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

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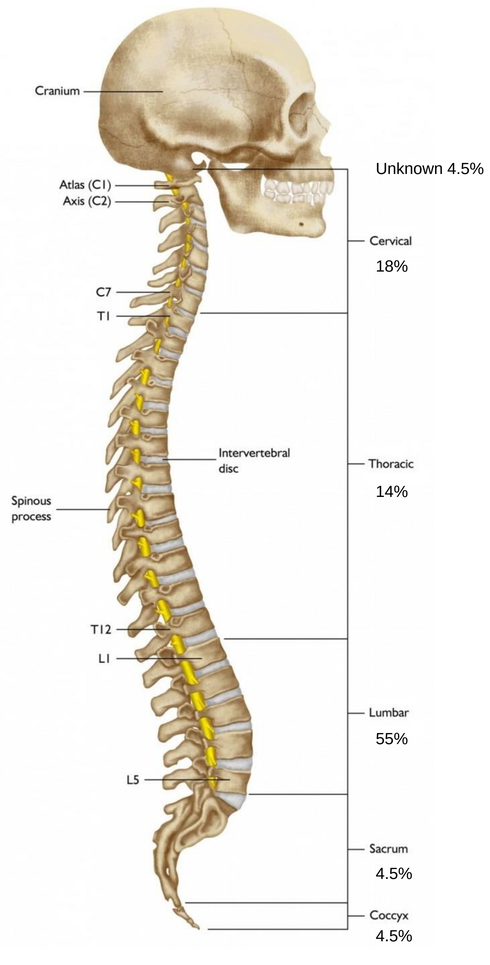
Background

Back pain during spaceflight has often been attributed to the lengthening of the spinal column due to the absence of gravity 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.

Purpose

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.

Post-flight cases by Spinal Regions
(reported up to R+1 year)



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 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 the 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. Univariate analysis of 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 ($p=0.003$). Multivariate 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 ($R^2=0.132$) and R+1y ($R^2=0.186$) cases showing that there are risk factors not represented in our model.

Multivariate Logistic Regression Model For Cases at R+45

Risk Factor	Odds Ratio	Std. Error	Z	P	95% Conf.	Interval
Age	1.11	0.103	1.08	0.282	0.921	1.327
Male sex	0.30	0.307	-1.18	0.240	0.041	2.218
Prior military	1.28	0.994	0.31	0.754	0.277	5.873
Prior case (L-3y)	1.09	0.857	0.11	0.916	0.232	5.098
Soyuz landing	1.55	1.692	0.41	0.685	0.184	13.120
EXP 19 or later	3.22	2.779	1.36	0.175	0.593	17.477
_cons	0.01	0.008	-1.46	0.145	0.001	8.450

Multivariate Logistic Regression Model For Cases at R+1y

Risk Factor	Odds Ratio	Std. Error	Z	P	95% Conf.	Interval
Age	1.16	0.106	1.60	0.110	0.967	1.386
Male sex	0.25	0.246	-1.41	0.159	0.036	1.718
Prior military	0.93	0.692	-0.10	0.919	0.214	4.004
Prior case (L-3y)	1.70	1.287	0.71	0.481	0.388	7.482
Soyuz landing	0.74	0.718	-0.31	0.759	0.112	4.930
EXP 19 or later	4.12	3.350	1.74	0.082	0.835	20.291
_cons	0.01	0.004	-1.74	0.081	0.001	2.434

Summary and Forward Work

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 evaluated here explains the data fully. Post-flight cases are probably due to multi-faceted factors that are not easily elucidated in the medical data.