

# Comparison of Retinal Vasculature Between Premature Twins

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## Introduction

This paper aims to determine whether the development of retinal blood vessels is governed by genetic factors. Identical twins share the same genes, whilst non-identical twins share around half. In terms of the nature of retinal vasculature, it is known that some diseases are linked to retinal blood vessel layout and distribution.<sup>3</sup> This study compares the retinal vasculature between sets of twins to ascertain whether the degree of similarity between them is greater in identical twins as compared with non-identical twins.

## Purpose

The discovery of a correlation between the variation of retinal vasculature to genetics may allow for a better understanding of the developmental processes governing the pathophysiology of retinal disease. This paper, however, will be of the first to focus on the vasculature of neonatal twins, and so hopes to add value to this realm of research in the sense that variables such as the influence of epigenetics or the environment are greatly minimised given that the same intrauterine conditions are kept for both twins throughout prenatal development, and in the majority of cases, in the early postnatal period also.

## Methodology

Retinal images were taken from twelve premature twins during Retinopathy of Prematurity (ROP) screening at the Royal Preston Hospital over the past 5 years.

Fundoscopy pictures taken from each twin were analysed, and the image which most clearly depicted the vessels from the optic disc were chosen for the comparative analysis. As to focus on the vessels more closely as they branched out from the optic disc, circles of one, two and four optic disc diameters were created and split into 45 degrees segments for a more accurate and direct comparison of each area of the retinal circumference.

These were objectively compared by creating a circular figure with segmented regions and superimposing these at different parts of the retina. Similarity between segments was confirmed if the same vascular features were shared.

This method was repeated in each set of twins for both the right and left eyes.

The identical/non-identical status of each set of twins, accessed on the patient notes, was recorded following the conduction of the study, to ensure a rata blinded study was carried out, mitigating for any observational bias which would have occurred. It was later found that there were six identical and non-identical twins respectively.

## Results and Analysis

Results show evidence of a difference in the similarity in the vasculature between identical and non-identical twins respectively. There was a mean percentage difference of 20.7 between the results, which shows that there is a significantly higher percentage similarity in the retinal vasculature of identical compared to non-identical twins. This is further emphasised by there being only a small degree of standard deviation between the results for all the twin sets in both categories as well as a narrow range between the upper and lower limits of the confidence interval, unexpected given that the sample population being observed was small. These results are suggestive of a strong correlation between the degree of retinal vasculature shared being higher if the twins are identical.

## Discussion

The main limitation of the results was the small number of participants included in the study. Findings may not be representative of the wider twin population as only premature twins in one hospital were observed.

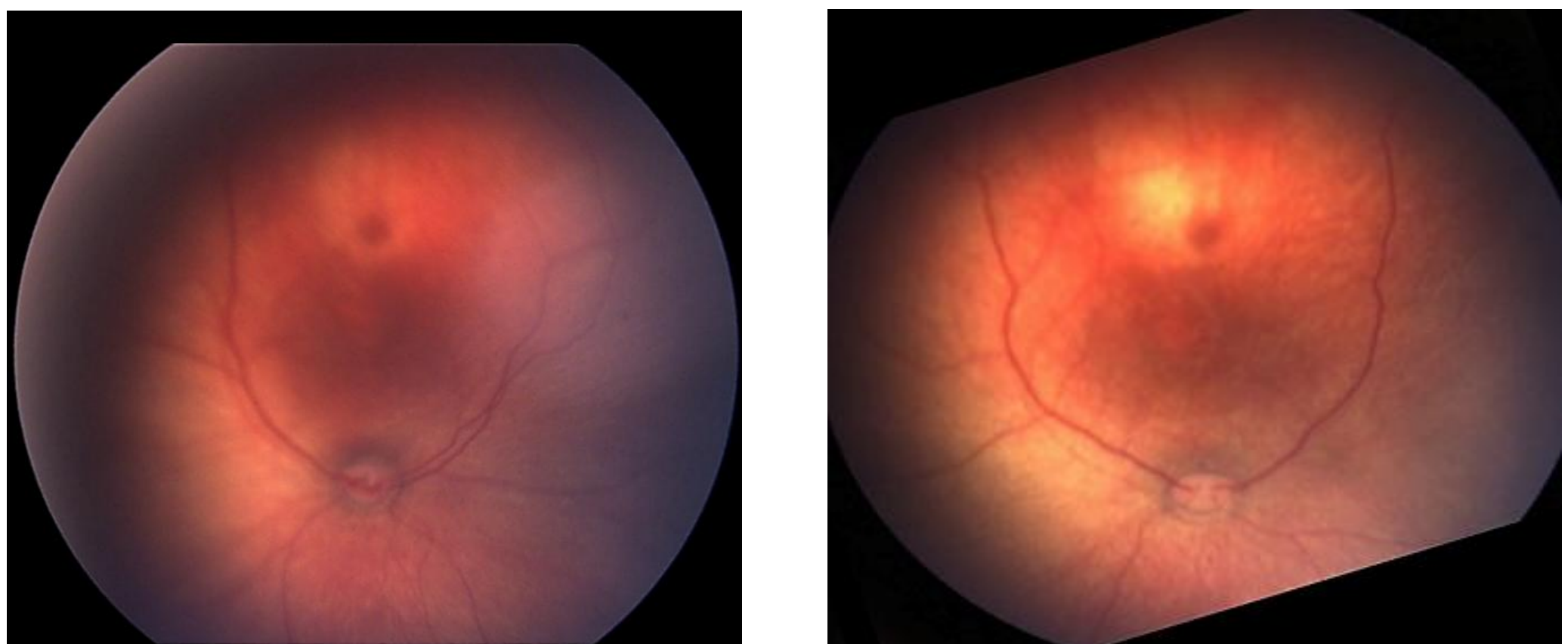
Several other factors which could not be controlled may also have had an effect on the differences in vasculature seen between a given set of twins. Due to their prematurity, the vasculature of the retina, is not fully developed at birth and develops at a different rate between the twins.<sup>4</sup> This may have implications on one twin having more developed vasculature than the other at the point of imaging. For these reasons, a radius of only 4 optic disc diameters only was looked at as opposed to the whole area of the fundus.

Additionally, a controlled amount of supplemental oxygen is often delivered to premature infants to maintain a sufficient level of oxygen in the blood, and twins had not been exposed to the same amount of oxygen. This could trigger anormal vessel growth, causing the vasculature of one twin to differ from the other due to an environmental factor rather than genetics.<sup>5</sup> Further studies may want to take such factors into consideration by looking more closely at the history of all patients who have had images taken for screening.

## Conclusion

The findings of this study align with that of previous research hypotheses regarding the strong genetic link and heritability of retinal vasculature. It acts as a pilot study for further investigations into the genetic predisposition of retinopathies. This may have implications for clinical practice i.e. medical guidelines could be developed to initiate screening for twins if one has a specific retinal disease. Additionally, the methods used in this study to analyse retinal images have the potential to act as a tool to determine the zygosity of twins. This may be valuable to some families and could also be important in identifying sample groups of mono and dizygotic twins for medical research.

In conclusion, the results of this study serve as preliminary evidence to show that retinal vasculature is determined by genetic factors. However, due to a small sample size, further larger studies are required to advance this field of research.



Images 1 and 2: An example of the fundoscopy images from one of the identical twin sets. Note the clear similarity in the pattern of vascularisation as the vessels emerge from the optic disc.

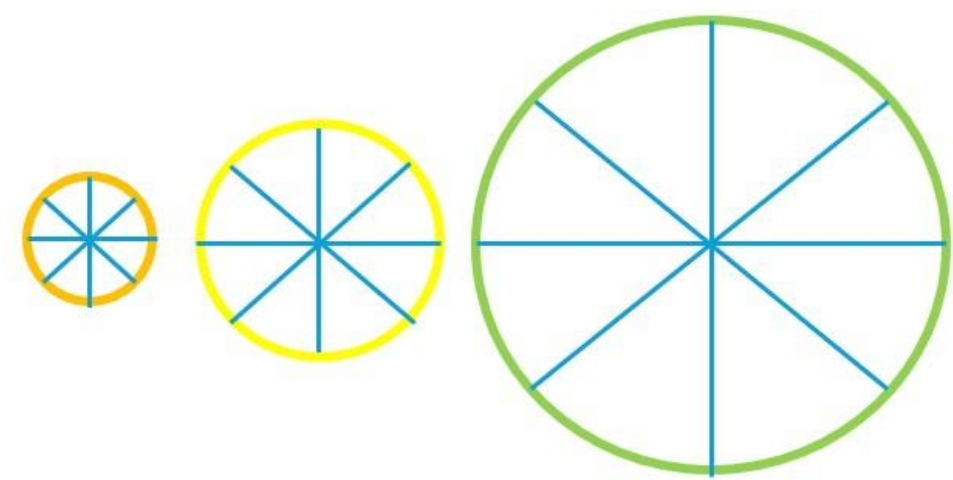


Figure 1:

Author drawn depiction of the optic disc diameters 1,2 and 4 (ODD) with 45-degree segmented divisions.

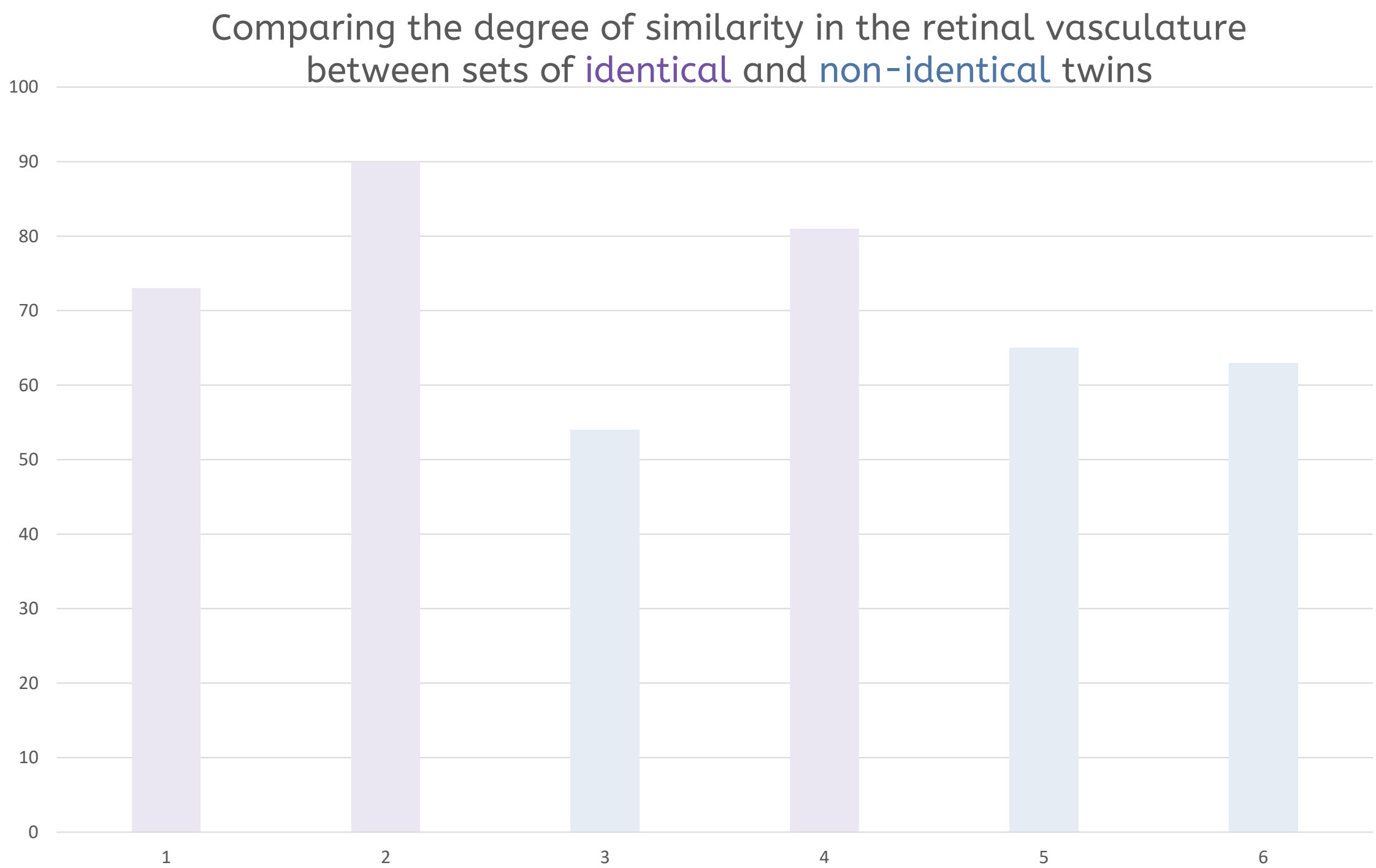


Figure 2: A graphical visualisation of the average results. The y-axis denotes the overall percentage average of similarity between the vasculature of each set of twins, at each level of the ODD ratios, in both eyes. The x-axis highlights the individual results belonging to each twin set.

## References and Acknowledgements

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Author Declaration Information: none declared