FRACTAL DIMENSION ANALYSIS IN THE HUMAN RETINA

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INTRODUCCIÓN

The retina is the only part of the human body where blood vessels are visible. This characteristic makes it an optimal site for a direct detection of any change in its vasculature. Diseases and systemic dysfunctions can alter the structure of the retinal vascular network, making fractal analysis a potential tool to detect and quantify the appearance of a pathology in a patient. This work presents a study of the fractal dimension of images of the retina from healthy patients using a different method of analysis. Although fractal dimension of the retina has been estimated before, this study proposes the estimation of fractal dimension using a different segmentation method before the estimation.

MATERIAL Y MÉTODO

The images were obtained from the STARE database (STructured Analysis of the Retina) and correspond to healthy patients. The images were taken using a specialized camera for fundus photography (TopCon TRV-50 at 35º FOV) and digitized to have a resolution of 700 X 605 pixels. Two of these groups were segmented manually by specialists, while a third group used the segmentation algorithm proposed by A. Hoover. The images from this third group were the ones used for this work, but before being segmented.
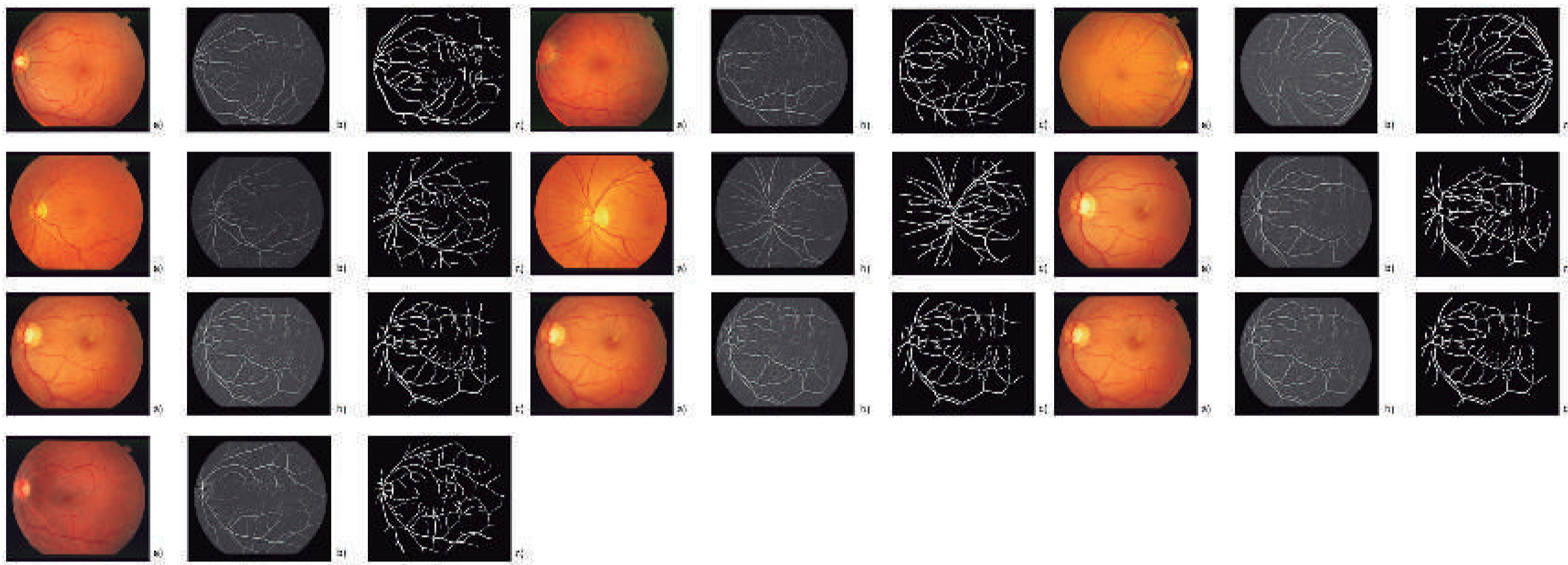

Figure 1. Images for a healthy patient. a) Original image; b) binary image; c) segmented image.

RESULTADOS

Image	Santiago Cortés	Uahabi-2015 [12]	Talu-2012	Stošic-AH-2006[14]	Stošic-VK-2006[14]
D_B	1.56 ± 0.01	1.60 ± 0.05	1.61 ± 0.02	1.60 ± 0.05	1.68 ± 0.03

Table 1. Fractal dimension for healthy patients of the STARE database as reported in the literature.
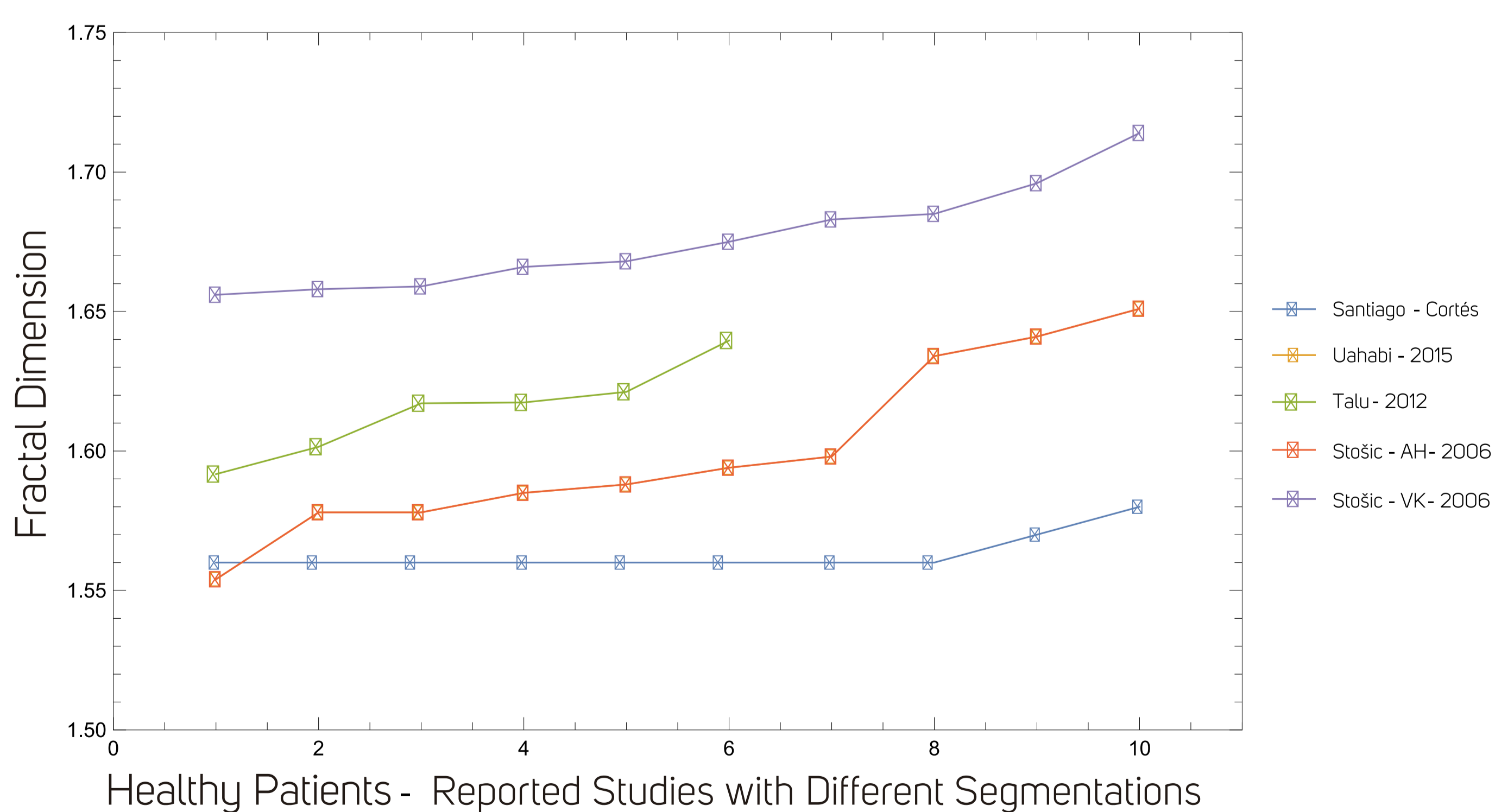

Figure 2. Fractal dimension of the retinas of healthy patients using different segmentation methods, as reported in the literature.
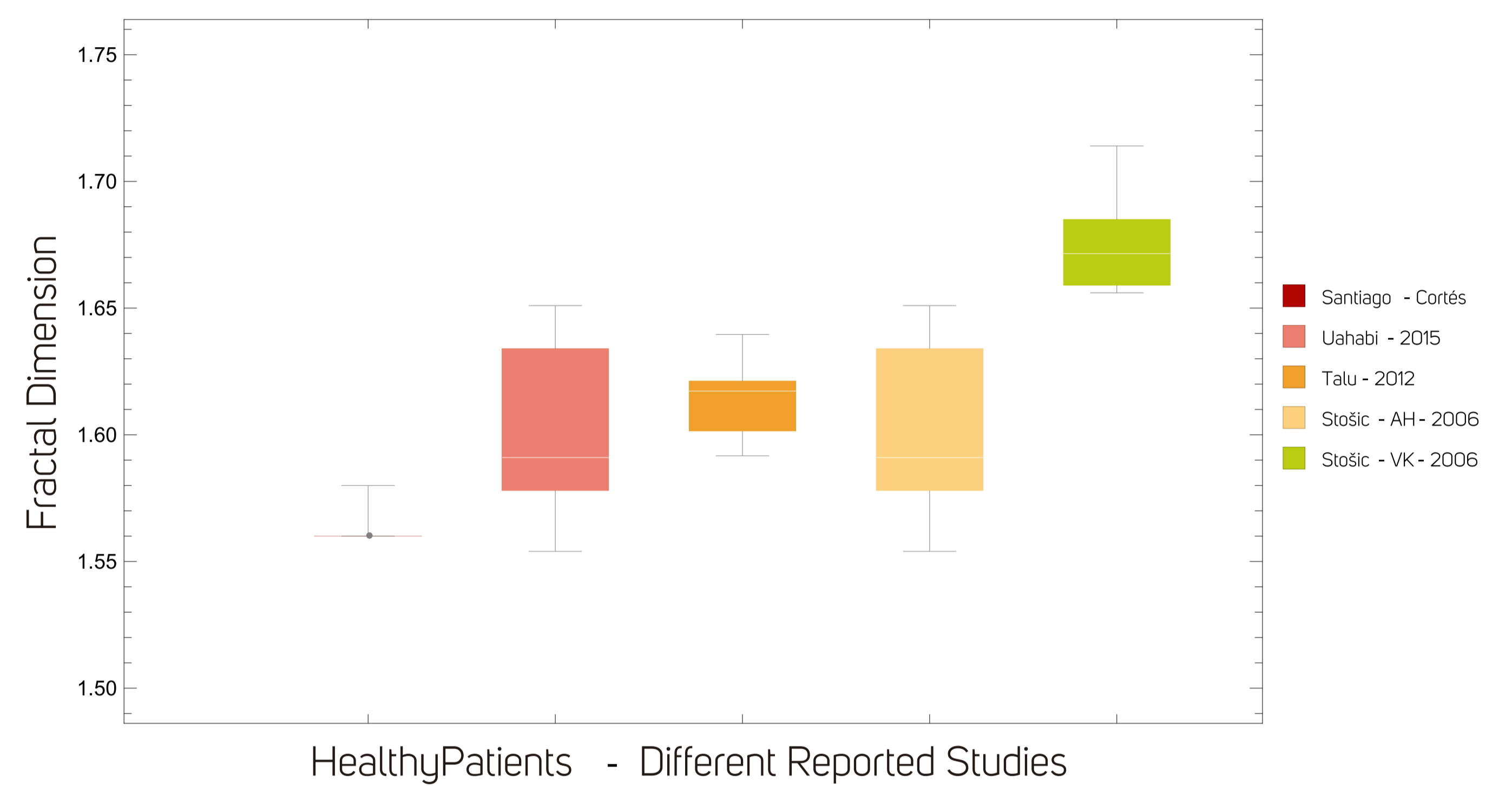

Figure 3. Boxplots for the fractal dimension of retinas of healthy patients using different egmentation methods.

DISCUSIÓN

Considering the results presented in this work, it is possible to confirm that fractal analysis used as a method to study the vascular retinal system, still suffers from a fundamental problem: there are no fundamental physical laws that can be expressed mathematically. Besides, the measurements of fractal dimension are based on the quality of the obtained images, the chosen segmentation method and the method used to estimate the fractal dimension. All these factors point to the necessity to standardize this technique following international parameters, which has not been done to date.

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