Diet, Sleep Disruptions, and Neurodegeneration: Investigating Risk Factors for Neurocognitive Disorders Using Caenorhabditis elegans

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As neurodegenerative diseases such as Alzheimer’s affect over 70 million individuals, it is crucial to investigate modifiable lifestyle factors such as diet and circadian rhythm patterns to prevent neurological decline. Using Caenorhabditis elegans, neurological function was assessed through lateral body bends (LBB) and touch responses with a worm pick at 0, 8, 16, 24, and 48-hours. To model dietary effects, 20 and 80 mM of glucose (high-sugar) and 1% and 2% medium-chain triglyceride oil (ketogenic) were added to the culture medium. Sleep disruption was modeled through blue light exposure, while melatonin treatment was applied to assess its neuroprotective role. The results from the 8-48 hour period indicate that higher glucose concentrations (80 mM) led to a significant decline in LBB (16.8 to 11.2) and a 12% decrease in touch responsiveness, and ketogenic conditions maintained higher LBBs (36 to 40.5) and a 15% increase in touch response. Blue light exposure reduced bends over time (17.5 to 10), while melatonin treatment led to a stark increase (30 to 39.5). Lastly, with combined variables, 1% medium-chain triglyceride oil/melatonin solution increased LBB from 38 to 42 with a 20% increase in touch responsiveness, while 80 mM of glucose/blue light exposure decreased BSR from 16.7 to 9.8 with a 23% decrease in touch response. These findings, coupled with the ANOVA's sub-0.05 p value, served to support the alternative hypotheses that high sugar intake and sleep disruption contribute to neurodegeneration, and a ketogenic diet and melatonin may offer preventive effects. This study establishes the importance of combined dietary and sleep-related interventions in controlling neurological decline with indications for human neurodegenerative diseases.

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