Maximum Oxygen Uptake during Long-Duration Space Flight: Preliminary Results

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INTRODUCTION

Maximum oxygen uptake (VO_2max) is maintained during space flight lasting <15 d, but has not been measured during long-duration missions. This abstract describes pre-flight and in-flight preliminary findings from the International Space Station (ISS) VO_2max experiment.

METHODS

Seven astronauts (4 M, 3 F: 47 ± 5 yr, 174 ± 7 cm, 74.1 ± 14.7 kg [mean ± SD]) performed cycle exercise tests to volitional maximum ~45 d before flight and tests were scheduled every 30 d during flight beginning on flight day (FD) 14. Tests consisted of three 5-min stages designed to elicit 25%, 50%, and 75% of preflight VO_2max, followed by 25 W•min^{-1} increases. VO_2 and heart rate (HR) were measured using the ISS Portable Pulmonary Function System (PPFS) (Damec, Odense, DK). Unfortunately the PPFS did not arrive at the ISS in time to support early test sessions for 3 crewmembers. Descriptive statistics are presented for pre-flight vs. late-flight (FD 147 ± 33 d) comparisons for all subjects (n=7); and pre-flight, early (FD 18 ± 3) and late-flight (FD 156 ± 5) data are presented for subjects (n=4) who completed all of these test sessions.

RESULTS

When all subjects are considered, average VO_2max decreased from pre- to late in-flight (2.98 ± 0.85 vs. 2.57 ± 0.50 L•min^{-1}) while maximum HR late-flight seemed unchanged (178 ± 9 vs. 175 ± 8 beats•min^{-1}). Similarly, for subjects who completed pre-, early, and late flight measurements (n=4), mean VO_2max declined from 3.19 ± 0.75 L•min^{-1} preflight to 2.43 ± 0.43 and 2.62 ± 0.38 L•min^{-1} early and late-flight, respectively. Maximum HR was 183 ± 8, 174 ± 8, and 179 ± 6 beats•min^{-1} pre-, early- and late-flight.

DISCUSSION

Average VO_2max declined during flight and did not appreciably recover as flight duration increased; however much inter-subject variation occurred in these changes.