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CENTRIFUGATION TRAINING FOR IMPROVING ORTHOSTATIC TOLERANCE

**Abstract**

**Aims:** Exposure to artificial gravity (AG) at different G loads and durations on human centrifuges has been shown to improve orthostatic tolerance in men. However, the effects on women and of an individual-specific AG training protocol carried out in microgravity/ simulated microgravity on tolerance are not known. **Methods:** We examined the effects of 90 minutes of AG vs. 90 minutes of supine rest on the orthostatic tolerance limit (OTL), using head up tilt and lower body negative pressure until presyncope of 7 men and 5 women. These subjects had rested in the head down bedrest position (HDBR) for 60 min prior to protocol 1 or protocol 2. Subjects were placed in the centrifuge nacelle while instrumented, and then they were tilted 6-degree head down (HDT). This was then followed by either: 1) AG exposure (90 minutes) in supine position [protocol 1, artificial gravity exposure], or 2) lay supine on the centrifuge for 90 minutes in supine position without AG exposure [protocol 2, control]. The AG training protocol was individualized, by first determining each subject's maximum tolerable G load, and then exposing them to 45 minutes of ramp training at sub-presyncopal levels. **Results:** Both sexes had improved OTL (14 minutes vs 11 minutes,  $p < 0.0019$ ) following AG exposure. When cardiovascular (CV) variables at presyncope in the control test were compared with the CV variables at the same tilt-test time (isotime) during post-centrifuge, higher blood pressure, stroke volume and cardiac output and similar heart rates and peripheral resistance were found post-centrifuge. **Conclusions:** These data suggest a better-maintained central circulating blood volume post-centrifugation across gender in participants that had been deconditioned by one hour of simulated microgravity and provide an integrated insight into mechanisms of blood pressure regulation and the possible implementation of in-flight AG countermeasure profiles during spaceflights.

**Keywords:** Microgravity, Head-down bedrest, Syncope, Centrifugation, Cephalic fluid shifts, Orthostatic intolerance, gender.