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ELECTRICAL LIGHTING FOR IMPROVED WELLBEING OF ELDERLY CITIZENS

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Abstract

Healthy elderly citizens living in their own homes may benefit from having replaced their existing indoor lighting with a lighting being superior in stimulating their circadian rhythm to improve sleep and general wellbeing. This was hypothesised in the presented study.

We replaced the existing indoor lighting in the main living room of elderly citizens in 20 uniform private houses in a suburb of Copenhagen. In a randomized cross-over design 29 healthy participants over 65 years were exposed over 3 weeks to blue-enriched and 3 weeks to blue-deprived light with similar corneal photopic illuminances from 8 am to 13 pm. The two light epochs were separated by one week neutral indoor light.

Daylight factors were measured for each of the houses. The pre-experimental lighting conditions were documented by pictures and the experimental light was measured on location using portable photometers and spectrometers.

Actiwatch spectrum® devises were used to measure light exposure and activity. Data from 7 consecutive 24-hour days at the end of each light epoch was used for light-exposure analyses measuring the red, green and blue spectrum of the light, as well as calibrated 'white light' output. Together with Activity data sleep duration was measured by diary and sleep quality assessed by Pittsburg sleep questionnaire. The Pittsburg sleep index (PSQI) and the Morningness-Eveningness questionnaire were registered at baseline and after both light epochs. Participants were instructed to refer only to the 3 foregoing weeks of experimental light when filling out the questionnaires. Morningness-Eveningness questionnaire, chromatic pupillometry and melatonin sampling was used to evaluate the circadian rhythm.

The main finding was that the experimental indoor light quality of the brighter experimental light was rated twice as good as the participants' habitual indoor light, while the rating was stable between light epochs (no significant difference between blue-enriched and blue-deprived lighting). The participants' habitual indoor light and daylight factors were found to differ considerable between the houses. The contribution from daylight to the indoor lighting levels was high and this caused that no differences were found between blue-enriched and blue-deprived conditions concerning the photopic illuminance and the blue light exposure during morning hours. However, we did find that the red light exposure was significantly higher during blue-deprived conditions than the blue-enriched during the morning ($p = 0.0214$). No significant differences were found for sleep duration, monitored rest hours, pupillometry, and melatonin. The baseline index found using the Pittsburg sleep questionnaire was for the female participants fairly low and was improved when exposed to blue-enriched light, but significant improvements were not found for blue-deprived light. No significant changes were found for males.

In conclusion, with a poor initial index of sleep quality found in women, it was possible by changing the electrical indoor light to increase the sleep quality of some participants from their habitual indoor light to the experimental blue-enriched light. This was found despite of a result showing very different pre-experimental lighting conditions and that relatively high amount of daylight was present during the study. Moreover, improved rating of the indoor light quality was achieved which indicates a poor lighting quality in general in many homes of healthy elderly citizens.