

Weekly Bone Loading Exercise Effects on a Healthy Subjects Strength, Bone Density, and Bone Biomarkers

BACKGROUND: Bone density loss affects astronauts in long-duration spaceflight. The OsteoStrong Company has shown increased hip (14.95%) and lumbar (16.6%) area bone mineral density (aBMD) after 6 mo of exercises with their loading devices. The devices were tested on one subject as a pilot study.

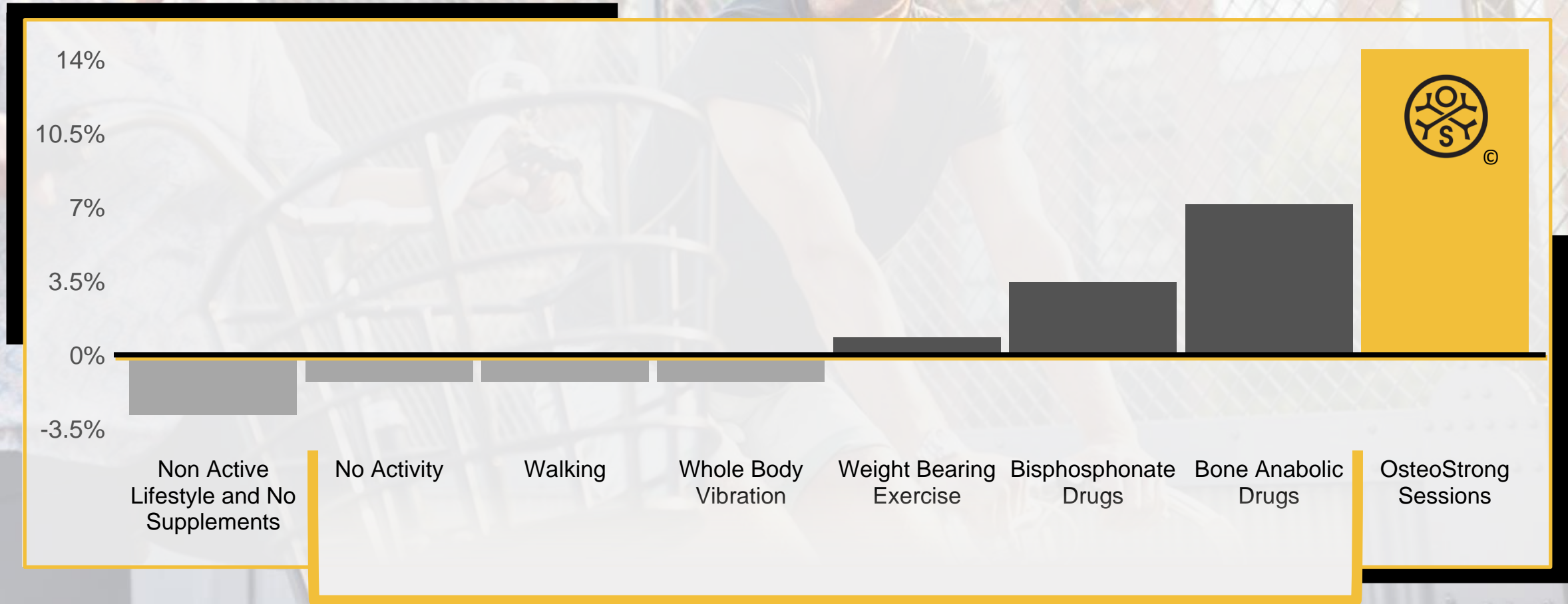
CASE REPORT: The subject performed 15 min of osteogenic exercises weekly for 24 wk. Total and regional aBMD, BAP (bone formation biomarker), NTX (bone resorption biomarker), forces exerted on devices, and weekly maximum weights lifted were collected. The control data was the subjects own lifting records 1.5 yr prestudy. The subject increased forces exerted on the devices in the upper extremity (97%, 197 to 390 kg; 435 to 859 lb), lower extremity (43%, 767 to 1097 kg; 1690 to 2418 lb), and spinal compression (22%, 275 to 336 kg; 607 to 740 lb). The monthly strength gain rate increased for snatch (2.3 vs. 0.71 kg; 5 vs. 1.56 lb), clean and jerk (2.5 vs. 0.4 kg; 5.5 vs. 0.88 lb), back squat (3.74 vs. 0 kg; 8.25 vs. 0 lb), front squat (2.15 vs. 0.2 kg; 4.75 vs. 0.47 lb), and deadlift (3.97 vs. 1.09 kg; 8.75 vs. 2.4 lb). The BAP increased by 39% (10.4 to 14.5 $\mu\text{g L}^{-1}$) and NTX decreased by 41% (13.4 to 7 nmol L^{-1} BME). aBMD increased in the head (6%), arms (4.3%), trunk (6.3%), ribs (3.8%), and pelvis (11%). There were no differences in body weight, legs, spine, and whole-body aBMD on the full-body dual-energy X-ray absorptiometry (DXA). There were no differences in lumbar, hip, and femoral neck aBMD on the regional DXA.

DISCUSSION: The osteogenic loading apparatus used for 15 min weekly

increased strength for the one individual in this preliminary study. Future studies on astronauts and other healthy populations are necessary.

Tsung A, Jupiter D, Jaquish J, Sibonga J. *Weekly bone loading exercise effects on a healthy subjects strength, bone density, and bone biomarkers.* Aerosp Med Hum Perform. 2021;92(3):201206.

ANALYSIS FROM 152 PEER REVIEWED STUDIES



In each of these studies, participants also took Calcium and Vitamin D3 supplements

AEROSPACE MEDICINE AND HUMAN PERFORMANCE: 2021

- PILOT STUDY
 - LENGTH: **6 MONTHS**
 - TITLE: Weekly Bone Loading Exercise Effects on a Healthy Subjects Strength, Bone Density, and Bone Biomarkers
 - LEAD RESEARCHER: TSUNG, ANN. NASA CONTRACTOR AND COMPETATIVE POWERLIFTER
- FOCUS OF THE STUDY:**
- AFFECTS OF OSTEOSTRONG SESSIONS IN THE AREAS OF:
- CORTICAL BONE DENSITY
 - Exterior Layer Bone - Hips and Lumbar Spine
 - PHYSICAL STRENGTH: Measured with the OsteoStrong devices and with maximum effort one-repetition weightlifting.
 - BLOOD TESTS FOR BONE TURN-OVER MARKERS:
 - **BAP**: BAP is an enzyme produced by osteoblasts, which are cells responsible for bone formation. It is a marker of bone formation and is typically elevated when there is active bone growth or remodeling.
 - **NTX**: NTX is a marker of bone resorption. It measures a fragment of collagen that is released during bone breakdown. Elevated NTX levels indicate increased bone resorption activity.



AREOSPACE 2021. Continued.

RESULTS: BONE DENSITY



6.28% AVERAGE **INCREASE** IN **CORTICAL BONE DENSITY** THROUGHOUT THE BODY.

RESULTS: PHYSICAL STRENGTH



AT OSTEOSTRONG: 54% **INCREASE** IN **STRENGTH** AS SHOW ON THE OSTEOSTRONG DEVICES.



AT THE GYM: 12% **INCREASE** IN **MAXIMUM WEIGHT LIFTED** IN DIFFERENT EXERCISES AFTER FIRST 4 SESSIONS.

RESULTS BLOOD TESTS FOR BONE TURN-OVER MARKERS:

BAP (typically elevated when there is active bone growth or remodeling):



39% INCREASE

NTX1 (Elevated NTX levels indicate increased bone resorption activity)



41% DECREASE

LATEST STUDY: Greece 2023

- POPULATION: Post-menopausal women, with an average age of 55 or above.
- SUBJECTS: **140**
- LENGTH: **9 MONTHS**
- OSTEOSTRONG SUBJECTS: **70**
- CONTROL GROUP: **70**
- ½ THE SUBJECTS IN EACH GROUP WERE ON BISPHOSPHINATES MEDICATION.
- LEAD RESEARCHER: George P. Chrousos, MD

FOCUS OF THE STUDY:

AFFECTS OF OSTEOSTRONG SESSIONS IN THE AREAS OF:

- Cortical Bone Density
 - Exterior Layer Bone - Hips and Lumbar Spine
- Trabecular Bone Density
 - Interior Bone - Hips and Lumbar Spine
- Balance
- Strength
- HbA1C: Long Term Blood Glucose Levels



OSTEOSTRONG EFFECTS ON THE LUMBAR SPINE: Greece 2023

OSTEOSTRONG GROUP:



2.21% INCREASE IN CORTICAL BONE DENSITY



1.73% INCREASE IN TRABECULAR BONE DENSITY

CONTROL GROUP:



0.12% DECREASE IN CORTICAL BONE DENSITY



1.31% DECREASE IN TRABECULAR BONE DENSITY

RESULTS:

179% GREATER IMPROVEMENT IN CORTICAL BONE DENSITY OVER THE CONTROL GROUP.

200% GREATER IMPROVEMENT IN TRABECULAR BONE DENSITY OVER THE CONTROL GROUP.

THE AVERAGE T-SCORE FOR THE OSTEOSTRONG GROUP INCREASED FROM -2.27 to -1.93.

GAINS IN STRENGTH

CASE STUDY:

60 seconds 1X wk.

500 People

Average Age 52



TYPE 2 DIABETES AND WEIGHT LOSS

THEULTIMATEBIOHACK®
#STRONGME

REDUCTION IN A1C

