D -18% and -24%, $p<0.05$ for all). Cold stress decreased BV/TV in EX mice at 16C and 22C (-24% and -24%), and decreased Tb.N (-8% and -8%) and Conn.D (-25% and -35%) in both CON and EX mice ($p<0.05$ for all). There were no differences among groups in trabecular thickness or spacing, nor in midshaft femur cortical bone cross-sectional geometry. At 16C and 26C, both CON and EX mice had higher UCP1 mRNA (+43%, +50%, $p<0.007$ for both) and higher UCP1 protein expression (+52%, +31%, $p<0.006$ for both). Within each temperature, EX mice had higher UCP1 protein expression compared to CON (+32% at 16C, +91% at 26C, $p<0.03$ for both). These results indicate that both cold stress and exercise upregulated UCP1 mRNA and protein levels, but both exercise and cold also decreased trabecular BV/TV, Tb.N, and Conn.D. These data indicate increased NST as reflected in UCP1 expression does not protect trabecular bone mass during cold exposure. This unexpected result could reflect energetic tradeoffs between thermogenesis and skeletal acquisition.

Disclosures: Amy Robbins, None