



Ocular Outcomes Comparison Between 14- and 70-day Head-down Tilt Bed Rest

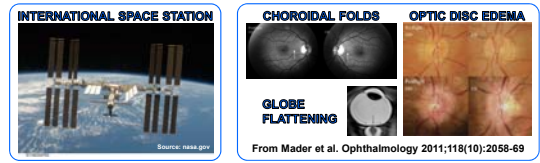


R.L. Cromwell,¹ G. Taibbi,² S. B. Zanello,¹ P.O. Yarbough,¹ R.J. Ploutz-Snyder,¹ and G. Vizzeri²

¹ Universities Space Research Association, Division of Space Life Sciences, Houston, TX ² Department of Ophthalmology and Visual Sciences, The University of Texas Medical Branch, Galveston, TX

BACKGROUND

Ophthalmological changes have been recently reported in some astronauts involved in long-duration space missions:



- Elevated intracranial pressure resulting from μ G-induced cephalad fluid shifts may be responsible for most of these findings
- Head-down tilt bed rest (HDTBR) produces cephalad fluid shifts; used to simulate the effects of μ G on the human body

PURPOSE

- To compare structural and functional ocular outcomes between 14- and 70-day HDTBR in healthy human subjects.
- Hypothesis: 70-day HDTBR induces ocular changes of greater magnitude as compared to 14-day HDTBR

METHODS

- Two integrated, multidisciplinary studies conducted at NASA Flight Analogs Research Unit (FARU): 14- and 70-day 6° HDTBR
- NASA standard HDTBR screening procedures (healthy adults)

NASA bed rest studies STANDARDIZED CONDITIONS

- Subject to rest in bed at all times
- Monitoring by a subject monitor and an in room camera 24 hrs a day
- Daily measurement of vital signs, body weight, fluid intake and fluid output
- No napping permitted between 6:00 am and 10:00 pm
- Standardized diet

NASA Flight Analogs Research Unit (FARU)

70 days	HDTBR Duration	14 days
YES 2 office visits	Pre-BR	YES 2 office visits
YES Weekly (FARU)	During BR	YES Weekly (FARU)
YES 2 office visits	Post-BR	YES 1 office visit

METHODS

Experimental protocols: **14-day HDTBR** **70-day HDTBR**

	14-day HDTBR				70-day HDTBR								
	Pre-HDTBR	HDTBR			Pre-HDTBR	HDTBR							Post-HDTBR
	-11	-5	3	10	-11	-5	3, 10, 17, 24, 31	38	45, 52, 59, 66	+2	+9		
Visual Acuity (Distance & Near)	*	*	*	*	*	*	*	*	*	*	*	*	
Modified Amsler Grid	*	*	*	*	*	*	*	*	*	*	*	*	
Red Dot Test	*	*	*	*	*	*	*	*	*	*	*	*	
Color Vision	*	*	*	*	*	*	*	*	*	*	*	*	
Confrontational Visual Field	*	*	*	*	*	*	*	*	*	*	*	*	
Cycloplegic Refraction	*	*	*	*	*	*	*	*	*	*	*	*	
IOP (Handheld)	*	*	*	*	*	*	*	*	*	*	*	*	
IOP (Goldmann)	*	*	*	*	*	*	*	*	*	*	*	*	
SD-OCT	*	*	*	*	*	*	*	*	*	*	*	*	
Color Fundus Photography	*	*	*	*	*	*	*	*	*	*	*	*	

Pre/post-HDTBR differences in near visual acuity, spherical equivalent, IOP and SD-OCT average RNFL thickness were compared between the two studies

RESULTS



	14-day HDTBR		70-day HDTBR	
	Pre-HDTBR	Post-HDTBR	Pre-HDTBR	Post-HDTBR
Intraocular Pressure (Goldmann), mmHg				
Right Eye	15.3	14.6	15.4	14.6
Left Eye	15.5	14.8	15.3	14.4

RESULTS

	14-day HDTBR	70-day HDTBR
n	16	6
Age	37.75 (8.78)	39.5 (7.8)
Gender (Male/Female)	12/4	5/1
Ethnicity:		
Caucasian/African-American	10/5	3/1
Others	1	2

1 subject who completed the 14-day HDTBR study also completed the 70-day HDTBR study

	14-day HDTBR	70-day HDTBR	P*
	Pre/post Δ	Pre/post Δ	
Near Visual Acuity, logMAR	-0.05	-0.05	0.66
Spherical Equivalent, D	-0.27	-0.23	0.83
IOP (Goldmann), mmHg	-0.95	-0.20	0.38
Average RNFLT (Spectralis OCT), μ m	1.16	1.33	0.87

- In both studies:
 - Subjects remained asymptomatic throughout the duration of HDTBR
 - distance and near visual acuity was 20/20 or better pre- and post-HDTBR in all subjects
 - modified Amsler grid, red dot test, color vision, confrontational visual field were within normal limits at all visits
 - no detectable changes on stereoscopic color fundus photography

CONCLUSIONS

- There were no significant pre/post-HDTBR differences between 14- and 70-day HDTBR for the structural and functional ophthalmological variables evaluated
- Further HDTBR studies with different duration and/or angle of tilt and/or environmental conditions (e.g., high CO₂ exposure during HDTBR) may help determine the validity of the HDTBR analog to investigate microgravity-induced ophthalmological changes

SUPPORT

NASA Flight Analogs Project, 516724.03.04.01
NIH/NCAT 1UL1RR029876-01

DISCLOSURE

Cromwell, RL None; Taibbi, G None; Zanello, SB None; Yarbough, PO None; Ploutz-Snyder, RJ None; Vizzeri, G None
ronita.l.cromwell@nasa.gov