Space Adaptation Back Pain
A Retrospective Study

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Space Adaption Back Pain

- Astronauts frequently report back pain in the early phase of space flight as they adapt to microgravity
- The epidemiology of space adaptation back pain (SABP) has not been well established
Objectives

• Determine the exact incidence of SABP among astronauts
• Develop a case definition of SABP
• Delineate the nature and pattern of SABP
• Review available treatments and their effectiveness in relieving SABP
• Identify any operational impact of SABP
Methods

Retrospective review of all available mission medical records of astronauts in the U.S. space program, which included:

- Preflight medical exams
- Flight surgeon logs
- Postflight medical exams
- Postflight medical debriefs
- Standardized back pain questionnaire
- Private Medical Conference (PMC) Tool
Missions

- Mercury
- Gemini
- Apollo
- Apollo-Soyuz Test Project (ASTP)
- Mir (U.S. Astronauts only)
- Skylab
- International Space Station (ISS) missions (Expedition 1 through 15)
- Shuttle missions STS-1 through STS-122 (Except STS-51L Challenger and STS-107 Columbia)
A total of 772 astronaut flights were reviewed
Case Definition of SABP

- Symptoms are not precipitated by an injury or related to prolonged recumbent sitting on the launch pad
- Symptoms develop within the first 5 days of space flight
- Multiple days of in-flight back pain were considered as one case
Results

Incidence of SABP was 52%
Gender Analysis

Comparison of Gender and Space Adaptation Back Pain

Males
- SABP: 52%
- No SABP: 48%

Females
- SABP: 58%
- No SABP: 42%

Males
SABP 52%

Females
SABP 58%
Shuttle Gender Analysis

- **Shuttle SABP Analysis Males**
  - 233 with SABP
  - 315 with No SABP
  - 43% SABP, 57% No SABP

- **Shuttle SABP Analysis Females**
  - 40 with SABP
  - 57 with No SABP
  - 41% SABP, 59% No SABP

**Males**
- SABP 57%

**Females**
- SABP 59%
SABP Intensity

Mild pain  86%
Moderate pain  11%
Severe pain  3%
SABP Location

Back Pain Location

- Lumbar: 86%
- Thoracic: 12%
- Cervical: 2%

Legend:
- Lumbar
- Thoracic
- Cervical
In most SABP cases, the initial onset of symptoms was within the first 2 days of space flight. Only 12 astronauts reported an onset of symptoms after flight day 2.
SABP & Flight Days

SABP is present in the early phase of spaceflight, with a peak prevalence on flight day 2 and none reported after flight day 12.

Flight Days Associated With SABP

Crew

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Temporal Component

Time of Day SABP Present

- Night: 75%
- Day: 15%
- Both: 10%
Effectiveness of Treatments

The most effective treatments were bending the knees to the chest (91%), stretching the lumbar spine (90%) and anti-inflammatory medication (85%).

![Interventions / Results](chart)

- **Nothing**: 28 Tried, 15 Helped
- **Exercise**: 28 Tried, 24 Helped
- **Medication**: 127 Tried, 108 Helped
- **Stretching**: 114 Tried, 103 Helped
- **Bent Knees**: 177 Tried, 161 Helped
Vehicle Analysis

The incidence of SABP varied in relation to the space flight vehicle.

![Space Adaption Back Pain by Vehicle](chart.png)

- **Mercury**: 0%
- **Gemini**: 0%
- **ASTP**: 0%
- **Skylab**: 0%
- **Apollo**: 10%
- **Mir**: 31%
- **ISS**: 39%
- **STS**: 58%
History of Pre-flight Back Pain

Positive History of Pre-flight Back Pain Analysis

- SABP = Y: 35%
- SABP = N: 65%
- Total: 106

Negative History of Pre-flight Back Analysis

- SABP = Y: 48%
- SABP = N: 52%
- Total: 142

Positive History
SABP 65%

Negative History
SABP 52%
Among astronauts who flew more than one mission; they had a higher incidence of SABP on their first mission than on subsequent missions.
SABP Characteristics

- Symptoms are usually mild to moderate
- Symptoms are usually localized to the lumbar region
- Symptoms are described as an ache or stiffness
- Symptoms typically occur during the sleep period
- Neurological symptoms (radicular pain, numbness, tingling) are absent
- Symptoms tend to improve or resolve with the use of bending the knees to the chest, stretching of the lumbar spine, or anti-inflammatory medication
Conclusions

- The incidence of SABP has been determined to be 53% among astronauts in the U.S. space program.
- Most cases of SABP are mild, self-limited, or respond to available treatments.
- There are no currently accepted preventive measures for SABP.
- It is difficult to predict who will develop SABP.
- The precise mechanism and spinal structures responsible for SABP are uncertain.
- There was no documented evidence of direct operational mission impact related to SABP.
- There is potential mission impact related to uncontrolled pain, sleep disturbance, or the adverse side effects of anti-inflammatory medications.
Limitations

• Retrospective study
  • Missing data
  • Misinterpretation of existing data

• Standardized back pain questionnaire only used on Shuttle missions

• Reluctance among astronauts to report in-flight back pain
Recommendations

• Promote the most effective treatments of SABP with the least potential for adverse side effects

• Sleep accommodations on all space flight vehicles should allow for crewmembers to bend their knees to the chest

• The precise mechanism, spinal structures and causative factors associated with SABP should be further investigated in order to facilitate the development of preventive measures, as well as additional effective treatments
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References

- Davis JR, Vanderploeg JM, Jennings RT, Stewart DF. Space motion sickness during 24 flights of the space shuttle. Aviat Space Environ Med. 1998 Dec; 59 (12) 1185-89.
References