Proposal for Forming an IAA Study Group  SG 2.17

Title of Study: Dynamic assessment and management of astronauts’ physical health post-landing

Proposer(s): Jean-Pierre Haignere  
(The proposer(s) must be member(s) of the Academy M or CM)

Primary IAA Commission Preference: Space life sciences  
(From Commission 1 to Commission 6)  
Commissions: 1 Space Physical Sciences, 2 Space Life Sciences, 3 Space Technology & Systems Development, 4 Space Systems Operations & Utilization, 5 Space Policy, Law & Economics, 6 Space and Society: Culture and Education

Secondary IAA Commission Interests: N/A  
(From Commission 1 to Commission 6)

Members of Study Team

Chair(s): Jean-Pierre Haignere  
(At least one must be member(s) of the Academy, M or CM)

Secretary: Dorin Prunaruiu  
(Preferably member(s) of the Academy, M or CM)

Other Members: Jeffrey Davis, Chiaki Mukai, Takao Doi, Claudie Haignere, Mrs Coleman, Marlene McLeish, Philip Njemanze, Christos Papadelis, julie Payette, Joan Vernikos, Yi Soyeon, Oleg Kotov, Elena Fomina

+ cooperation with Space Explorer Association  
(Open to members and non-members of the Academy)

Short Description of Scope of Study

Humans’ exploration of outer space has advanced enormously during the past few decades. However, specific environmental factors like microgravity, space radiation, extreme temperature, high vacuum, micro-magnetic field, noise, vibration, and circadian rhythm changes have been reported to adversely affect the human body. Different organisms, including the circulatory system, motor system, neurological system and immune system are all known to be affected. Most of previous studies focused on the astronauts’ health status during and immediately after flights. Nonetheless, the long-term effects of external stimuli in the space on the physiological processes remain unclear. Moreover, the national distribution of astronauts is dispersed and the number of astronauts in a single country is limited. The study population of previous researches was relatively small and the reliability of the results needs to be further verified. Currently, there’s not a widely-accepted standard of astronauts’ health status assessment and management post-landing. Thus, understanding these physiological changes and
performing systemic physical status assessment for astronauts post-landing are of great importance. We will be able to better protect astronauts’ health and plan longer duration missions accordingly. Therefore, the aims of this study are to (1) convey dynamic and systemic assessment of astronauts’ physical status after returning to earth; (2) describe risk factors correlated with impaired physiological function; (3) provide evidence for future prevention and intervention measures.

**Overall Goal:**
(Expected scientific or practical benefit of the study group’s efforts)

The goals of this study are to (1) convey dynamic and systemic assessment of astronauts’ physical status after returning to earth; (2) describe risk factors correlated with impaired physiological function; (3) provide evidence for future prevention and intervention measures

**Intermediate Goals:**

i) Collect baseline information of astronauts’ physical health status; Convey systemic assessment and consistent follow-up

ii) Propose health management and intervention measures for astronauts post-landing

**Methodology:**
(Email works, workshops, stand alone conferences, mailing of questionnaire, interim publications, etc.)

- **Pilot study**
  2-3 healthy volunteers will be enrolled on earth. Volunteers will live 20-30 days in space shuttle simulators. Systemic physical health assessment will be performed during and after the spaceflight simulation process. The aims of the pilot study are to (1) analyze the effects of external stimuli on physiological processes; (2) find appropriate timings for physical status evaluation.

- **Dynamic assessment of astronauts’ physical health**

Astronauts completed missions before Dec. 2019 (including those accomplished several space flights) will be enrolled. Baseline and dynamic follow-up information will be acquired by questionnaires. Subjects will be further grouped according to different flight patterns.

**Part I: Baseline information**

i) Demographic information: gender, age, nationality, marital status, ethnicity, etc.

ii) Space flight information: astronauts’ age during the mission, flight duration (short vs. long duration), frequency of missions, flight orbit patterns, returning time, radiation exposure, extravehicular activities

iii) Preflight and flight health: symptoms during missions, exercises (patterns, time, frequency), specific measures of medical isolation rehabilitation post-landing

**Part II: Physical examination**

Vitals: Body Temperature, Pulse Rate, Respiration Rate, Blood Pressure

General:

Eyes: Conjunctivae and lids, pupils, visual acuity
ENNT: external ears, external nose, hearing, tongue, posterior pharynx, neck, trachea, thyroid
Lymph nodes: cervical, clavicular, or posterior auricular lymphadenopathy
Cardiovascular: S1, S2, rhythm, murmur, rub, or gallop; thrill or palpable murmurs, JVD, displacement of the left ventricular point of maximal impulse; carotid or abdominal bruits; enlargement of abdominal aorta; Carotid, radial, posterior tibialis, and pedal pulses symmetric, edema
Respiratory: auscultation, tactile fremitus, respiratory effort
Gastrointestinal: tenderness to palpitation, abdomen masses, bowel sounds, liver size; liver nodularity or masses, splenomegaly
Rectal Exam: rashes, lesions or sores, guaiac positive stool
Skin: rash, lesions, ulcerations, subcutaneous nodules or induration
Musculoskeletal: alignment, mobility and deformity of head and neck, spine, ribs, pelvis; ROM in all extremities; clubbing, cyanosis, petechiae, or nodes of digits and nails
Neurologic: Cranial nerves; responses to touch, pin, vibration, and position in lower extremities; finger-to-nose, homberg and Pronator drift
Mental Status Exam: Judgment and insight; orientation to time, place, and person; memory for recent and remote events; depression, anxiety, or agitation

Part III: Pertinent tests

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<thead>
<tr>
<th>Respiratory:</th>
<th>During and post isolation period</th>
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<tr>
<td>During isolation period: lung function tests</td>
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<th>Circulatory:</th>
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<tr>
<td>During isolation period: ECG, HR variability, BP, cardiac ultrasound</td>
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<tr>
<td>Post-isolation period: CMR, tilting test, Treadmill Exercise Test, Holter monitoring, 24-hour BP monitoring</td>
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<tr>
<th>Gastrointestinal:</th>
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<tr>
<td>During isolation period: abdominal ultrasound</td>
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<th>Genitourinary:</th>
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<tr>
<td>During isolation period: ultrasound</td>
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<th>Endocrinal:</th>
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<tr>
<td>During isolation period: thyroid and adrenal ultrasound</td>
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<th>Neurological:</th>
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<tr>
<td>During isolation period: Transcranial Doppler ultrasound, EEG, Evoked potentials</td>
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<tr>
<td>Post-isolation period: Multimodal brain MRI, MRI+DWI, PWI, Brain MRA or CTA, DTI, VBM, BOLD</td>
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<th>Vestibular System/Balance system:</th>
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<tr>
<td>During isolation period: Nystagmography examination, Vestibular double temperature examination, head impulse test, ocularvestibular evoked myogenic potentials, cervical vestibular evoked myogenic potential, subjective visual vertical, sensory organization test</td>
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<th>Motor system:</th>
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Instructions and application form: see: “Scientific Activity” section at http://iaaweb.org/content/view/256/393/

- During isolation period: Bone mineral density examination, Calf circumference, Leg muscle ultrasound, Grip, Gait analysis
- Post-isolation period: Spine MRI

Eyes:
- During isolation period: vision, intraocular pressure, Eye film
- Post-isolation period: Eye MRI

Psycho:
Monca cognitive scale, Hamilton Depression Scale, Hamilton Anxiety Scale, Pittsburgh Sleep Quality Index

Lab tests:
- Routine tests: CBC, urine test, stool test, Peripheral blood lymphocyte micronucleus test, CRP level, Oxygen saturation, Thyroid function test, Tumor markers, Coagulation test, Troponin tests
- Immunology tests: Thyroglobulin antibody, Thyroid microsomal antibodies, Rheumatic autoimmune antibodies
- Hormone tests: melatonin, renin, Aldosterone, Serum osteocalcin, cortisol, 5-HT, dopamine, Adrenocorticotropic hormone, Adrenaline, ANP, Parathyroid hormone, Superoxide dismutase, Glutathione, N-terminal peptide, C-terminal peptide
- Cytokines: BTM, TPO, VEGF, CCL, CCL4, CXCL5, IL, INF, G-CSF, GM-CSF, TNF, HSP70, ICAM-1, VCAM-1, eNOS, T cell surface receptor, B cell surface receptor
- Chromosome tests: Chromosome aberration analysis of peripheral blood lymphocytes, Chromosome fragile locus expression rate, Changes in DNA replication and repair rates, Telomerase test
- Intestinal flora inspection

Time Line: Two years (Jan. 2018 to Dec. 2019)
(Cannot exceed two years)

Final Product:
(The final product is a study booklet (up to 100 pages) or a book (100 to 400 pages).

Target Community:
(The target community should be identified with the study team and the dissemination undertaken during the 2 years work. Beyond the UN COPUOS other target must be identified such as space agencies, space industry, international organizations, etc.)

Support Needed:
(sponsor of a publication identified, etc.)

Potential Sponsors:

To be returned to the IAA Secretary General Paris by fax: 33 1 47 23 82 16 or by email: sgeneral@iaamail.org

Date: February 25, 2018
(No Signature required if document authenticated).