Blue Light Study: Vision Health

Macular carotenoid supplementation improves visual and physical outcomes related to High energy source exposure and Electronic digital devices

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Exposure to damaging blue light wavelengths is thought to be responsible for everything from disrupted sleep patterns to retina damage. Blue light has very short wavelengths, and produces a higher amount of energy, which can cause more damage to the eye. We use digital devices more and more with each year, and are exposed to more LED lighting and compact fluorescent lighting (CFLs) – all emit high levels of blue light. Blue light damages the back of the eye, causing conditions like AMD and cataracts, The purpose of our study was to characterize and to see the effect of macular carotenoid supplementation, in a group of college students with at least 4 hours of daily indoor and outdoor exposure to high light energy sources including digital devices.

Methods

48 healthy young adults (mean age = 21.2 years) participated in this 6-month, double-blind, placebo-controlled study. Visual performance measures included contrast sensitivity (CS), critical flicker fusion (CFF), disability glare (DG), and photostress recovery (PSR). Serum L/Zi levels were assessed before and after supplementation.

Measurement of Macular Pigment Optical Density (MPOD)

MPOD was assessed with a non-invasive, perceptual task called heterochromatic flicker photometry (HFP).

Measurement of temporal vision (CFF)

Subjects were presented with a 550 nm narrow-band (10 nm at half peak), 1^0 disc of light that was alternated on and off in square-wave counterphase. Thresholds for flicker fusion (when the light was flickering at a rate such that there was no longer any flickering or pulsing evident) were obtained for both ascending and descending trials. The overall threshold for the CFF task was calculated as the average of two ascending and two descending thresholds.

Contrast sensitivity testing

CS testing was conducted on the same computer / monitor as described above. A subject's threshold for detection of a Gabor patch's orientation (tilted right or left 450 from vertical) was determined for a single stimulus, an 8 cycle / degree target subtending 20 of visual angle.

Photostress recovery / disability glare

A custom apparatus for assessing DG and PSR time was created to provide sufficient intensity of light and a uniform spatial distribution with minimal reliance on optics.

Assessment of physical indicators

A short questionnaire, containing questions regarding weekly occurrence of headache, eye strain, neck strain, eye fatigue, and blurry vision was administered at each visit. If a specific item occurred less frequently than once / week, but still occurred on a monthly basis (e.g. twice / month), participants were instructed to write down the monthly frequency next to the item. Physical indicators of excessive screen time included headache frequency, eye strain, blurry vision, eye fatigue, and neck strain, and were assessed via questionnaire.

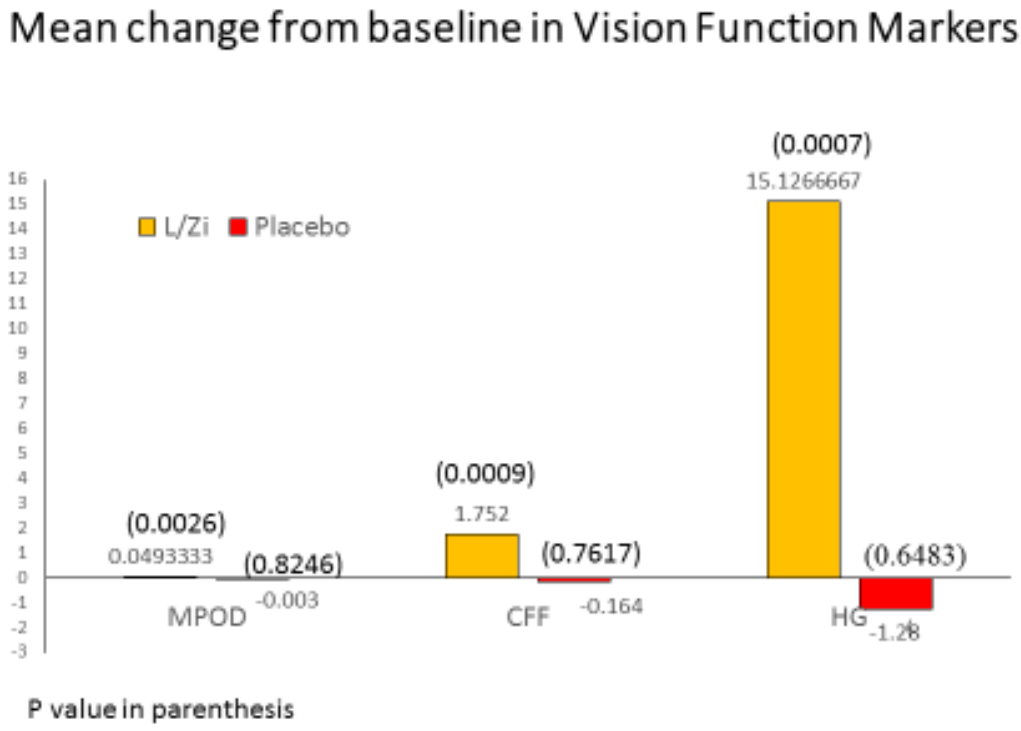
Intervention: Subjects were randomly assigned to ingest daily either the placebo (n = 13), or 24 mg macular carotenoids (n = 35). Measures were taken at baseline, 3 months, and 6 months after supplementation.

Statistical Analysis

The statistical and graphing program OriginPro 9.3 (Northampton, MA) was used to conduct repeated-measures ANOVA, t test and Pearson product-moment correlations. Differences with $P < 0.05$ were considered significant.

Results

Repeated-measures ANOVA revealed that, versus placebo, the treatment group improved significantly at 6 months in terms of headache frequency, eye strain, eye fatigue, CFF, CS, DG, and PSR (all $p < 0.05$). MPOD increased significantly versus placebo at both 3- and 6-month measures ($p < 0.05$ for both). CFF was also found to improve significantly at 3 months ($p = 0.023$). At 6 months, several physical indicator variables were found to have changed significantly versus placebo. These included headache frequency ($p = 0.029$), eye strain ($p = 0.046$), and eye fatigue ($p = 0.016$). Figure 1 shows significant change from baseline in L/Zi treated group and no significant change in placebo.



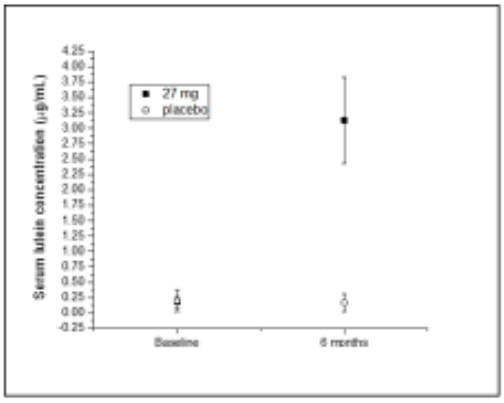
Summary of the results: Subjects exposed by number of hours to high energy sources

3 mos	<4 hr		≥4-8h		≥8hr	
	L/Zi N=1	PLA N=1	L/Zi N=14	P value	L/Zi N=20	P value
MPOD	0.001	-0.01	0.030±0.017	0.0068	0.03±0.04	0.0298
CFF	0.92	1.04	1.41±1.28	0.0889	0.79±0.7	0.0690
CS	5.5	2.4	13.75±10.5	0.024	7.79±6.3	0.0028

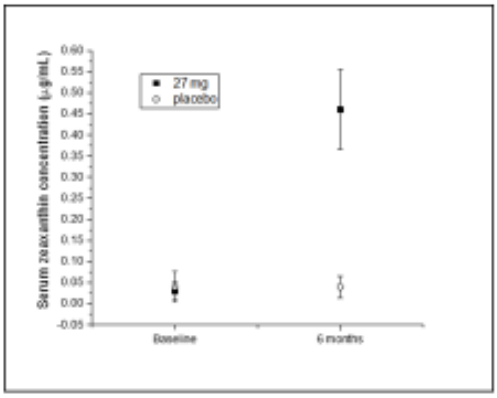
L/Zi significantly improved vision function markers at ≥ 4-8 h and ≥8 h and no significance in placebo.

Serum lutein and Zi concentrations increased after supplementation in L/Zi treated group no change in placebo Figure 2).

Serum L



Serum Zi



Conclusions

Daily supplementation with L+Zi resulted in significant increase in serum levels of L/Zi and MPOD and improvements in vision markers, physical indicators such as headache, eye strain and fatigue due to highenergy exposure and digital devices. In addition we saw changes in sleep quality.

Definitions

Optical density

The ability of a laboratory specimen to absorb or block the passage of light. The optical density o f a laboratory sample canbe used as an indicator of the concentration of specific components in t he sample.

Macular PIgment Optical Density

The thickness or the density of the MP varies from person to person. The density can also change over time depending on several factors such as aging and lifestyle and dietary choices. The values or score that is used for MPOD ranges from 0 to 1. A low MPOD is in the range of 0 to .21, mid-range is .21 to .44 and high range is .45 to 1.0.

Contrast Sensitivity:

- Ability to
  - Distinguish between finer and finer increments of light versus dark (contrast)
  - Perceive differences between an object and its background

Disability glare results when a light source reflects from or otherwise covers the visual task, like a veil, obscuring the visual target, reducing its contrast and making the viewer less able to see and discriminate what is being viewed.

The photostress recovery test is a clinical procedure measuring the amount of time required for the macula to return to its normal level of function after being exposed to a bright light source. Photostress Recovery Time (PSRT) is the time recorded as the period between when the light is removed and the subject can again begin to read the optotypes on the visual acuity chart jus above the initial acuity.

Critical Flicker Fusion Frequency: Processing speed of brain determines rate at which it can use information provided by optic nerve. The classical method for testing temporal resolution in vision is the Critical Flicker Frequency (CFF) threshold. The CFF is the minimum frequency of a pulsating light source at which the light appears to be perceptually fused into a continuous rather than flickering stimulus.

Hermann grid illusion: The Hermann grid illusion is an optical illusion reported by Ludimar Hermann in 1870. The illusion is characterized by "ghostlike" grey blobs perceived at the intersections of a white (or light-colored) grid on a black background. The grey blobs disappear when looking directly at an intersection. HG stands for Hermann Grid (a measure of contrast sensitivity)