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The retina is one of the highest oxygen-consuming tissues because visual transduction and light signaling processes require large amounts of ATP. Thus, because of the high energy demand, oxygen-rich environment, and tissue transparency, the eye is susceptible to excess production of reactive oxygen species (ROS) resulting in oxidative stress. Oxidative stress in the eye is associated with the development and progression of ocular diseases including cataracts, glaucoma, age-related macular degeneration, and diabetic retinopathy. During oxidative stress, ROS can modify and damage cellular proteins. In particular, the thiol groups of cysteines can undergo reversible or irreversible oxidative post-translational modifications (PTMs). Identifying the redox-sensitive cysteines on a proteome-wide scale provides insight into those proteins that act as redox sensors or become irreversibly damaged upon exposure to oxidative stress. In this study, we profiled the redox proteome of the *Drosophila* eye under prolonged, high intensity blue light exposure and age using iodoacetamide isobaric label sixplex reagents (iodo-TMT) to identify cysteine modifications induced by oxidative stress. Although redox metabolite analysis of the major antioxidant, glutathione, revealed similar oxidative stress levels in aged or light-stressed eyes, we observed different changes in the redox proteome under these conditions. Both conditions resulted in significant oxidation of proteins involved in phototransduction and photoreceptor maintenance but affected distinct targets and cysteine residues. Moreover, redox changes induced by blue light exposure were accompanied by a large reduction in light sensitivity that did not arise from a reduction in the photopigment level, suggesting that the redox-sensitive cysteines we identified in the phototransduction machinery might contribute to light adaptation. Our data provide a comprehensive description of the redox proteome of *Drosophila* eye tissue under acute and chronic stress and show how these distinct oxidative stresses might contribute to distinct physiological outcomes such as light adaptation in response to acute light stress.