

The Acute Effects Of Different Light Modalities On Alertness And Cognitive Performance: A Systematic Review And Meta-Analysis

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Background: Recent systematic reviews have evaluated the acute effects of light during the biological day and night on alertness, and on alertness and higher cognitive functions during the biological day. However, previous reviews have not included all relevant objective outcomes. Only Mu et al. (2022) have performed a meta-analysis, in which categorical subgroup analyses were conducted based on wavelength, illuminance level, and CCT level. In this meta-analysis, light modalities and melanopic EDI are included as continuous moderators. Further, all outcome measures of cognitive performance across different cognitive domains are included. Additionally, the present review aims to include age as an important covariate.

Methods: This meta-analysis was and pre-registered (CRD42023394616) and conducted according to the PRISMA guidelines. A systematic literature search was carried out in several data bases (Embase, Ovid MEDLINE, PSYchINFO, and Web of Science) and reviews were screened for eligible studies. Data was extracted using a coding scheme and authors were contacted in case of missing data. All analyses were conducted using RStudio and the metafor package.

Results: The literature search yielded 8.306 hits, resulting in 61 eligible studies. Preliminary results of subjective data show that participants were more alert in the experimental conditions when compared to dim light ($g = -2.769$, $p = .003$, $k = 16$). Subgroup analyses show that this effect is stronger when coloured light (mainly blue light; $g = -5.424$, $p < .001$, $k = 8$), but not when bright light ($g = -0.206$, $p = 0.674$, $k = 8$) is compared to dim light. Further, in an age range between approx. 20 and 40 years of age, the acute alerting effect of light is more pronounced in older adults.

Conclusions: Regarding subjective alertness, preliminary data analyses show evidence for an acute alerting effect of light. This effect is likely to be moderated by several light modalities such as illuminance and CCT values. Light has different effects according to age, though there are not studies including older adults.