



**HAL**  
open science

## Physiology-enhanced data analytics to evaluate the effect of altitude on intraocular pressure

Giovanna Guidoboni, Marcela Szopos, Alice Chandra Verticchio Vercellin, Carlo Bruttini, Ivano Riva, Brent Siesky, Alon Harris, Luciano Quaranta

► **To cite this version:**

Giovanna Guidoboni, Marcela Szopos, Alice Chandra Verticchio Vercellin, Carlo Bruttini, Ivano Riva, et al.. Physiology-enhanced data analytics to evaluate the effect of altitude on intraocular pressure. *Investigative Ophthalmology & Visual Science* June 2021, Vol.62, 559, 2021, ARVO, United States. hal-03890205

**HAL Id: hal-03890205**

**<https://hal.science/hal-03890205>**

Submitted on 12 Jul 2024

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - NonCommercial - NoDerivatives 4.0 International License

## OPEN ACCESS

ARVO Annual Meeting Abstract | June 2021

# Physiology-enhanced data analytics to evaluate the effect of altitude on intraocular pressure

[Giovanna Guidoboni](#); [Marcela Szopos](#); [Alice Chandra Verticchio Vercellin](#); [Carlo Bruttini](#); [Ivano Riva](#); [Brent A Siesky](#); [Alon Harris](#); [Luciano Quaranta](#)

+ Author Affiliations & Notes

Investigative Ophthalmology & Visual Science June 2021, Vol.62, 559. doi:

## Abstract

**Purpose :** While it is known that altitude affects intraocular pressure (IOP), the underlying mechanisms remain unclear. Mean arterial pressure (MAP) and osmotic pressure difference (OPD) are considered important factors governing the IOP change with altitude. Herein we use a novel physiology-enhanced approach to analyze data from the Mont Blanc Study (MBS) (Bruttini et al. 2020), with the goal of assessing the relative roles of MAP and OPD on IOP.

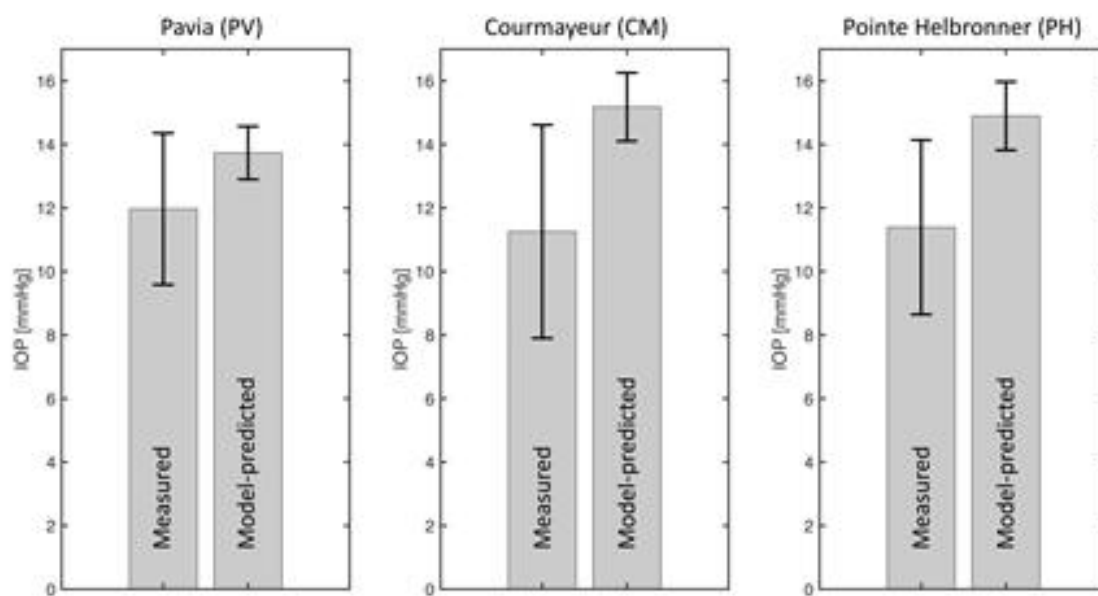
**Methods :** In MBS, IOP and MAP were measured in 33 healthy volunteers at 77 m above sea level (a.s.l.) (Pavia, PV, Italy), at 1,300 m a.s.l. (Courmayeur, CM, Italy) and 3,466 m a.s.l. (Pointe Helbronner, PH, Mont Blanc Mountain, Italy), in addition to other systemic factors. A validated mathematical model for aqueous humor (AH) circulation (Szopos et al 2016) was used to analyze the MBS data. In the model, IOP is predicted as the result of the balance between AH production and drainage, with MAP and OPD included as parameters regulating AH production.

**Results :** A first analysis is conducted using measured MAP as an individualized model input to predict the corresponding IOP and compare it with IOP measured at different altitudes (PV, CM, PH). Fig.1 shows that changes in MAP are not sufficient to explain the measured IOP differences, since the measured IOP decreases with altitude while the model-predicted IOP increases. A second analysis is conducted by using the measured MAP and IOP as an individualized model inputs and estimates the OPD that would be

necessary to have AH flow balance at different altitudes (PV, CM, PH). Fig. 2 shows that changes in OPD, in conjunction with MAP, capture the decreasing trend of IOP with altitude as observed in MBS.

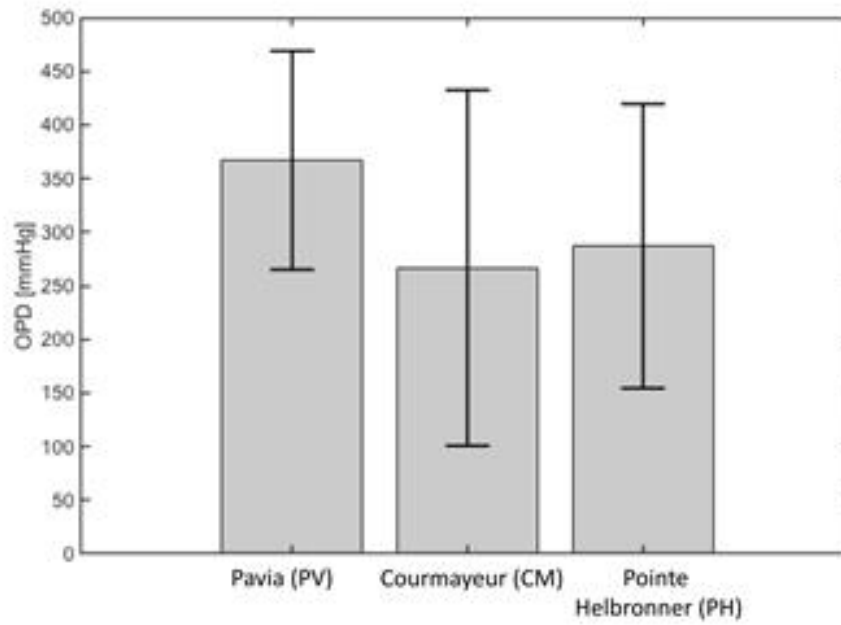
**Conclusions :** Physiology-enhanced data analytics based on mathematical modeling suggests OPD plays an important role in regulating IOP with changes in altitude. Modeling factors that are conjectured to be relevant such as OPD may provide insights into parameters that cannot be measured directly. Future model analytics will include the effect of temperature and central corneal thickness for enhanced specificity.

This is a 2021 ARVO Annual Meeting abstract.



[View Original](#) [Download Slide](#)

Comparison between measured and model-predicted IOP based on individualized MAP.



[View Original](#) [Download Slide](#)

Model-predicted OPD based on individualized MAP and IOP inputs.

This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](https://creativecommons.org/licenses/by-nc-nd/4.0/).

