CASE STUDY

Discover how Model Organism Data Deposited into the Open Science Data Repository Informs Both Space and Clinical Findings

Can space travel impact future pregnancies of female astronauts? Discover how miRNAs and studies using them yield clues about determining potential long-term health risks.

Using two datasets from the NASA Open Science Data Repository (OSDR) and additional data from the National Institute of Allergy and Infectious Diseases (NIAID) ImmPort database, researchers compared molecular signatures that compared model organism data to clinical observations (Beheshti et al, 2024).

How Do Public Data Repositories Enable Gestational Studies?

With emerging tools and protocols, the ability to generate data has steadily grown over the decades. Data access, however, can be limited due to ethical concerns and availability of reliable, reproduceable data especially in the field of space life sciences and in reproductive health. In combination with respect to anticipated space missions that include more females in long-duration spaceflight, space stressors such as radiation and microgravity pose different risks to be considered for female astronauts, as well as long-term consequences.

This study investigates the connection between small-for-gestational-age risks and spaceflight by analyzing shared microRNA (miRNA) signatures in humans and mice using datasets publicly available through the NASA OSDR and the NIAID ImmPort database.

What are miRNAs and Why do they Matter?

In general, miRNAs are molecules smaller than other RNAs (such as mRNA known for their role in taking information from DNA to ribosomes), which are implicated in gene expression. Processes influenced by miRNAs include cellular growth, development, and immunity, with health applications in cancer and genetic disorder treatments.

The authors of this publication identified thirteen miRNAs linked to both SGA and spaceflight conditions. These miRNAs are associated with regulating pathways for DNA repair, mitochondrial function, and immune responses. Growing literature resources describe how space conditions significantly alter mitochondrial pathways, increasing oxidative stress and lipid metabolism irregularities, and these are features that are shared with small-for-gestational-age pregnancies. Consequently, dysregulation of these pathways due to spaceflight conditions could elevate risks of having small-for-gestational-age infants for female astronauts.

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How is Model Organism Data Valuable to Understanding miRNAs and Gestational Studies?

Terrestrial-based gestational studies ranging from medication use to reproductive health practices face myriad limitations due to ethical concerns. Model organism data, such as through datasets available in the OSDR, is critical for understanding complex biological processes in human health and disease, such as the potential risks associated both on Earth and in space. In this publication, the mouse radiation studies from OSDR were able to be compared to gestational data from ImmPort, to assess whether similar miRNA signatures were occurring and persistent, and by using this analytical method, also highlights the molecular and functional conservation of miRNA across organisms. Being able to ensure that data are relevant between mice and humans further protects against the ethical concerns of human data access while still providing reliable insights into the biological pathways affected by space conditions.

Implications for Space Health

The findings reported in the publication reveal the importance of addressing sex-specific health risks in space. Tailored countermeasures, such as miRNA-targeting drugs, could mitigate SGA risks that occur due to exposure to spaceflight conditions. Further research is needed to confirm these findings and ensure astronaut safety during long-term missions.

Future directions that can be derived from this study include development of FDA-approved countermeasures such as estrogen receptor agonists or vitamin D to regulate miRNA activity and enhancing space health policies to include female-specific reproductive risks and solutions.

This study exemplifies the intersection of space biology and terrestrial health research, offering insights into reproductive health risks posed by spaceflight conditions.

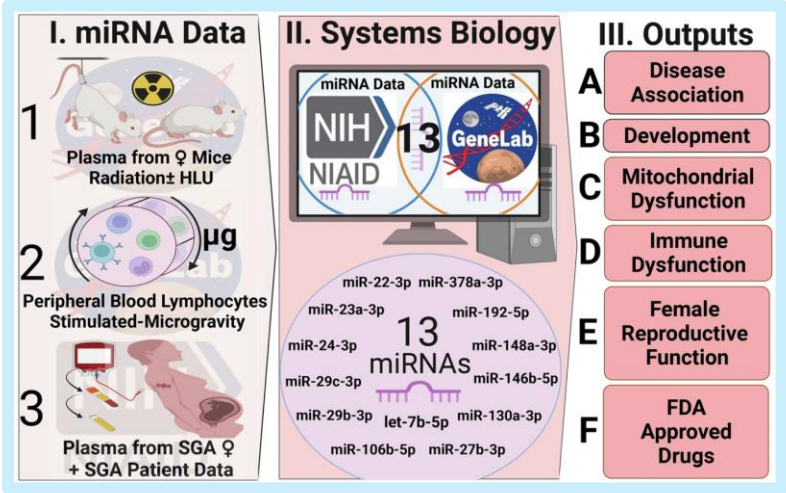

*Image shown is **Fig. 9: Overall summary of the findings from this study** from the original publication.*

Want to know more? Access these links!

To boldly go where no microRNAs have gone before: Spaceflight impact on risk for small-for-gestational-age infant

Datasets Available through OSDR:

OSD-55 OSD-336