HUMANS IN SPACE 19

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Eye optics study in experiments with dry immersion

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Introduction

There is plenty of data in literature about astronauts' post-flight changes in visual acuity, eye refraction and other parameters of visual functions.

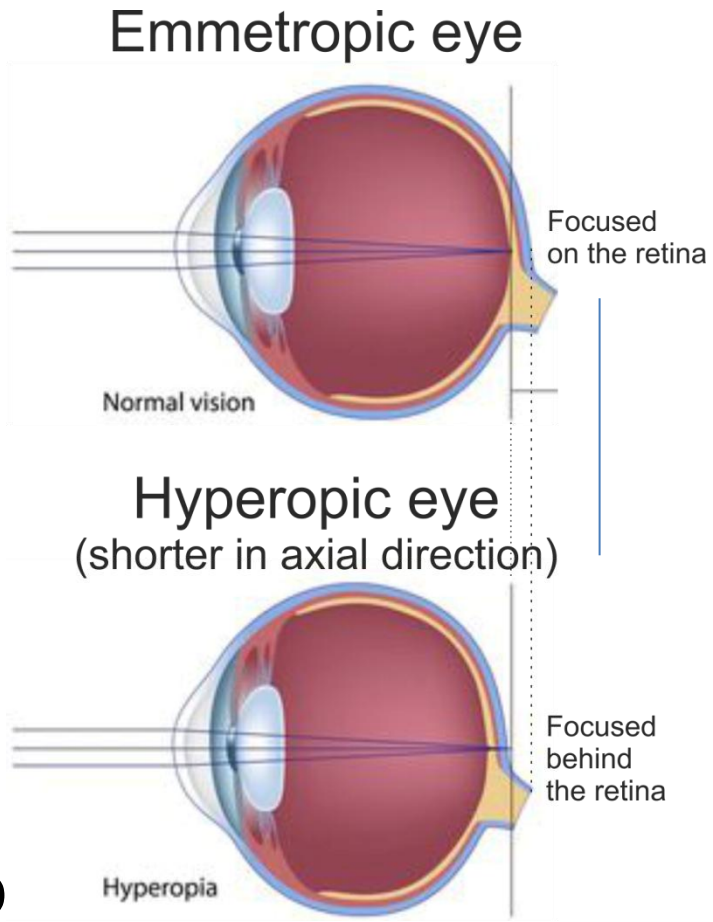
The mechanisms of these changes are not fully studied, and this field is a trending issue in space medicine and biology.

Introduction: Refraction

Hyperopic shift in **refraction** was previously reported.

It was also reported that post-flight changes include optic disc edema and globe flattening (in axial direction), which may lead to refraction changes.

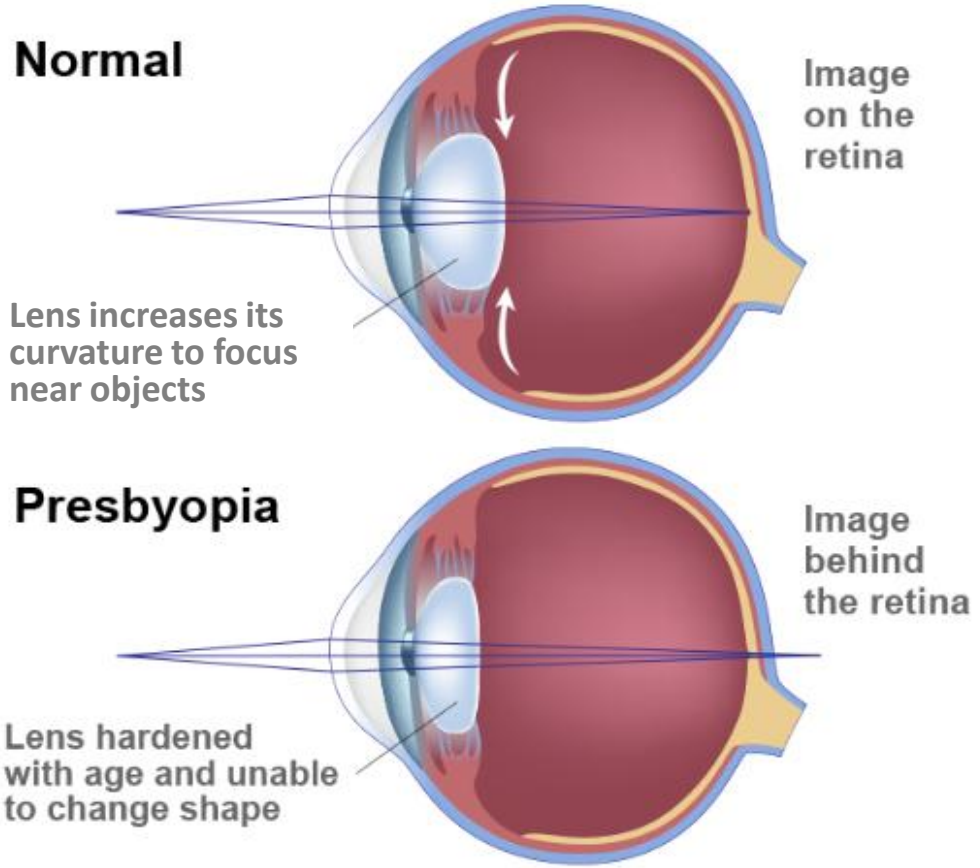
Nevertheless, the mechanisms are still not clear and need to be further investigated.



Introduction: Accommodation

In view of hyperopic shifts reported in astronauts and their typical near presbyopic age (35-50 years), it seems important to investigate **accommodation** changes.

However, there are few (if any) publications on measuring accommodation in space.



The aims

The aims of the work were:

- to assess **refraction** and **accommodation** changes before and after staying in dry immersion condition;
- to assess the dry immersion suitability for studying visual function changes in space.

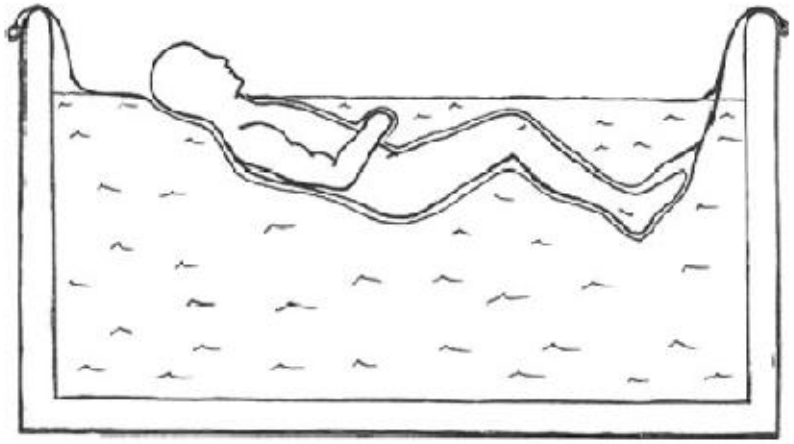
The study was conducted in the framework of the Project “Dry Immersion” at the Institute of Biomedical Problems, Russian Academy of Sciences (Moscow).

Dry immersion

Dry immersion bath provides unsupported conditions, in which, due counteraction of water, the subject's weight doesn't exerts local pressure on his feet and other parts of the surface.

During the experiment, the subjects were immersed in a bath with warm water solution, being separated from the water by a freely floating waterproof elastic sheeting.

Such conditions are used as an on-Earth imitation of the space weightlessness.



The study: Subjects and Procedure

Two series: 5 days and 21 days

	Immersion period	Number of subjects
I experiment	5 days	10 males of 25-45 years
II experiment	21 days	6 males of 25-35 years

Subjects were laying in the bath during the whole experimental period (5 or 21 days), except 15 min a day reserved for hygienic procedures (during that time they were also laying horizontally).

The study: Equipment

Refraction and
Accommodation
were measured by Righton-i Speedy k Model autorefkeratometr.

The measurement was contactless and absolutely safe.

Results: Refractometry

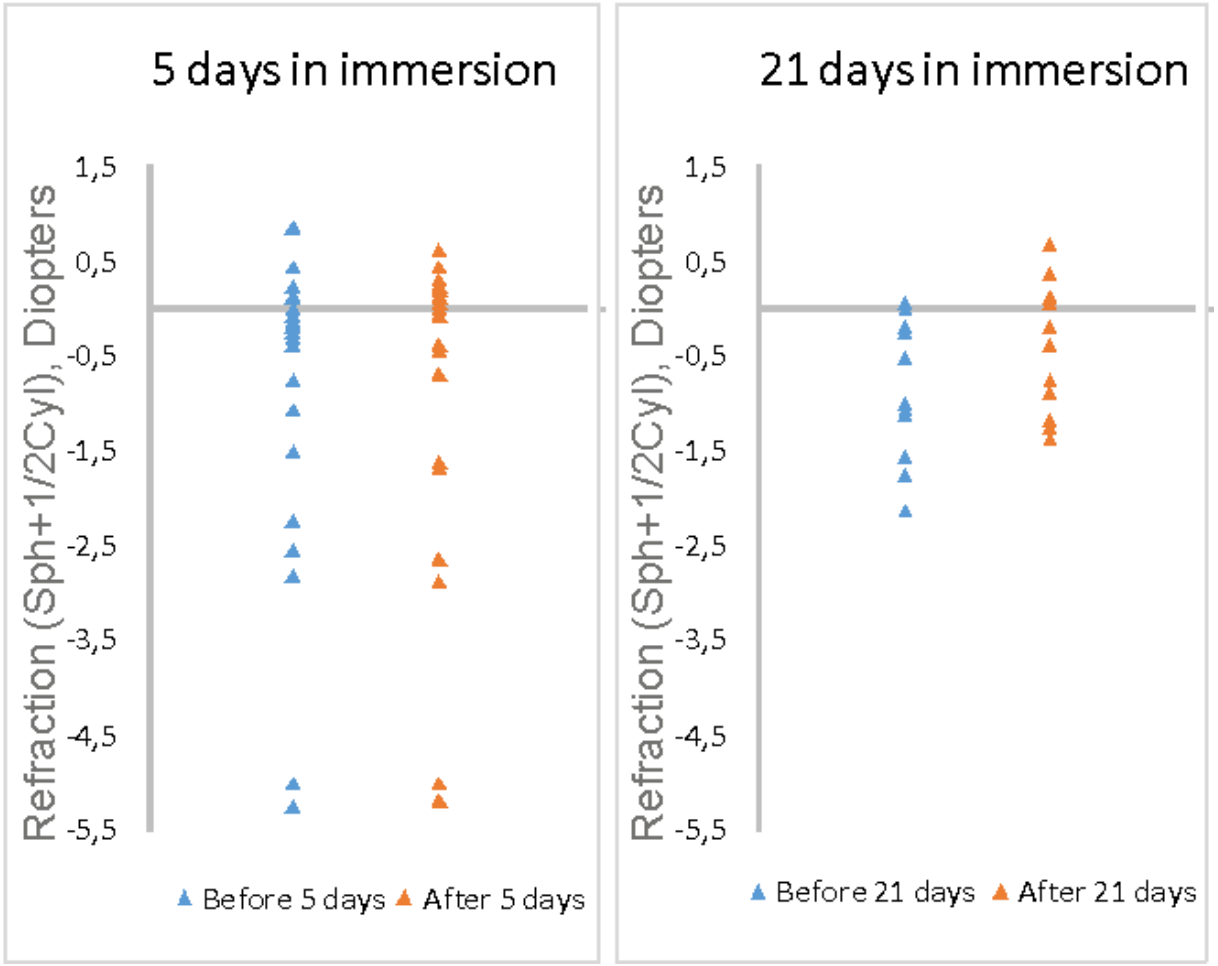
Table 1. Refraction difference After - Before immersion:

	5 days	21 days
Average, diopters	0.11	0.29
Confidence interval	(-0.06)-(+0.28)	(-0.28)-(+0.86)

We found some tendency to hyperopic refraction shift in both groups.

However, the differences are not statistically significant, which may be due to the small sample size and low sensitivity of the statistical criterion used.

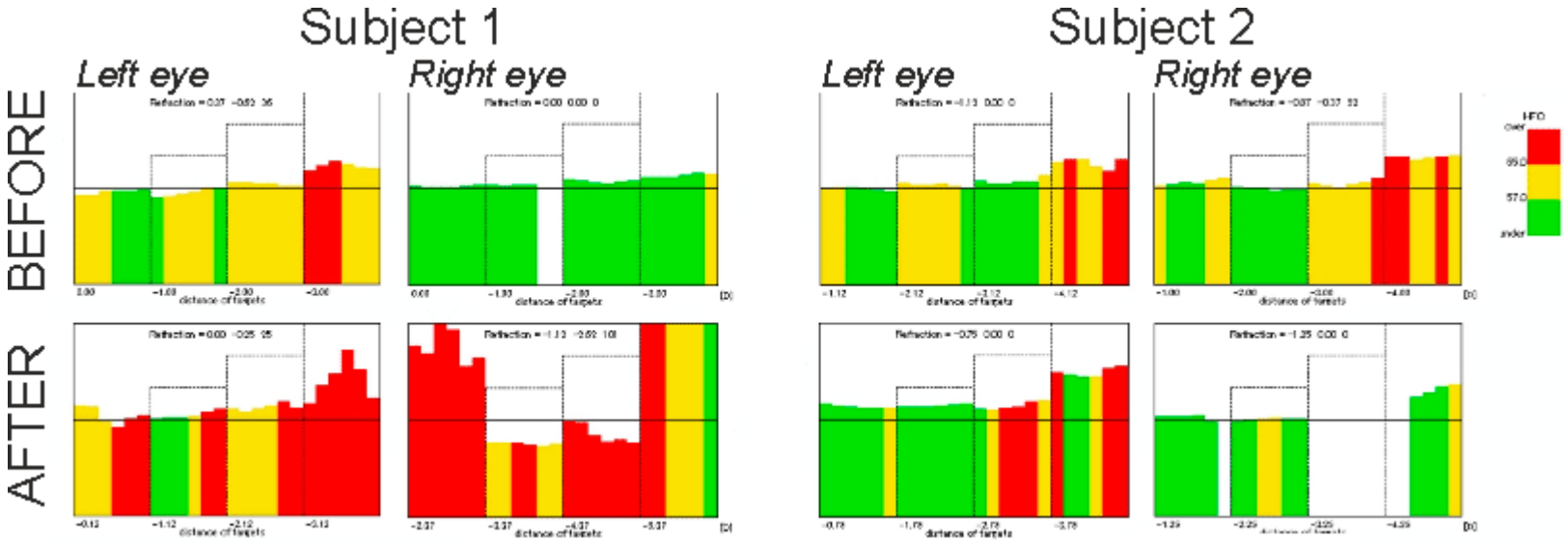
Results: Refractometry (individual data)



Results: Accommodography

In our experiment, we studied accommodation response and accommodation microfluctuations. The data obtained appeared to be insufficient for reliable conclusions. In experiment I, the duration of immersion was too short; in experiment II, the number of subjects was too small. As a result, we could only report substantial interindividual variability.

For example, the accommodogramms obtained before and after immersion (21 days) in two subjects are shown.



Conclusions

- Dry immersion shows a tendency to produce **hyperopic refraction shift**, similar to the space flights.
- It seems that dry immersion might be a **promising tool** to study refraction shift in astronauts.
- Further studies are needed.

Thank you for your attention!

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