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"Effect of domestic white LED exposure on retina and visual cortex amelioration by commercially available blue light blocking lenses (BBLs) in Wistar rats"

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ABSTRACT

Purpose: Studies have explored the changes in retinal layers/cells and its consequences due to excessive exposure to different wavelengths of lights. LED's sources are used worldwide in daily activities which are designed to reduce the carbon dioxide and less energy consumption Exposure to blue light leads to a variety of health problems, according to a growing body of research resulting in retinal, biochemical, and neuronal damage in visual system. Chronic exposure and adaptive responses to light and self-protective mechanism against these LED exposures to be explored and essential to understand the implications of LED's radiations on visual system.

Method: Male *Wistar rats* were exposed with white LEDs (100Lumen; 12Watt) and with 2 different protective blue light blocking lenses (BBLs) for 28 days (12:12 light-dark cycle) with uniform illumination (450-500 lux). Rats of the normal control group are exposed to normal laboratory environment. Post light exposure animals were trained for Morris water maze *(MWM)* test for four consecutive days and retention test was performed on last day. Post behavioral assessment animals were sacrificed with overdose of pentobarbital intraperitoneally. Eyes are enucleated and stored in 10% paraformaldehyde for histopathology assessment and brains are stored in freshly prepared Golgi-Cox solution. Golgi impregnation technique was used for visual cortex neurons staining and Sholl's grading used to quantify the apical and basal dendrites branching points and neuronal intersections.

Results: Animals in the DB group showed statistical significance in the behavioral analysis on the day 1 ($p=0.05$) and day 2 ($p=0.01$) of training compared to the CP group. Statistically no change observed in day3, day 4 and retention test. Post hoc test for retention day showed significance of LE−NC groups ($p= 0.633$), CP−NC groups ($p=0.84$), DB−NC groups ($p= 0.689$), CP−LE groups ($p= 0.232$), DB−LE groups ($p= 1$) and DB−CP groups ($p= 0.267$). Structural analysis with Golgi stain showed significant alterations in the P5 neurons due to light exposure. Normal control group neurons showed a significant effect in apical branching (AB) points ($F_{18, 140} = 0.001$, $p < 0.001$) and DuraVision Blue group showed a significant change in basal branching (BB) points ($F_{18, 140} =0.001$, $p < 0.001$). Normal control group showed a significant change in apical intersection (AI) points ($F_{18, 140} = 0.001$, $p < 0.001$) and white LED exposure group and DuraVision Blue treatment group showed significance for arborization of neurons ($F_{18, 140} = 0.001$, $p < 0.019$). These results showed that cognitive impairment function in Wistar rats with chronic exposure white LED exposure and amelioration with blue blocking protective lenses.

Conclusion: Chronic exposure to white LED resulted in adverse effect of the visual cortex P5 neurons functionally and structurally. DuraVision Blue showed protective efficacy for amelioration of neurons.

Keywords: Light emitting diodes (LED's), white-light exposure, blue protective lenses, wavelength, behavior analysis, retinal damage, ganglion cell layer, Golgi-Cox, Pyramidal neurons