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## 2013 Nutrition Risk Standing Review Panel

### Evidence Review for: *The Risk Factor of Inadequate Nutrition*

### Final Report

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#### I. Executive Summary and Overall Evaluation

The 2013 Nutrition Risk Standing Review Panel (from here on referred to as the SRP) met for a site visit in Houston, TX on November 20 - 21, 2013. The SRP reviewed the new Evidence Report for the Risk Factor of Inadequate Nutrition (from here on referred to as the 2013 Nutrition Evidence Report), as well as the Research Plan for this Risk.

Overall, the SRP thinks the well-qualified research team has compiled an excellent summary of background information in the 2013 Nutrition Evidence Report. The SRP would like to commend the authors in general and particularly note that while the 2013 Nutrition Evidence Report has been written using a single nutrient approach, the research plan takes a much more integrated and physiologically based approach.

#### II. Review of the Evidence for the Risk Factor of Inadequate Nutrition

##### 1. Evaluate the 2013 Nutrition Evidence Report using the following criteria:

A. *Does the 2013 Evidence Report provide sufficient evidence that the Risk is relevant to long-term space missions?*

Yes, the SRP thinks the 2013 Nutrition Evidence Report provides sufficient evidence that the Risk is relevant to long-term space missions.

B. *Are the Risk Title and Statement properly stated in the current version of the HRP Integrated Research Plan (IRP)?*

The SRP suggests rewording the Risk Statement to: Given that adequate nutrition is a key factor in all physiological functions, that spaceflight has been shown to alter many physiological functions in humans, and that countermeasures for individual systems may alter nutritional status, there is a possibility that inadequate **and/or suboptimal** nutrition will compromise crew health, including endurance, muscle mass and strength, immune function, bone mass and strength, cardiovascular performance, gastrointestinal function, endocrine function, and ocular, psychological and physical health, **behavior and performance**, and ability to mitigate oxidative damage.

C. *Is the text of the Risk Context provided in the HRP IRP clear?*

The SRP suggests rewording the Risk Content to: In general, nutritional risks increase with duration of exposure to a closed (or semi-closed) food system and when countermeasures are employed. Understanding nutrient requirements **and optimal intake** in micro- or partial gravity environments and the effect of countermeasures on nutrient requirements is critical to

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ensure crew health and safety and mission success. Provision of these nutrients in safe amounts (*neither insufficient or excessive*) depends on provision of appropriate, palatable, foods with the stability of nutrients for the duration of the mission, and *on* actual intake of the nutrients, and *on* knowledge that countermeasures are not altering requirements.

*D. Does the evidence base make the case for the knowledge-type gaps presented?*

Yes, the SRP thinks the evidence base makes the case for the knowledge-type gaps presented.

*E. Are there any additional knowledge-type gaps that should be considered for this specific Risk?*

Yes, the SRP suggests adding the following knowledge-type gaps presented:

- i. No data on vitamin A.
- ii. Carotenoids.
- iii. pCO<sub>2</sub> issue need to be part of evidence and expanded.
  - Discuss possible consequences of high ambient CO<sub>2</sub>.
  - Consider possibility of chronic respiratory acidosis development.
  - That the combination of mild acidosis with zero gravity may have impact on bone and muscle metabolism.
- iv. No data on arterial pH
- v. Fish and bone (p. 101 of 2013 Nutrition Evidence Report).
  - There should be a more detailed study of fatty acid profile in serum pre-, during and post flight to complement the dietary records, which are relatively insensitive, since body stores are slow to change.
- vi. Fish oil intake and fatty acid in blood omega 3, 6, 9.
- vii. Effects on reproductive hormone levels in both women and men.

*F. Does the Evidence Report address relevant interactions between this Risk and others in the HRP IRP?*

The SRP was pleased with the interaction between the nutrition discipline and the bone discipline and encourages the nutrition discipline to look at other disciplines for relevant interactions. The SRP thought specifically of the Space Radiation Program Element and the Behavioral Health and Performance Element. The SRP also felt that in future presentations and reports the nutrition discipline could highlight their specific projects and interactions with the musculoskeletal discipline and perhaps discuss this in the context of “bone-muscle” interactions.

*G. Are the qualifications of the author(s) appropriate for identifying the evidence base necessary to characterize the given Risk?*

Yes, the SRP strongly believes that the team is very knowledgeable and has enough team members of different disciplines and backgrounds to make assessments.

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*H. Is there information from other HRP disciplines that need to be included in the 2013 Nutrition Evidence Report?*

Comments included above in Section II. 1. F.

*I. Is the breadth of the cited literature sufficient?*

The SRP thinks that the authors have cited a comprehensive list of literature.

*J. What is the overall quality and readability of the 2013 Evidence Report?*

The SRP thought the 2013 Nutrition Evidence Report was well written, organized, and served its purpose well.

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## **VI. 2013 Nutrition Risk SRP Evidence Review: Statement of Task for the Risk Factor of Inadequate Nutrition**

In 2008, the Institute of Medicine reviewed NASA's Human Research Program Evidence Books that described the Risks that were identified in NASA's Human Research Program Requirements Document (PRD). The 2013 Evidence Report for the Risk of Inadequate Nutrition has not been reviewed since the last IOM review and there have been significant changes to the evidence base for the Risk.

The 2013 Nutrition Risk Standing Review Panel (SRP) is chartered by the Human Research Program (HRP) Chief Scientist to review the Evidence Report for the Risk of Inadequate Nutrition. The 2013 Nutrition Risk SRP will generate a final report of their analyses of the evidence base, including any recommendations on how to improve the current Evidence Report, and submit it to the HRP Chief Scientist. Your report will also be made available on the Human Research Roadmap (HRR) website.

### **The 2013 Nutrition Risk SRP is charged to:**

1. Evaluate the 2013 Nutrition Risk Evidence Report based on each of the following criteria:
  - A. Does the 2013 Evidence Report provide sufficient evidence that the Risk is relevant to long-term space missions?
  - B. Are the Risk Title and Statement properly stated in the current version of the HRP Integrated Research Plan (IRP)?
  - C. Is the text of the Risk Context provided in the HRP IRP clear?
  - D. Does the evidence base make the case for the knowledge-type gaps presented?
  - E. Are there any additional knowledge-type gaps that should be considered for this specific Risk?
  - F. Does the Evidence Report address relevant interactions between this Risk and others in the HRP IRP?
  - G. Are the qualifications of the author(s) appropriate for identifying the evidence base necessary to characterize the given Risk?
  - H. Is there information from other HRP disciplines that need to be included in the 2013 Evidence Report?
  - I. Is the breadth of the cited literature sufficient?
  - J. What is the overall quality and readability of the 2013 Evidence Report?
2. Provide comments on any important issues that are not covered by the criteria in #1 above.

### **Additional information regarding this review:**

1. After the 2013 Nutrition Risk SRP members have received the review materials and had the opportunity to look over the documents, the panel members will participate in a conference call to discuss any issues, concerns, and expectations of the review process to start the review prior to the meeting.
  - A. Discuss the 2013 Nutrition Risk SRP Statement of Task and address questions about the SRP process.

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- B. Identify any issues the 2013 Nutrition Risk SRP would like to have answered prior to or during the meeting.
2. Attend a meeting at the NASA JSC on November 20 – 21, 2013 to discuss the Evidence Report with the Human Health Countermeasures (HHC) Element. At this meeting, prepare a draft report that addresses each of the evaluation criteria listed in the panel charge (A-J) including any recommendations on how to improve the Evidence Report. Debrief the HRP Chief Scientist and a representative from the HHC Element on the salient points that will be included in the final report and specifically the items in the panel charge.
  3. Prepare a draft final report (within one month of the site visit debrief) that contains a detailed evaluation of the Evidence Report specifically addressing items #1 and #2 of the SRP charge. The draft final report will be sent to the HRP Chief Scientist and he will forward it to the appropriate Element for their review. The HHC Element and the HRP Chief Scientist will have two business days to review the draft final report and identify any misunderstandings or errors of fact and then provide official feedback to the SRP. If any misunderstandings or errors of fact are identified, the SRP will have 10 business days to address them and finalize the 2013 SRP Final Report. The 2013 SRP Final Report will be submitted to the HRP Chief Scientist and copies will be provided to the HHC Element that sponsors the nutrition discipline and also made available to the other HRP Elements. The 2013 SRP Final Report will be made available on the HRR website (<http://humanresearchroadmap.nasa.gov/>).

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**To clarify, the Risk Statement and Risk Context are defined as follows:**

**Risk Statement:**

“Given the CONDITION, there is a possibility that a CONSEQUENCE will occur”.

Condition: a single phrase briefly describing current key circumstances, situations, etc. that are causing concern, doubt, anxiety, or uncertainty – something that keeps you up at night.

Consequence: a single phrase or sentence that describes the key, negative outcome(s) of the current conditions.

Notes:

The condition-consequence format provides a more complete picture of the Risk, which is critical during mitigation planning. The condition component focuses on what is currently causing concern. This is something that is true or widely perceived to be true. This component provides information that is useful when determining how to mitigate a Risk.

The consequence component focuses on the intermediate and long-term impact of the risk. Understanding the depth and breadth of the impact is useful in determining how much time, resources, and effort should be allocated to the mitigation effort.

A well-formed Risk Statement usually has only one condition, and has one or more consequences.

**Risk Context:**

Purpose: provide enough additional information about the Risk to ensure that the original intent of the Risk can be understood by other personnel, particularly after time has passed.

Description: capture additional information regarding the circumstances, events, and interrelationships not described in the Risk Statement.

An effective context captures the what, when, where, how, and why of the Risk by describing the circumstances, contributing factors, and related issues (background and additional information that are NOT in the Risk Statement).

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## VII. 2013 Nutrition Risk Standing Review Panel Roster

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