

Mitochondrial transcriptomic responses to real spaceflight vary across mouse tissue-mission contexts

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Overview

This supplement provides the complete systematic accession log and numerical results underlying the corrected Article. The former 14-publication contextual map has been removed because it was non-systematic and single-coded. It does not contribute to the manuscript's inference or supplementary evidence.

The systematic analysis screened the OSDR API on 19 August 2026, retained 26 of 30 target-tissue candidate accessions and calculated 28 accession-tissue effects from 447 samples. Repeated tissues from the same Source Name were averaged before 17 mission-tissue effects were estimated. HKSJ random effects are primary; fixed and DerSimonian-Laird values are shown for comparison.

Supplementary Table S1 | Systematic OSDR screening log

OSDR	Project	Mission	Status	Reason
OSD-47	RR-1	SpaceX-4	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-99	RR-1	SpaceX-4	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-101	RR-1	SpaceX-4	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-103	RR-1	SpaceX-4	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-104	RR-1	SpaceX-4	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-105	RR-1	SpaceX-4	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-137	RR-3	SpaceX-8	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-164	RR-1	SpaceX-4	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-168	RR-1, RR-3	SpaceX-4; SpaceX-8	excluded	accession combines more than one flight project
OSD-173	BSP135	STS-135	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-194	RR-3	SpaceX-8	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-242	RR-9	SpaceX-12	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-245	RR-6	SpaceX-13	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage

OSDR	Project	Mission	Status	Reason
OSD-255	RR-9	SpaceX-12	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-326	RR-4	SpaceX-10	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-379	RRRM-1 (RR-8)	SpaceX-16	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-397	RR-1	SpaceX-4	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-401	RR-5	SpaceX-11	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-419	RR-1	SpaceX-4	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-457	MHU-3	SpaceX-14	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-463	RR-23	SpaceX-21	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-576	RR-23	SpaceX-21	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-665	RR-23	SpaceX-21	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-666	RR-23	SpaceX-21	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-686	MHU-2	SpaceX-12	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-714	MHU-1, MHU-4, MHU-5	SpaceX-9; SpaceX-17; SpaceX-20	excluded	accession combines more than one flight project
OSD-758	MHU-8	SpaceX-27	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-770	RR-23	SpaceX-21	included	flight and hardware-ground samples; standardized counts; sufficient gene coverage
OSD-905	RRRM-1 (RR-8)	SpaceX-16	excluded	no standardized unnormalized count matrix
OSD-924	RRRM-1 (RR-8)	SpaceX-16	excluded	no standardized unnormalized count matrix

Supplementary Table S1. All target-tissue candidates identified from the systematic API census. Count and ISA filenames plus SHA-256 values are supplied in the machine-readable screening log in Supplementary Software 1.

Supplementary Table S2 | Accession-tissue OXPHOS effects

OSDR	Project	Class	Tissue	F	G	g	95% CI	p
OSD-137	RR-3	Liver	Liver	6	6	0.13	-1.00, 1.27	0.818
OSD-164	RR-1	Liver	Liver	3	3	0.49	-1.15, 2.13	0.557
OSD-173	BSP135	Liver	Liver	2	2	-0.01	-1.97, 1.95	0.993
OSD-242	RR-9	Liver	Liver	5	4	-0.45	-1.78, 0.89	0.513
OSD-245	RR-6	Liver	Liver	20	19	-0.72	-1.37, -0.07	0.03

OSDR	Project	Class	Tissue	F	G	g	95% CI	p
OSD-379	RRRM-1 (RR-8)	Liver	Left lobe of liver	35	35	-0.13	-0.60, 0.34	0.59
OSD-457	MHU-3	Liver	Liver	12	12	-1.83	-2.79, -0.86	0.0
OSD-463	RR-23	Liver	Left lobe of liver	12	10	0.59	-0.27, 1.45	0.179
OSD-47	RR-1	Liver	Liver	3	3	0.59	-1.06, 2.24	0.486
OSD-686	MHU-2	Liver	Liver	6	3	-1.38	-2.95, 0.18	0.083
OSD-101	RR-1	Muscle	Left gastrocnemius	6	6	1.03	-0.18, 2.25	0.096
OSD-103	RR-1	Muscle	Left quadriceps femoris	6	6	-0.24	-1.38, 0.90	0.678
OSD-104	RR-1	Muscle	Soleus - both sides	6	6	0.35	-0.79, 1.49	0.549
OSD-105	RR-1	Muscle	Left tibialis anterior	6	6	1.04	-0.18, 2.26	0.095
OSD-326	RR-4	Muscle	Quadriceps femoris	4	4	-0.63	-2.06, 0.80	0.388
OSD-401	RR-5	Muscle	Gastrocnemius	3	3	-1.87	-3.93, 0.19	0.075
OSD-401	RR-5	Muscle	Quadriceps femoris	3	3	-1.89	-3.95, 0.18	0.073
OSD-419	RR-1	Muscle	Right gastrocnemius	4	8	-0.64	-1.87, 0.59	0.307
OSD-576	RR-23	Muscle	Right tibialis anterior	9	9	-1.93	-3.07, -0.79	0.001
OSD-665	RR-23	Muscle	Right extensor digitorum longus	10	10	-3.0	-4.32, -1.69	0.0
OSD-666	RR-23	Muscle	Right quadriceps femoris	10	10	-2.95	-4.25, -1.65	0.0
OSD-770	RR-23	Muscle	Right soleus	10	10	-0.25	-1.13, 0.63	0.572
OSD-99	RR-1	Muscle	Extensor digitorum longus - both sides	6	6	1.04	-0.18, 2.26	0.095
OSD-194	RR-3	Retina	Left retina	5	3	-1.11	-2.68, 0.45	0.163
OSD-255	RR-9	Retina	Right retina	8	8	0.7	-0.31, 1.72	0.175
OSD-397	RR-1	Retina	Left retina	4	2	-0.94	-2.75, 0.88	0.312
OSD-397	RR-1	Retina	Right retina	5	5	-0.27	-1.52, 0.97	0.668
OSD-758	MHU-8	Retina	Right retina	23	12	-0.15	-0.85, 0.55	0.681

Supplementary Table S2. Hedges g for each estimable accession-tissue contrast before mission-level animal de-duplication.

Supplementary Table S3 | Mission-tissue effects

Project	Class	Accessions	F animals	G animals	g	95% CI	p
BSP135	Liver	OSD-173	2	2	-0.01	-1.97, 1.95	0.993
MHU-2	Liver	OSD-686	6	3	-1.38	-2.95, 0.18	0.083
MHU-3	Liver	OSD-457	12	12	-1.83	-2.79, -0.86	0.0
RR-1	Liver	OSD-164; OSD-47	6	6	0.35	-0.79, 1.49	0.548
RR-23	Liver	OSD-463	9	9	0.24	-0.69, 1.17	0.612
RR-3	Liver	OSD-137	6	6	0.13	-1.00, 1.27	0.818
RR-6	Liver	OSD-245	20	19	-0.72	-1.37, -0.07	0.03
RR-9	Liver	OSD-242	5	4	-0.45	-1.78, 0.89	0.513
RRRM-1 (RR-8)	Liver	OSD-379	35	35	-0.13	-0.60, 0.34	0.59

Project	Class	Accessions	F animals	G animals	g	95% CI	p
RR-1	Muscle	OSD-101; OSD-103; OSD-104; OSD-105; OSD-419; OSD-99	8	10	-0.79	-1.76, 0.18	0.109
RR-23	Muscle	OSD-576; OSD-665; OSD-666; OSD-770	9	9	-3.08	-4.49, -1.67	0.0
RR-4	Muscle	OSD-326	4	4	-0.63	-2.06, 0.80	0.388
RR-5	Muscle	OSD-401	3	3	-1.9	-3.97, 0.17	0.072
MHU-8	Retina	OSD-758	23	12	-0.15	-0.85, 0.55	0.681
RR-1	Retina	OSD-397	9	7	-0.73	-1.75, 0.30	0.165
RR-3	Retina	OSD-194	5	4	-0.79	-2.17, 0.59	0.261
RR-9	Retina	OSD-255	8	8	0.7	-0.31, 1.72	0.175

Supplementary Table S3. Repeated target tissues with the same Source Name were averaged before Hedges g was calculated. One project contributes at most one effect per tissue class.

Supplementary Table S4 | Tissue-class meta-analysis

Class	Model	k	g	95% CI	p	tau^2	Q
Liver	fixed effect	9	-0.37	-0.66, -0.08	0.012	0.0	16.6
Liver	random effects (DL)	9	-0.41	-0.88, 0.06	0.085	0.239	16.6
Liver	random effects (HKSJ)	9	-0.41	-0.98, 0.15	0.131	0.239	16.6
Muscle	fixed effect	4	-1.37	-2.03, -0.71	0.0	0.0	8.27
Muscle	random effects (DL)	4	-1.53	-2.70, -0.36	0.01	0.882	8.27
Muscle	random effects (HKSJ)	4	-1.53	-3.37, 0.32	0.078	0.882	8.27
Retina	fixed effect	4	-0.16	-0.63, 0.31	0.503	0.0	4.75
Retina	random effects (DL)	4	-0.18	-0.80, 0.44	0.569	0.147	4.75
Retina	random effects (HKSJ)	4	-0.18	-1.21, 0.85	0.618	0.147	4.75

Supplementary Table S4. HKSJ random effects are the primary inferential model. DL denotes DerSimonian-Laird.

Supplementary Table S5 | Cross-method comparison

Supplementary Table S5. The independent sample-rank direction agrees with GSEA in seven of nine targeted contrasts. These are method comparisons on shared count matrices, not independent confirmation experiments.

OSDR	Tissue	Class	GSEA NES	GSEA FDR	Rank g	Agrees
OSD-255	Retina	Retina	1.197	0.742	0.702	yes
OSD-47	Liver	Liver	2.608	0.000	0.587	yes
OSD-576	Tibialis anterior	Muscle	-2.169	0.000	-1.927	yes
OSD-137	Liver	Liver	1.180	0.860	0.133	yes
OSD-173	Liver	Liver	1.043	0.703	-0.009	no
OSD-242	Liver	Liver	0.549	0.995	-0.446	no

OSDR	Tissue	Class	GSEA NES	GSEA FDR	Rank g	Agrees
OSD-326	Quadriceps femoris	Muscle	-1.250	0.342	-0.630	yes
OSD-401 G	Gastrocnemius	Muscle	-1.312	0.431	-1.870	yes
OSD-401 Q	Quadriceps femoris	Muscle	-1.478	0.175	-1.887	yes

Supplementary Table S6 | Leave-one-mission-out HKSJ estimates

Class	Omitted project	k	g	95% CI	p	tau^2
Liver	BSP135	8	-0.44	-1.07, 0.20	0.149	0.272
Liver	MHU-2	8	-0.35	-0.94, 0.25	0.213	0.232
Liver	MHU-3	8	-0.23	-0.59, 0.14	0.186	0.000
Liver	RR-1	8	-0.50	-1.11, 0.11	0.094	0.245
Liver	RR-23	8	-0.51	-1.13, 0.11	0.095	0.251
Liver	RR-3	8	-0.48	-1.11, 0.16	0.119	0.270
Liver	RR-6	8	-0.36	-1.03, 0.31	0.247	0.308
Liver	RR-9	8	-0.41	-1.06, 0.24	0.179	0.286
Liver	RRRM-1 (RR-8)	8	-0.48	-1.16, 0.20	0.140	0.342
Muscle	RR-1	3	-1.87	-5.05, 1.31	0.127	1.237
Muscle	RR-23	3	-0.89	-2.10, 0.31	0.086	0.000
Muscle	RR-4	3	-1.86	-4.84, 1.13	0.116	1.290
Muscle	RR-5	3	-1.46	-4.80, 1.88	0.201	1.232
Retina	MHU-8	3	-0.22	-2.36, 1.91	0.694	0.452
Retina	RR-1	3	-0.01	-1.67, 1.65	0.981	0.164
Retina	RR-3	3	-0.07	-1.73, 1.60	0.881	0.196
Retina	RR-9	3	-0.40	-1.31, 0.51	0.199	0.000

Supplementary Table S6. HKSJ tissue-class synthesis after omission of each mission.

Supplementary interpretation boundaries

- No component of the corrected analysis was preregistered.
- The OXPHOS target was selected after the original discovery analysis.
- Tissue and mission are not independently randomized; the estimand is a tissue-mission context distribution.
- Repeated tissues are de-duplicated with ISA Source Name, but unrecorded cohort relationships may remain.
- The rank score is relative to the mitochondrial transcriptome and is not a functional respiration measurement.
- HKSJ intervals are wide because only four muscle and four retina missions are available.
- The six-sample OSD-47 liver GSEA is retained but is not used as an anchor for a pooled liver claim.
- The non-systematic 14-study literature map has been removed from the evidentiary package.