POST-FLIGHT BACK PAIN FOLLOWING INTERNATIONAL SPACE STATION MISSIONS:
EVALUATION OF SPACEFLIGHT RISK FACTORS

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INTRODUCTION
Back pain during spaceflight has often been attributed to the lengthening of the spinal column due to the absence of
gavity during both short and long-duration missions. Upon landing and re-adaptation to gravity, the spinal column
reverts back to its original length thereby causing some individuals to experience pain and muscular spasms, while
others experience no ill effects. With International Space Station (ISS) missions, cases of back pain and injury are
more common post-flight, but little is known about the potential risk factors. Thus, the purpose of this project was to
perform an initial evaluation of reported post-flight back pain and injury cases to relevant spaceflight risk factors in
United States astronauts that have completed an ISS mission.

METHODS
All US astronauts who completed an ISS mission between Expeditions (EXP) 1 and 41 (2000-2015) were included
in this evaluation. Forty-five astronauts (36 males and 9 females) completed 50 ISS missions during the study time
period, as 5 astronauts completed 2 ISS missions. Researchers queried medical records of the 45 astronauts for
occurrences of back pain and injury. A case was defined as any reported event of back pain or injury to the cervical,
thoracic, lumbar, sacral, or coccyx spine regions. Data sources for the cases included the Flight Medicine Clinic’s
electronic medical record; Astronaut Strength, Conditioning and Rehabilitation electronic documentation; the
Private Medical Conference tool; and the Space Medicine Operations Team records. Post-flight cases were classified
as an early case if reported within 45 days of landing (R+45) or a late case if reported from R+46 to R+365 days
after landing (R+1y).

Risk factors in the astronaut population for back pain include age, sex, prior military service, and prior history of
back pain. Additionally, spaceflight specific risk factors such as type of landing vehicle and onboard exercise
countermeasures were included to evaluate their contribution to post-flight cases. Prior history of back pain included
back pain recorded in the medical record within 3 years prior to launch. Landing vehicle was included in the model
to discern if more astronauts experienced back pain or injury following a Shuttle or Soyuz landing. Onboard
exercise countermeasures were noted for those astronauts who had a mission following 2009 deployment of the
Advanced Resistive Exercise Device (aRED) (EXP 19 to 41). T-test and chi-squared tests were performed to
evaluate the association between each individual risk factor and post-flight case. Logistic regression was used to
evaluate the combined contribution of all the risk factors on post-flight cases. Separate models were calculated for
cases reported by R+45 and R+1y.

RESULTS
During the study time period, there were 13 post-flight cases reported by R+45 and an additional 5 reported by
R+1y. Most of these cases have been reported since EXP 19 with 10 cases by R+45 and 4 by R+1y. Individual risk
factors of age, sex, landing vehicle, and prior military service were not significantly associated with post-flight cases
identified at R+45 or R+1y (p>0.05). Having back pain or injury within 3 years prior to launch significantly
increased the likelihood of becoming a case by R+1y (p=0.041), but not at R+45 (p=0.204). Additionally,
astronauts who experienced onboard exercise countermeasures that included aRED had a significantly increased risk
of becoming a case at R+45 (p=0.024) and R+1y (p=0.003). Multiple logistic regression evaluating all the risk
factors for cases identified no significant risk factors at either the R+45 or R+1y time period (p>0.05). Overall
model fit was poor for both the R+45 (R²=0.132) and R+1y (R²=0.186) cases showing that there are risk factors not
represented in our model.

CONCLUSIONS
Regardless of cause, post-flight cases are reported more often since aRED was deployed in 2009. This may reflect
improved documentation or unidentified risk factors. No spaceflight risk factor explains the data fully. Post-flight
cases are probably due to multi-faceted factors that are not easily elucidated in the medical data.