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The Relationship Between Macular Pigment and Visual Performance

James Loughman  
*Dublin Institute of Technology, james.loughman@dit.ie*

Peter Davison  
*Dublin Institute of Technology, Peter.Davison@Dit.ie*

Grainne Scanlon  
*Dublin Institute of Technology, grainne.scanlon@dit.ie*

Veronica O'Dwyer  
*Dublin Institute of Technology, veronica.odwyer@dit.ie*

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INTRODUCTION

Macular pigment (MP), which is composed of three dietary carotenoids, lutein (L), zeaxanthin (Z) and meso-zeaxanthin (MZ), is predominantly located at the site of maximum visual acuity in the human retina. MP absorbs short wavelength light prior to photoreceptor stimulation. Filtering such defocused short wavelength (blue) light could enhance visual performance by reducing the effects of chromatic aberration and light scatter.1

PURPOSE

In this poster, we present baseline data from the Collaborative Optical Macular Pigment Assessment Study (COMPASS), which represents a cross-sectional evaluation of the relationship between MP optical density (MPOD) and visual performance and comfort across a broad and refined range of functional tests. We also present preliminary data from the COMPASS longitudinal lutein supplementation investigation.

SUBJECTS and METHODS

At baseline, we recruited 142 young healthy subjects (mean ± SD age = 28.85 ± 6.37 years). A typical study visit lasted approximately four hours. Those aspects of visual performance assessed, and their sequence, is presented in Table 1.

MPOD measurement

MPOD measurements were obtained by customised heterochromatic flicker photometry (cHFP, using the Macular DensitometerTM) at five loci (0.25°, 0.50°, 1°, 1.75° and 3° of retinal eccentricity), with a reference point at 7°, to generate a complete spatial profile of MP.

Best corrected visual acuity (BCVA)

BCVA was assessed using a computer-generated LogMAR, high contrast chart, employing a SLOAN ETDRS letterset. A visual acuity rating (VAR) was computed to quantify precise acuity limits.

Contrast sensitivity function (CSF)

Mesopic (3 cd/m²) and photopic (100cd/m²) CSF curves were plotted using spatial frequencies of 1 cycle per degree (cpd), 4.1 cpd, 7.5 cpd, 11.8 cpd and 20.7 cpd.

Table 1. DESCRIPTION

<table>
<thead>
<tr>
<th>TIME (minutes)</th>
<th>Information leaflet and informed consent</th>
<th>Collection of blood for serum carotenoid analysis</th>
<th>Lifestyle and vision case history questionnaires</th>
<th>Refraction, visual acuity, and ocular dominance</th>
<th>Colour vision</th>
<th>Glare sensitivity</th>
<th>Visual function questionnaire</th>
<th>Contrast sensitivity</th>
<th>Break</th>
<th>Macular pigment optical density spatial profile</th>
<th>Dietary questionnaire</th>
<th>Short wavelength automated perimetry</th>
<th>Photostress recovery</th>
<th>Fundus and iris photography</th>
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<tbody>
<tr>
<td>10</td>
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<td>30</td>
<td>15</td>
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</table>

Table 2. Retinal eccentricity  Mean MPOD

<table>
<thead>
<tr>
<th>Retinal eccentricity</th>
<th>Mean MPOD</th>
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<tbody>
<tr>
<td>0.25°</td>
<td>0.48 (±0.16)</td>
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<tr>
<td>0.5°</td>
<td>0.39 (±0.17)</td>
</tr>
<tr>
<td>1°</td>
<td>0.21 (±0.12)</td>
</tr>
<tr>
<td>1.75°</td>
<td>0.09 (±0.09)</td>
</tr>
<tr>
<td>3°</td>
<td>0.09 (±0.07)</td>
</tr>
<tr>
<td>Average</td>
<td>0.25 (±0.12)</td>
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</tbody>
</table>

RESULTS

Reliability testing of methods

Following pre-test training, repeat testing on 10 subjects at three separate study visits (over a 10 day period) was conducted. The intraclass correlations (ICC) obtained for all methods were high (Mean ± S.D = 0.705 ± 0.158).

The mean (±SD) MPOD, at all degrees of retinal eccentricity measured at baseline are summarized in Table 2. There was a statistically significant positive relationship between BCVA and MPOD at all retinal eccentricities measured (r = 0.237 to 0.308, p < 0.01) [e.g. Figure 1].

There was a statistically significant positive relationship between mesopic and photopic contrast sensitivities (at 7.5 and 11.8 cpd) and central MPOD (r = 0.167 to 0.220, p < 0.05) [e.g. Figure 2].

CONCLUSION

Photostress recovery and glare sensitivity were unrelated to MPOD cross-sectionally. However, measures of central visual function, including BCVA and contrast sensitivity, were positively associated with MPOD. These effects of MP on visual performance are likely to apply equally and possibly more significantly in an older population, where, for example, the incidence of driving accidents and falls directly relate to visual performance. The COMPASS longitudinal, placebo-controlled and randomized, supplementation trial will ascertain whether augmentation of MPOD can influence visual performance in such a young, healthy subject group.

REFERENCES