SUN-538: Osteogenic Markers in Postmenopausal Diabetics Respond to Higher Mechanical Loading during Exercise after Rather Than before the Meals

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Background: Structural integrity of bones is supported by mechanical loading, energy intake, and sex hormones. It is unclear why postmenopausal (PM) diabetics experience more bone breaks despite higher body weight and positive energy balance than non-diabetics. We hypothesized that greater bone fragility in PM diabetics may result from peripheral insulin resistance and reduced nutrient access to the bone.

Methods: We engaged 15 diabetic women, age 57.7y, BMI 27.2 kg/m2, in two of five day-long experiments: SED (no exercise), UBM and UAM (40 min of uphill treadmill exercise, respectively one h before, or one h after eating two daily isocaloric meals at 10 and 17 h and containing 50% carbohydrate, 15% protein, and 25% fat), and DBM and DAM (downhill exercise at -6o slope with meals and exercise timed the same way). Markers of bone formation osteocalcin (OCN) and CICP (c-terminal propeptide of type I collagen) and of resorption, CTX (c-terminal telopeptide of type I collagen), anabolic growth hormone and catabolic cortisol were measured hourly in the serum. Glucose and insulin were measured to assess insulin resistance by the homeostatic HOMA-IR method from 7-h postprandial (PP) insulin and glucose areas under the curve (AUCs). Peak ground-reaction forces (GRFs) were monitored with Novel Pedar mechanosensitive shoe insoles, and physical effort was assessed as percent of VO2max with a metabolic cart.

Results: During uphill trials, mean effort was 75.2%, and GRFs were 780.7 N. During downhill trials, the corresponding values were 47.9% of VO2max and 1104.8 N (both >0.05). A similar CTX decline in all 5 trials after the 10h meal was larger than after the 17 h meal (7h negative PP AUCs: 1.52 vs 1.37 ng/ml*h, respectively) and coincided with PP insulin AUCs. CICP rise in DAM trial was 44% greater than in DBM trial after 10h meal (AUCs, 685.9 vs 384.1 ng/ml*h, respectively) and produced a 40 percent greater osteogenic CICP/CTX ratio after 10h meal in the in the DAM than DBM trial. No group difference was seen in brief postprandial serum glucose rises, while PP insulin was highest in UBM and SED trials and low in the two downhill and UAM trials. HOMA-IR in the two downhill trials (355.6) was reduced to 47% of that in two uphill trials (759.1) and to 62% of the SED trial (571.4). Circulating OCN and hormones showed no clear relationship to either the loading or meal-exercise timing patterns.

Conclusion: We conclude that in PM diabetics, downhill (as opposed to uphill) exercise after a meal conveys a clear benefit in stimulating a bone- forming CICP, more so after the 10h than the 17 h meal. Meal eating, independently of exercise, lowers the bone resorption marker CTX. In diabetic PM women, Increased GRFs of downhill exercise reduce HOMA-IR insulin resistance to high-carbohydrate meals more than uphill exercise or SED control. Postprandial downhill exercise has the highest osteogenic potential.

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