# BEDREST STUDIES: CHALLENGES AND OPPORTUNITIES

Accompanying video: https://youtu.be/pig07mLjhrY?t=342

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Testing humans who venture into a zero-gravity environment is logistically difficult, expensive, and can only test a very limited number of people over a very long period of time. Because of these and other issues, ground-based analogues to spaceflight have been developed. These analogues are administered by international space agencies and governments, providing a global network of research centres, including: the high Antarctic plateau (Concordia), undersea facilities (NEEMO, Florida Keys, USA), and even atop volcanoes (HI-SEAS, Hawaii, USA). Regarding bedrest centres specifically, there are currently three dedicated facilities in Europe located in Toulouse, France, Cologne Germany, and Planica, Slovenia. Each bedrest facility has unique functional capabilities. This talk addresses aspects of carrying out short- and medium-term bedrest studies that have been conducted in France and Slovenia over the past 10 years.

Logistical considerations for conducting successful bedrest studies include an acute awareness for the importance of recruiting exceptional study participants, the number of studies to be implemented, and how each experiment may impact on the physiological responses of the participants i.e. the order effect of the planned studies might influence the results of another study. This kind of cross-contamination between studies must be avoided at all costs during the planning phase of the experiment. Participants in bedrest studies must adhere to very strict daily schedules, which specify everything from what they eat, and when, to how many experiments are performed each day, to when they sleep. Participants need a very specific mindset to successfully complete this kind of rigorous testing; on the one hand they need to be highly internally-motivated, and on the other, there needs to be a certain level of relaxation and patience to 'go with the flow' when challenges inevitably arise (e.g. testing delays, changes to schedules, meal times, content of meals, etc.).

Bedrest studies provide unique, high-risk and high-reward research opportunities for understanding human physiology and psychology. One can gather insights into a variety of conditions that may otherwise be unavailable due to other complications (e.g. clinical populations, inactivity due to pregnancy, ageing process, actual spaceflight). Some of the challenges to bedrest studies include recruiting and retaining excellent participants, test scheduling, team morale (both participants and researchers), and the 'one-shot' testing situation (i.e. missing data points are costly, especially if due to human error).

## REFERENCES

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## SELF-CHECKING QUESTIONS

1. Name three (3) physiological factors that are significantly altered in both spaceflight and bedrest environments (e.g. significant decreases are observed in plasma volume in the short-term).

2. List three (3) experimental interventions that could be useful for combating the negative effects of inactivity, specifically addressing loss of muscle mass in the lower limb, for example.

3. You are responsible for scheduling five (5) physiological tests in the 2 days before participants go into bedrest. You cannot schedule tests between 8-9:00, 12-13:00, 15-15:30 or 18-19:00 since they will be eating. You can change mealtimes. All participants must be in bed with lights out by 22:30; all testing completed by 20:30. All times listed include instrumenting your participant, clean up, and preparations for testing the next person. You must schedule these times based on participants entering the study in pairs.

**TEST Battery**

1) Muscle biopsy (vastus lateralis, 30 min)

2) orthostatic tolerance tilt test (90 min protocol, includes lower body negative pressure)

3) $VO_{2max}$ test (cycle ergometer, 60 min protocol, includes warm up)

4) Body composition (DEXA body scan, 40 min protocol)

5) Muscle function 1 (isokinetic dynamometer, testing of upper body range of motion and strength/power relationships, 90 min protocol)

| Time (h) | Notes | Tests | | | |
|---|---|---|---|---|---|
| | Test Day | Day -2 | | Day -1 | |
| | Person | 1 | 2 | 1 | 2 |
| **7:30** | Wake | | | | |
| **8:00** | Breakfast | | | | |
| **8:30** | | | | | |
| **9:00** | | | | | |
| **9:30** | | | | | |
| **10:00** | | | | | |
| **10:30** | | | | | |
| **11:00** | | | | | |
| **11:30** | | | | | |
| **12:00** | Lunch | | | | |
| **12:30** | | | | | |
| **13:00** | | | | | |
| **13:30** | | | | | |
| **14:00** | | | | | |
| **14:30** | | | | | |
| **15:00** | Snack | | | | |
| **15:30** | | | | | |
| **16:00** | | | | | |
| **16:30** | | | | | |
| **17:00** | | | | | |
| **17:30** | | | | | |
| **18:00** | Dinner | | | | |
| **18:30** | | | | | |
| **19:00** | | | | | |
| **19:30** | | | | | |
| **20:00** | | | | | |
| **20:30** | | | | | |