A Ground-Based Comparison of the Muscle Atrophy Research and Exercise System (MARES) and a Standard Isokinetic Dynamometer

K. J. Hackney,1,2 K. L. English,2,3 E. Redd,2,4 J. K. De Witt,2,5 R. Ploutz-Snyder,6 and L. L. Ploutz-Snyder2,7

1Syracuse University, Syracuse, NY, USA, 2NASA Johnson Space Center Exercise Physiology and Countermeasures Laboratory, Houston, TX, USA, 3JES Tech, Houston, TX, USA, 4University of Houston, Houston, TX, USA, 5Wyle Integrated Science and Engineering Group, Houston, TX, USA, 6NASA Johnson Space Center Biostatistics Laboratory, Houston, TX, USA, and 7Universities Space Research Association, Houston, TX, USA.

PURPOSE
1) To compare the test-to-test reliability of MARES with a standard laboratory isokinetic dynamometer (ISOK DYN) and 2) to determine if measures of peak torque and total work differ between devices.

METHODS
Ten subjects (6M, 4F) completed 2 trials on both MARES and an ISOK DYN in a counterbalanced order. Peak torque values at 60°·s⁻¹ and 180°·s⁻¹ were obtained from 5 maximal repetitions of knee extension (KE) and knee flexion (KF). Total work at 180°·s⁻¹ was determined from the area under the curve of torque vs. displacement during 20 maximal repetitions of KE and KF. Reliability of measures within devices was interpreted from the intraclass correlation coefficient (ICC) and compared between devices using the ratio of the within-device standard deviations. Indicators of agreement for the 2 devices were evaluated from 1) a calculation of concordance (rho) and 2) the correlation between the mean of measures and the difference between measures (μ vs. Δ).

RESULTS
For all outcome measures ICCs were high for both the ISOK DYN (0.95-0.99) and MARES (0.90-0.99). However, ratios of the within-device standard deviation were 1.3 to 4.3 times higher on MARES. On average, a wide range (3.3 to 1054 Nm) of differences existed between the values obtained. Only KE peak torque measured at 60°·s⁻¹ and 180°·s⁻¹ showed similarities between devices (rho = 0.91 and 0.87; Pearson’s r for μ vs. Δ = −0.22 and −0.37, respectively).

CONCLUSION
Although MARES was designed for use in microgravity, it was quite reliable during ground-based testing. However, MARES was consistently more variable than a standard ISOK DYN. Future longitudinal studies evaluating a change in isokinetic peak torque or total work should be limited within one device.