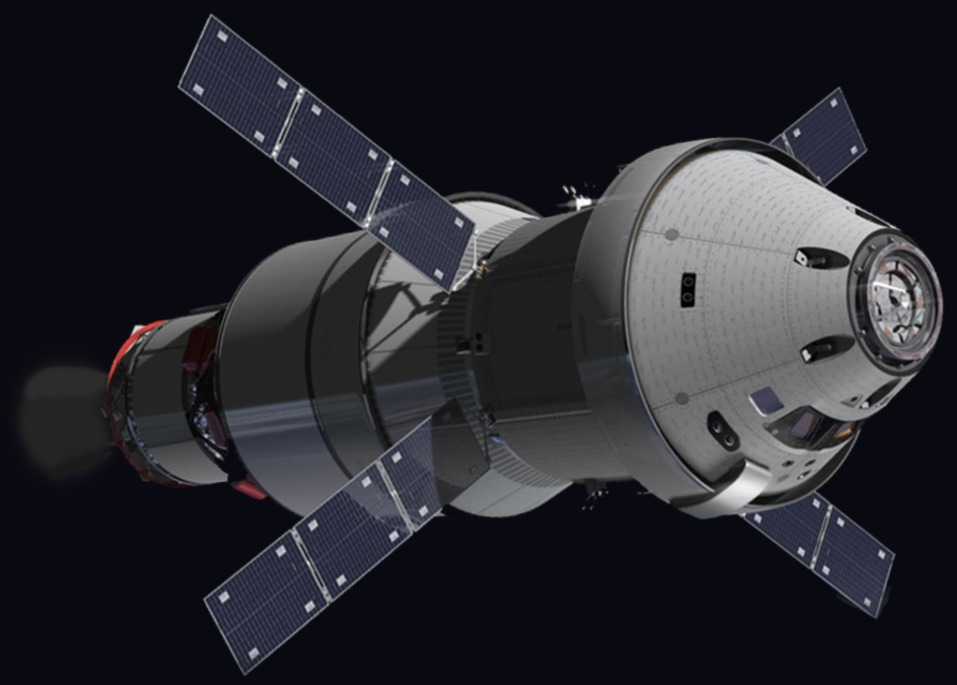

Winnard A, Richter C, Weber T, Braunstein B, Nasser M, Boudreu E, Velho R, Caplan N , Gradwell D, 2018

Synergistic Research Synthesis Enabling Evidence Based Practice

The Group:

Systematic standardised synthesis enables an accurate and unbiased picture of the evidence base to inform medical opinions. Synthesis that highlights gaps or deficiencies in the evidence base proves that medical opinions in those areas rely more on "expert opinion" and can justify funding research to improve the available evidence. Aerospace is one of the final medical fields to begin organising a critical summary, adapted periodically, of evidence underpinning medical operations, and the Aerospace Medicine Systematic Review Group is a new initiative that is filling this gap.

The aim of the Aerospace Medicine Systematic Review Group (AMSRG) is to facilitate the highest quality, most transparent synthesis of evidence, informing operational medical guidelines in best practice to support those participating in aviation and spaceflight, while simultaneously guiding future research with thorough evidence base gap analysis.

The review group works with individual research teams from around the world, enabling teams to conduct high quality, transparent reviews. The group website publishes open access tools to facilitate the review process, along with a list of publications and identified gaps in the evidence base. We use reviews to inform operational guidelines based on the current evidence base. Since the group formed in early 2017, nine tools have been developed and listed on the website (in Feb 2018), with seven of these developed by the group itself. The group will also explore possibilities for creating a database of published clinical trials in Aerospace Medicine.

Below are two examples of tools created by the group:

Tool for assessing quality of bed rest study methods. A higher number of met criteria is considered to indicate greater rigour

Tool:

Point	Criteria
1	Was the bed-rest six degree head down tilt to simulate cephlad fluid shift?
2	Was diet individualised and controlled?
3	Was the daily routine fixed – with set wake – sleep times and same routines for all?
4	Are all phases of bed-rest standardised for all participants – same baseline data collection period, same bed-rest time and same recovery phase?
5	Was the bed-rest 'horizontal posture' maintained except for when the test condition required it? I.e. personal hygiene, bowel movements, urination should all occur in bed, no visitors should be allowed and knees should not be flexed?
6	Was sunlight exposure prohibited and participants supplemented with vitamin D?
7	Were all measurements scheduled the same for all participants and done at the same time of day?
8	Was the duration of bed-rest stated?

Tool for assessing methololdigical quality of partial gravity simulation. The underlying assumption is how will the simulation reflects reality and provides a rating of how will the simulation results are transferable to real human partial gravity missions

Tool:

Methods/ Parameter	Cardiovascular properties	Respiratory & Metabolic properties	Musculo-skeletal properties	Kinematics	Ground reaction forces	Muscle activation pattern	Points	Ranking
Partial gravity parabolic flight	xxx	xxx	xxx	xxx	xxx	xxx	18	1
Vertical body weight support systems	x	xx	xx	xx	xxx	xx	12	4
Lower body positive pressure treadmills	xx	xx	xx	xx	xxx	xxx	14	2
Tilted body weight support systems	xx	xx	xx	xx	xxx	xx	13	3
Supine suspension systems	xx	xx	xx	xx	xxx	xx	13	3
Head-up tilt	xx	xx	xx	xx	xxx	xx	13	3

An example output - helping ESA progress towards human Lunar missions

Human Biomechanical and Cardiopulmonary Responses to Partial Gravity - A Systematic Review by Richter, Braunstein, Winnard, Nasser and Weber 2017. This review summarised all terrestrial studies along with experiences from the Apollo missions that reported effects of partial gravitu (0.1-0.4g) on the human musculoskeletal, cardiovascular and respiratory systems. The final report on the current full evidence base informs decision making concerning the best medical and exercise support to maintain astronaut health during future missions in partial gravity.

A search strategy using Boolean logic was used to search Pubmed, Web of Science, Cochrane Collaboration Library, Institute of Electrical and Electronics Engineers database, the ESA Erasmus Experiment Archive, the NASA Technical Reports Server and Life Science Data Archive and the German Aerospace Centre's elib database. The results were screened (fig1) for inclusion criteria as follows:
Population - Astronauts and partial gravity simulation study participants.
Interventions - Apollo missions and various spaceflight simulations.
Control - 1 g gravity. Outcomes - any energetics and/or biomechanics.
All studies were assessed with the Cochrane risk of bias tool and a newly developed quality appraisal tool that assessed included studies ability to relfect true effects of partial gravity on included outcome measures. Effect sizes (Hedge's g) were calculated between 1 g and the partial g conditions to quantify the effect of partial gravity on the included outcomes.

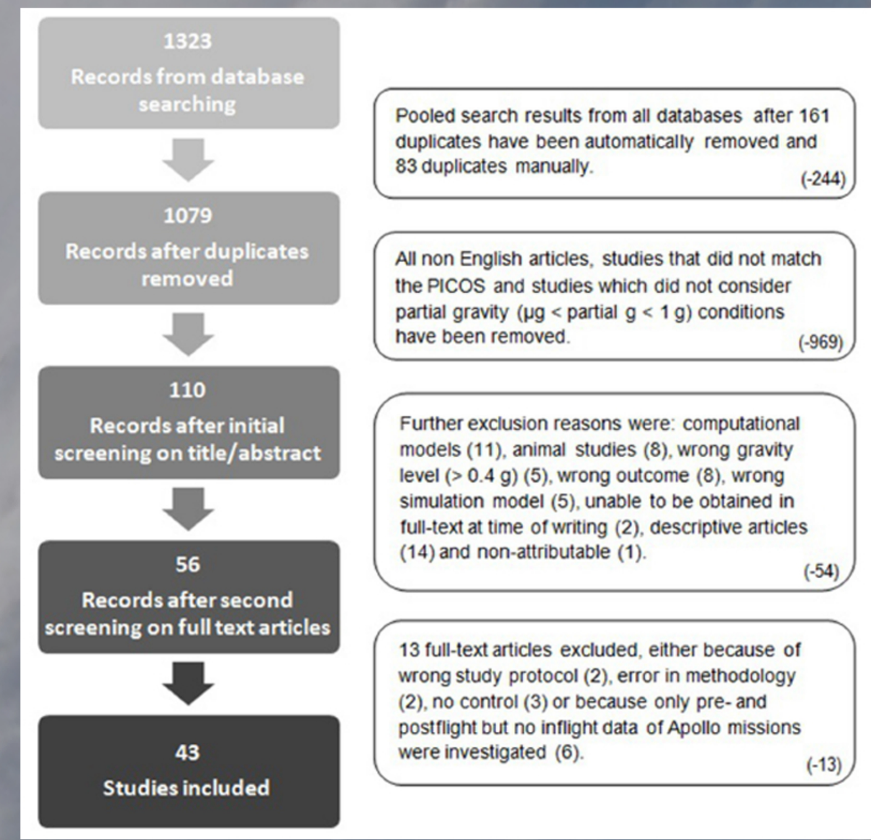

Fig 1. Search and screening strategy and numbers

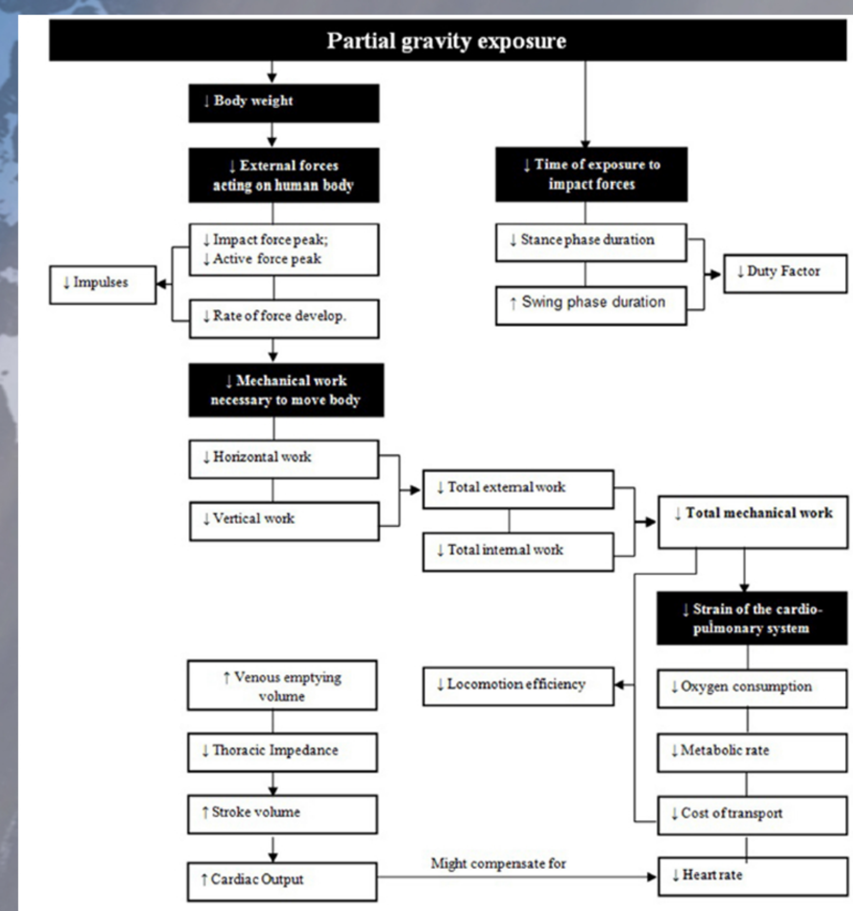

Fig 2. Interaction of cardiopulmonary and biomechanical parameters
Black boxes = main factors of partial g exposure, white = underlying outcome

Full results can be viewed in the published article. Results were heterogeneous and many low quality methodologies used in the studies. In brief, cardiopulmonary parameters such as heart rate, oxygen consumption, metabolic rate, and cost of transport are reduced compared to 1 g, whereas stroke volume seems to increase with decreasing gravity levels. Biomechanical studies reveal that ground reaction forces, mechanical work, stance phase duration, stride frequency, duty factor and preferred walk-to-run transition speed are reduced compared to 1 g. Partial gravity exposure below 0.4 g seems to be insufficient to maintain musculoskeletal and cardiopulmonary properties in the long-term. The interaction of effects can be seen in Fig2.

Exercise countermeasures appear to be necessary in order to maintain reasonable astronauts' health, and thus ensure both sufficient work performance and mission safety.

The Aerospace Medicine Systematic Review Group

www.aerospacemed.rehab/systematic-review-group