EXAMINATION OF 10.2 PSIA SHUTTLE MISSIONS AS A PRECURSOR TO THE FUTURE EXPLORATION ATMOSPHERE

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INTRODUCTION: The proposed future exploration atmosphere enabling high frequency extravehicular activity (EVA) represents a balance between flammability concerns, material selection for a habitat, man’s adaptable physiology, and a necessity to avoid decompression sickness during EVA [1]. The designed atmospheric constituency will be 34% oxygen (O₂) and 66% nitrogen at a pressure of 8.2 psia [2]. This combination of factors drives a physiologic inspired O₂ partial pressure (PᵢO₂) of 128 mmHg, representing a slightly hypoxic condition that equates to breathing air at about 4000 ft altitude. Interestingly, NASA has prior spaceflight experience with this slightly hypoxic condition, through the Staged 10.2 psia prebreathe protocol used during some shuttle missions. This combination of 10.2 psia and 26.5% O₂ equates to a PᵢO₂ of 127 mmHg on those missions. In effect, those now-historical space shuttle missions may provide scientific insight for the future. METHODS: A retrospective data mining exercise was undertaken to assess whether or not the 34 slightly hypoxic shuttle missions caused human physiological or behavioral changes. The distribution and frequency of these changes will be compared between the 10.2 psia shuttle missions and the missions that maintained 14.7 psia. Within NASA’s Java Mission Evaluation Workstation System, a subprogram called the Archive Data Retrieval Interface Tool was utilized to determine the exact times on each flight that the depress to 10.2 psia and repress to 14.7 psia both occurred. RESULTS: After investigation of Lifetime Surveillance of Astronaut Health (LSAH), Life Science Data Archive (LSDA), and the Operational Prebreathe Database, two major study avenues remain viable for detailed analysis for spaceflight experience under slight hypoxic stress. The first housed in the LSDA, and is the Detailed Supplementary Objective (DSO) 634 which is the study ‘Sleep-Wake Actigraphy and Light Exposure During Spaceflight’. The second is harvesting discrete, non-attributable medical data and conditions from Private Medical Conferences (PMC) which are contained within the LSAH database. In order for this to be successful, the actual times of each shuttle mission’s depress and repress had to be determined and recorded. A spreadsheet was recently generated and will be used as the basis for the PMC data mining effort. DISCUSSION: Experience on Earth indicates that a chronic exposure to a mildly hypoxic PᵢO₂ of 128 mmHg is well-tolerated by healthy humans as millions of people live at altitudes above 4000 ft. However, adaptation to microgravity induces changes in physiology such as a cephalad fluid shift, which may complicate how well hypoxia is tolerated in space. This type of investigation has never been formally evaluated. Confirmation that the Staged 10.2 psia protocol had no measurable impact on any physiological or behavioral measures would help us understand one aspect of living in space at 8.2 psia while breathing 34% O₂.

REFERENCES: