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Light therapy glasses during night shift work: a field study

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Abstract

Background: Night shift work leads to severe short- and long-term side effects, posing a risk to personal and occupational safety.
Objective: This study aimed to test the effects of blue-enriched light-emitting glasses on sleepiness, alertness, and sustained attention during the early morning hours of night shift work.
Methods: To remedy the risks of reduced alertness, sustained attention, and increased sleepiness in a single-blind study design, Luminette® 3 (Lucimed SA, Wavre, Belgium) glasses emitting blue-enriched light (BL) were tested from 05:00 to 05:30 during night shift work in 21 participants at a sleep laboratory, and the effects were compared with those of glasses emitting sham dim red light (DRL). Sleepiness was rated hourly from 21:00 to 07:30 using the Karolinska Sleepiness Scale, while alertness was assessed using the PC Psychomotor Vigilance Task before and after the intervention. At the end of the night shift, sustained attention (using the computerized Mackworth Clock Test), comfort ratings, and fatigue were measured. Statistical analyses were conducted using the Friedman and Wilcoxon signed-rank tests.
Results: Sleepiness increased significantly throughout the night and was not significantly reduced after the intervention, with a more prolonged reduction using BL. Compared with using DRL, using BL revealed no clear benefit in terms of alertness or sustained attention, yet comfort ratings were slightly better, without any negative side effects.
Conclusion: In the current study, BL glasses were not clearly superior to DRL glasses in ameliorating the negative side effects of night shift work. Despite some limitations, however, this field study showed high ecological validity and demonstrated the convenient use of an intervention that is easy to implement in a realistic workplace setting.

Keywords
Blue-enriched light-emitting glasses · Shift work · Sleepiness · Alertness · Occupational safety

Supplementary Information

The online version of this article (https://doi.org/10.1007/s11818-023-00439-y) contains supplementary material, which is available to authorized users.

Supplementary material online – scan QR code

Introduction and background

Night shift work is a major contributor to economic value creation and myriad societal and economic benefits worldwide. According to the German Working Hours Act (*Arbeitszeitgesetz*; § 2 II, III, IV ArbZG; Federal Ministry of Justice [*Bundesministerium der Justiz*]), night shift work is defined as working for longer than 2 h between 23:00 and 06:00 [10], which applies to 4.6% percent of employees in Germany [54]. Despite its benefits for economies, night shift work poses severe risks to employees [19]. Humans are primarily diurnal, and night shift work creates a misalignment between natural circadian and wake/sleep rhythms [40]. This leads to an increased risk for cancer and reduced metabolic, cardiac, and mental health compared to non-night shift workers [27]. Moreover, a considerable num-

Table 1 Subjective and objective measurements used throughout the study, along with the parameters measured and references

Assessment and time	Measurements and measures	Reference/ Manufacturer
Screening		
Sleep disorders	Berlin Questionnaire Sleep Apnea: obstructive sleep apnea	[39]
	Restless legs syndrome diagnostic criteria: restless legs syndrome	[6]
	Regensburg Insomnia Scale (RIS): psychophysiological insomnia	[18]
Daytime sleepiness	Epworth Sleepiness Scale (ESS): overall daytime sleepiness, sleep propensity	[28]
Fatigue	Fatigue Severity Scale (FSS): fatigue severity	[31]
	Modified Fatigue Impact Scale (MFIS): fatigue impact	[23, 21]
Sleep quality	Pittsburgh Sleep Quality Index (PSQI): overall subjective sleep quality	[11]
	Functional Outcomes of Sleep Questionnaire (FOSQ): overall impact of sleep impairment	[58]
Chronotype	Morningness–Eveningness Questionnaire (D-MEQ)	[25, 26]
Mental health, quality of life	Beck Depression Inventory II (BDI-II): depressive symptoms	[8]
	Multicultural Quality of Life Index (MQLI): health and life quality	[37]
Baseline and test nights		
Sleep quality and quantity[a]	Sleep diary: sleep times before and after test nights Actigraphy device GENEActiv: activity and sleep times before and after test nights	ActivInsights, (Huntingdon, United Kingdom)
Sleepiness	Karolinska Sleepiness Scale (KSS): acute levels of sleepiness	[4]
Fatigue[a]	Fatigue Impact Scale for daily use (D-FIS) German adaptation: fatigue	[22]
Comfort ratings[a]	Comfort ratings for sham and active light glasses	–
Objective psychomotor vigilance, sustained attention	Psychomotor Vigilance Task (PVT): mean RT, refractional RT, lapses, fastest 10% of reaction times, slowest 10% of reaction times as measure for changes in vigilance	[29]
	VIGIL S1–computerized Mackworth Clock Test Vienna Test System (MCT): mean RT, number of false and true reactions as measure for sustained vigilance under monotonous conditions	Schuhfried GmbH, Mödling, Austria

[a]Measurement not used during the baseline measurement

ber of shift workers suffer from shift work sleep disorder, which is characterized by severely disturbed sleep, fatigue, and daytime sleepiness [44].

In addition to such long-term effects, sleep deprivation and night shift work increase the risk for work- and commute-related errors and accidents [2, 5, 17, 20]. Sleep deprivation, a major effect of night shift work, negatively affects physiological sleepiness, performance, concentration, and sustained attention as well as cognitive, motor, and memory function, which are all crucial for work safety, proficiency, and professionality [15, 42, 49]. Torsvall et al. [55] demonstrated that 20% of night shift workers were unable to maintain sufficient wakefulness at work, while Åkerstedt [3] identified somnolence during night shift as one of the most troublesome symptoms of night shift work, which also causes impairments on subsequent days off. This can lead to substantially higher error rates and performance decrements [17]. Lee et al. [33] highlighted the dangers of sleep-deprived driving following night shift work, revealing that 43.8% of drives on a closed driving track after night shift work had to be prematurely terminated for safety reasons.

Past research has examined various interventions to mitigate these risks (see Neil-Sztramko et al. [38] and Slanger et al. [51] for an overview), including caffeine supplementation, shown to be an effective countermeasure against sleepiness-induced errors [56], and napping, which can effectively reduce sleepiness and increase performance [46]. Evidence for the effect of pharmacological interventions is sparse and rather inconclusive [34, 38]. Since some methods are difficult to implement in many work settings (i.e., naps), research on easily administrable and non-disruptive methods to increase alertness and wakefulness during night shift work is warranted. Interventions using light supplementation use the acute alerting effects of light at wavelengths of around 460 nm or illumination levels around 5000 to 10,000 lx [12, 13, 45]. To ensure convenient application in different work settings, light-supplementing eyeglasses that are wearable during low- to moderate-intensity work tasks may be a suitable choice. The use of such glasses has already been tested in different clinical [24, 30, 32] and non-clinical settings [16, 48, 50] as well as in the workplace during daytime work [9]. Regarding night shift work, Aarts et al. [1] demonstrated positive effects of using active light glasses in the middle of the night on sleepiness during the commute home. A second study conducted by van Woerkom [60] compared napping at any time and/or using light therapy glasses between 02:00 and 04:00 during night shift work in terms of positive outcomes on fatigue and wellbeing. However, these studies did not include objective measures of alertness and sustained attention. Additionally, using light therapy glasses during the early morning hours was not compared to a placebo/sham condition.

To the best of our knowledge, no studies have compared the effects of light-supplementation glasses with those of sham glasses (i.e., using dim red, non-blue-enriched light) on subjective sleepiness, objective alertness, and sustained attention during the early morning hours of actual night shift work. We hypothesized

Table 2 Inclusion and exclusion criteria for study participation

Inclusion criteria	Exclusion criteria
Age 18–65 years Night shift workers of the Center of Sleep Medicine Regensburg-Donaustauf or people shadowing at the Center of Sleep Medicine used to irregular night shifts Sufficient cognitive and verbal ability to understand the study purposes, participant information documents, and all questionnaires and tests Compliance and willingness to adhere to the study protocol Provided written informed consent to participate in the study	Distinct psychotic symptoms and/or other relevant cognitive disability History of any neurologic and/or epileptic disorders Diagnosed psychological/psychiatric disorders according to the International Classification of Disorders 10th Edition Sleep disorders diagnosed according to the International Classification of Sleep Disorders 3rd Edition criteria [7] Inability to consent Intercontinental travel within 6 weeks prior to study participation Diseases of the eye, such as retinopathy, retinitis pigmentosa, diabetic retinopathy, macular degeneration, glaucoma Use of psychoactive substances within the prior week that could influence sleep or wakefulness History of or current substance use or substance use disorder according to the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition criteria (alcohol, hypnotics, or other substances except nicotine)

that blue-enriched light supplementation, compared with a sham condition, can positively affect nighttime alertness and sleepiness as well as sustained attention at the end of the night.

Materials and methods

Study design

The present study comprised a single-blind, randomized, placebo-controlled, within-subjects design. After an introduction and screening session, two test nights were conducted at the Center of Sleep Medicine of the University of Regensburg. All participants took part in both the active and the sham conditions in a randomized order. During the active condition (blue-enriched light, BL), genuine Luminette® 3 light glasses (Lucimed SA, Wavre, Belgium) were used at an illuminance level of 1500 lx for 30 min, emitting blue-enriched white light at 468 nm with a bandwidth of 70 nm. The sham condition (dim red light [DRL]) included sham Luminette 3 glasses that emitted light at 660 nm with an illuminance level of 175 lx for 30 min. The study was conducted in accordance with the World Medical Association Declaration of Helsinki and was approved by the ethics committee of the University of Regensburg (reference number: 20-1835-101). All participants gave informed written consent.

Measurements and procedure

Table 1 shows an overview of all measurements included in the screening, baseline, and test nights. A detailed description of all measurements included in the screening and descriptive and statistical analyses can be found in the Supplementary Materials Appendix A.

Screening

General information about sleep, sleep habits, chronotype, (mental) health, depression, quality of life, and sleep disorders such as increased daytime sleepiness, fatigue, restless legs syndrome, and obstructive sleep apnea syndrome were assessed during participant screening (see **Table 1** and Supplementary Materials Appendix A for details). We obtained baseline values for subjective sleepiness (Karolinska Sleepiness Scale [KSS]), alertness (Psychomotor Vigilance Task [PVT]), and sustained attention (Mackworth Clock Test [MCT]).

During screening, participants received detailed information on the procedure during test nights, which were conducted unsupervised.

Test nights

Participants wore an actigraphy device (GENEActive, Activinsights Ltd, Huntingdon, UK) from 3 days prior to 3 days after the test nights to monitor activity and rest phases regarding study protocol adherence. Throughout the test nights, KSS and VAS ratings were completed hourly starting at 21:00 as well as before and after the alertness and sustained attention tests. Since the acute alerting effects of light are most effective when the circadian drive for sleep is at its peak between 02:00 and 06:00 [12], the intervention phase took place from 05:00 to 05:30. During this time, participants were instructed to follow their regular work schedule and to take note of any notable events (e.g., if a patient monitored in the sleep lab needed the worker's attention, the glasses' usage could be interrupted briefly). Before and after the intervention, participants completed the PVT. Ratings of comfort for the light glasses, fatigue during the night (daily Fatigue Impact Scale [D-FIS]), and sustained attention were assessed once after completion of the night shift at 07:00.

The average time between screening and the first test night was 18.9 ± 21.1 days (range 2–76 days), and that between the first and second test night was 8.7 ± 3.5 days (range 4–18 days).

Participants

Prior to study inclusion, 24 participants were screened who either worked irregular night shifts (once or twice per month) or shadowed night shifts in the sleep laboratory of the Center of Sleep Medicine Regensburg. A power analysis with an estimated effect size of $d_z = 0.60$, an α error of 0.05, and a power of $1 - \beta = 0.80$ provided a sample size of 19 participants for our within-subject design. The final sample consisted of 21 healthy participants aged 19–30 years (mean = 23.7 years; standard deviation = 3.1 years), of whom 20 (95.1%) were enrolled students and 16 (76.1%) were women. The inclusion and exclusion criteria for study participation are listed in **Table 2**. All participants received compensation for study participation. Table B.1 in Supplementary Materials Appendix B provides an overview of participants' screening results and base-

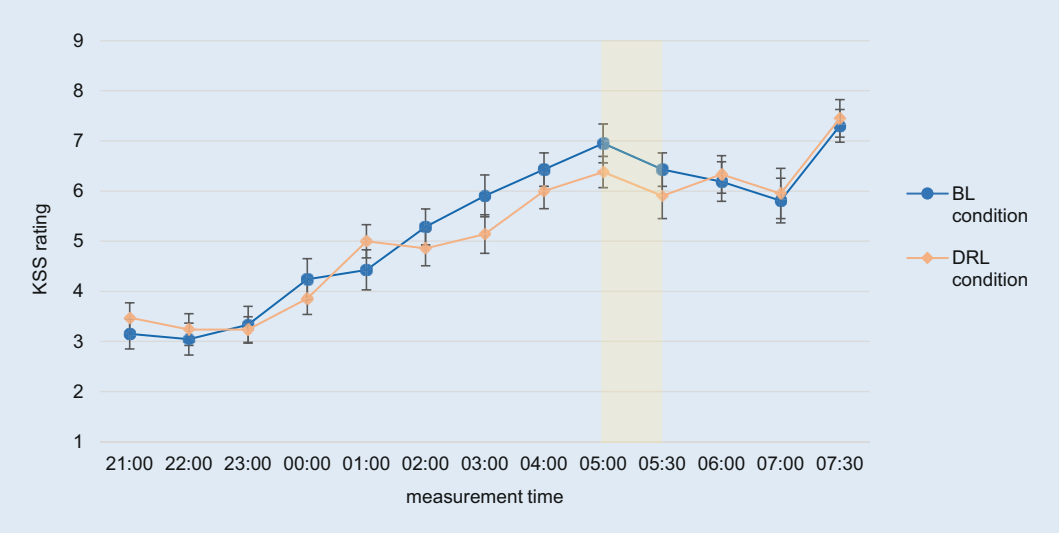

Fig. 1 ◀ Ratings on the Karolinska Sleepiness Scale (*KSS*) throughout the test nights for the *BL* (blue-enriched light) and *DRL* (dim red light) conditions; participants' KSS scores ranging from 1 (extremely alert) to 9 (extremely sleepy) were measured hourly from 21:00 to 07:30 in the BL and DRL conditions; *yellow bar* indicates the period (from 05:00 until 05:30) in which the light intervention took place

line PVT and MCT data, which were used descriptively to exclude any participants with deficient alertness and sustained attention.

Analyses

All data were pseudonymized before storage. Actigraphy and sleep diary data were only used to check for adherence to the study protocol. Four PVT values (three lapses, one mean RT) and four MCT values (two correct responses, two false starts) deviated more than three standard deviations from the group mean and were considered outliers. Of those, all PVT values and three MCT values were deemed systematic and retained in the dataset; one MCT outlier (correct response) was identified as unsystematic and replaced by the group mean. Means, standard deviations, and standard errors were calculated for descriptive analyses. The Shapiro–Wilk test was used to check for data normality. PVT and MCT data were not normally distributed; all other data were questionnaire data; therefore, only non-parametric tests were used for statistical analyses. PVT and KSS data were analyzed using the Friedman test, and significant variables were entered into the post-hoc pairwise Dunn's test with Bonferroni correction. Data from the MCT, D-FIS, and comfort ratings were analyzed using the Wilcoxon signed-rank test with Bonferroni correction for multiple comparisons. All analyses were performed in SPSS software (v29.0; IBM Corp., Armonk, NY, USA) and all tests were two-sided. The significance level was set to $\alpha = 0.05$.

Results

Subjective sleepiness and fatigue

Figure 1 shows participants' KSS ratings throughout the night from 21:00 to 07:30.

Before the intervention

The Friedman test was used to compare scores within and between the DRL and BL conditions. In one comparison, we analyzed scores at 21:00, 00:00, 03:00, and 05:00. During this period, subjective sleepiness increased in both conditions, (χ^2 [7, $N = 18$] = 86.310, $p < 0.001$), with significant differences in the DLR condition between 21:00 and 05:00 ($z = -4.194$, $p < 0.001$) and between 00:00 and 05:00 ($z = -3.639$, $p < 0.001$), as well as significant differences in the BL condition between 21:00 and 03:00 ($z = -3.994$, $p < 0.001$), between 21:00 and 05:00 ($z = -4.778$, $p < 0.001$), and between 00:00 and 03:00 ($z = -2.750$, $p = 0.021$). No significant differences were observed in the between-group comparisons (all $p > 0.05$).

During the intervention

At 05:30, participants in both conditions rated their sleepiness to be slightly lower than before the intervention at 05:00. However, a second Friedman test revealed no significant differences between or within conditions (χ^2 [3, $N = 20$] = 4.113, $p > 0.05$).

After the intervention

In the early morning hours between 05:30 and 07:00, sleepiness increased in the DRL condition but decreased further in the BL condition. This was, however, not significant within or between conditions (χ^2 [5, $N = 21$] = 2.799, $p > 0.05$). At the end of the night, sleepiness ratings differed significantly between 07:00 and 07:30—before and after the MCT (χ^2 [3, $N = 19$] = 18.058, $p < 0.001$, Friedman test). Sleepiness was significantly higher after the MCT than before in the BL condition ($z = -2.827$, $p = 0.028$) and marginally higher in the DLR condition ($p = 0.06$).

At the end of the night, D-FIS ratings were non-significantly higher in the DLR (11.6 ± 7.4) compared with the BL condition (10.9 ± 7.9; $z = -0.507$, $p > 0.05$, Wilcoxon signed-rank test).

Objective alertness and sustained attention

Table 3 shows PVT data before and after the intervention and MCT data at the end of the night shift.

PVT performance was worse after both interventions compared with before, with a higher number of lapses, mean RT, and fastest 10% of RTs, showing slightly fewer false starts and a faster mean RT in the MCT in the BL condition compared with the DRL condition. Significant differences were not, however, found within or between groups in either the PVT or the MCT (all $p > 0.05$).

Table 3 Performance in the Psychomotor Vigilance Task and Mackworth Clock Test VIGIL S1

	Descriptive statistics				*Inferential statistics*	
	DRL condition		**BL condition**			
	Pre intervention	**Post intervention**	**Pre intervention**	**Post intervention**		
	M (SD)	**M (SD)**	**M (SD)**	**M (SD)**	**χ^2 (df, *N*) or z-value**	***p*-value**
Psychomotor Vigilance Task						
Lapses	5.00 (8.72)	7.38 (10.37)	4.48 (5.68)	6.67 (10.25)	3.018 (3, 21)[a]	0.389
Mean RT	311.97 (80.47)	329.77 (86.94)	315.58 (59.37)	331.00 (91.97)	4.257 (3, 21)[a]	0.235
FRT	219.22 (22.94)	227.00 (29.42)	222.83 (25.46)	227.00 (26.80)	3.514 (3, 21)[a]	0.319
Speed (1/RT)	3.53 (0.55)	3.41 (0.62)	3.47 (0.50)	3.41 (0.60)	6.736 (3, 21)[a]	0.081
Mackworth Clock Test						
Correct reactions	n. a.	91.62 (8.59)	n. a.	92.60 (6.91)	–0.589[b]	0.556
False starts	n. a.	4.81 (6.49)	n. a.	3.05 (3.06)	–1.002[b]	0.316
Mean RT	n. a.	515.57 (74.13)	n. a.	510.38 (89.80)	–0.939[b]	0.348

Inferential statistics for comparisons between both conditions were calculated using the Friedman test and Wilcoxon signed-rank test
DRL dim red light, ***BL*** blue light, ***M*** mean, ***SD*** standard deviation, ***RT*** reaction time in ms, ***FRT*** fastest 10% of RT, ***n. a.*** not applicable
[a]χ^2 *(*df*, N)*
[b]z-value

Table 4 Comfort ratings for the sham and active light glasses

	Descriptive statistics				*Inferential statistics*	
	DRL condition		**BL condition**			
	Mdn	**M (SD)**	**Mdn**	**M (SD)**	**z**	***p*-value**
Rating for intervention (5-point Likert scale: 1 = not at all; 5 = very): the light glasses…						
…increased my fitness	2	2.1 (1.2)	3	2.7 (1.2)	–1.906	0.057
…increased my wellbeing	2	2.5 (1.2)	2	2.5 (1.1)	–0.288	0.773
…facilitated wakefulness	3	2.9 (1.2)	3	3.0 (1.0)	–0.453	0.651
…had a positive effect on the morning	2	2.4 (1.0)	3	2.8 (1.2)	–1.072	0.284
… positively influenced my concentration	2	2.7 (1.2)	3	2.7 (0.9)	–0.066	0.948
…irritated me	3	2.9 (1.4)	3	2.9 (1.3)	–0.051	0.959
…disturbed me	2	2.5 (1.3)	3	2.9 (1.3)	–1.257	0.209
…irritated my eyes	2	2.3 (1.2)	2	2.5 (1.4)	–0.480	0.631
…negatively affected my view	2	2.4 (1.4)	2	2.4 (1.4)	–0.045	0.964
…disturbed my work	2	2.1 (1.1)	2	2.0 (1.1)	–0.551	0.582
…generated disturbing reflections in the computer screen	1	1.8 (0.9)	1	1.9 (1.1)	–0.355	0.722
Semantic differential (7-point Likert scale: 1 = very…; 4 = neither nor; 7 = very…)						
Pleasant–unpleasant	4	4.0 (1.5)	4	4.3 (1.2)	–0.717	0.473
Fitness increasing–fitness decreasing	4	3.8 (1.0)	4	3.7 (1.0)	–0.241	0.809
Drowsing–activating	5	4.8 (1.6)	5	4.8 (1.3)	0.000	> 0.999
Not disturbing–disturbing	4	3.9 (2.1)	4	4.1 (1.8)	–0.288	0.773
Too short–too long	4	3.5 (0.8)	4	3.7 (0.8)	–1.040	0.298
In the foreground–in the background	3	3.4 (1.5)	4	4.0 (1.3)	–1.547	0.122
Weak–strong	4	4.5 (1.2)	4	4.5 (0.9)	–0.480	0.631
Overall rating for intervention (6-point Likert scale: 1 = not at all; 6 = absolutely)						
Recommendation	3	3.0 (1.5)	3	3.4 (1.1)	–1.331	0.183
Evaluation of the intervention (6-point Likert scale: 1 = very good; 6 = insufficient)						
Grade (i.e., German school grade)	4	3.5 (1.2)	3	3.1 (1.0)	–1.253	0.210

DRL dim red light, ***BL*** blue-enriched light, ***Mdn*** median, ***M*** mean, ***SD*** standard deviation
Inferential statistics were calculated using the Wilcoxon signed-rank test comparing ratings for the DRL (sham) and BL (active) conditions

Comfort ratings

Table 4 provides an overview of participants' comfort ratings regarding the light glasses in both conditions.

Participant ratings showed that the BL glasses increased participants' fitness slightly more than the DRL glasses ($p = 0.057$). No negative side effects were reported, with similar ratings for BL and DRL glasses regarding negative aspects such as irritation to the eyes, disturbances to eyesight or work, and reflections on the computer screen. Using a semantic differential scale with converse adjectives, both glasses were rated mostly neutral. The rating for "recommendation" and the school grade given by participants was slightly better for the BL glasses compared with the DRL glasses. However, none of these differences were statistically significant (all $p > 0.05$).

Discussion

To investigate mitigating the negative effects of night shift work on alertness and sleepiness during work hours as well as on sustained attention after work, we tested the effects of blue-enriched light therapy glasses during night shift work and compared these to sham glasses emitting dim red light without blue enrichment. Some well-known short-term negative effects of night shift work became apparent in the current study, such as increasing sleepiness throughout the night, reaction times, and error rates. However, compared to a sham condition, our results revealed no clearly significant benefit of using blue-enriched light glasses for 30 min from 05:00 to 05:30.

After a significant increase in sleepiness throughout the night, the BL intervention at 05:00 decreased sleepiness until 07:00. In the DRL condition, sleepiness increased again after a short decline at 05:30. These differences were not significant; however, they may indicate a slight superiority of the BL glasses to counteract sleepiness. Similar research conducted by Aarts et al. [1] also showed no clear sleepiness-related benefit of using BL glasses compared with DRL glasses during night shift work, while van Woerkom [60] showed a beneficial effect of light therapy glasses on fatigue during night shift work.

Performance in the PVT was worse after both interventions and MCT performance was similar between groups, without any significant differences. Inconclusive results have been reported from studies using light (specifically blue-enriched light) to increase alertness. In particular, objective outcomes of alertness and sustained attention failed to show substantial effects [14, 53]. Therefore, the results of the present study are not an exception.

Comfort ratings were similar for both the BL and DRL glasses. The BL glasses, however, were rated to improve fitness more than the DRL glasses. Importantly, no negative side effects were reported. Intervention methods to reduce sleepiness and improve alertness during night shift work should be effective, comfortable, and easy to use and implement. Therefore, the importance of positive comfort ratings should not be underestimated. To improve user comfort, further research should investigate allowing participants to determine the light intensity and duration of use.

In the context of treatment options, various studies have provided support for the beneficial effects of using light therapy glasses to treat mood disorders [35], seasonal affective disorders [41], and daytime sleepiness in Parkinson's disease [43, 52]. Regarding the alerting effects of light therapy glasses during night shift work, the available literature is much less clear, with inconclusive results reported by Aarts et al. [1] and positive effects reported by van Woerkom [60]. The current study aimed to provide a clearly beneficial intervention for sleep-deprived night shift workers. Despite its comfortable, easy usage and easy implementation, the active light glasses, compared with sham glasses, were not proven to be an effective countermeasure to the short-term side effects of night shift work.

This may be explained by the following limitations of the present study. A final sample size of 21 participants may be too small to detect significant differences. However, based on our power analysis, our sample size should have been sufficient for this within-subjects design. Further research should include a larger sample size. The included participants were not typical night shift workers (i.e., not working several night shifts in a row). This may have influenced the results, considering that the first night shift in particular can affect sustained attention [47]. We did not include a control group without an intervention. The goal of using a sham condition was to optimize consistency between test nights. However, this could have led to an expectation bias [59] or a placebo effect of the sham glasses, which has been reported in studies using similar sham conditions [36, 57]. Further research should include a control condition without a light intervention to investigate the general effects of light supplementation during night shifts, similar to Comtet et al. [16]. During test nights, participants were not monitored. Some may have engaged in activities that affect sleepiness and alertness even further, such as studying. It was, however, the purpose of the current field study to investigate the use of light glasses during night shift work in a workplace setting as realistically as possible, which is a major strength of our study.

Conclusion

Night shift workers experience short- and long-term side effects of sleep deprivation [15] and circadian rhythm disruptions [40]. Several interventions, including light supplementation, have been tested to reduce the short-term side effects [1, 60], with often inconclusive results [1, 53]. Our study is no exception, as no significant improvement in alertness was observed on the basis of objective outcome measures. However, our study demonstrated the feasibility of a convenient, easy-to-use light supplement in a real workplace setting without any negative side effects. As another relatively recent field study showed promising effects of bright light supplementation using a high proportion of blue light in industrial evening shifts [45], future research should focus on testing various aspects of light interventions (i.e., mode, duration, and timing of light application; light color or intensity; light use during different shifts) to identify critical factors that may ameliorate the short-term negative effects of shift work without disturbing sleep.

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Data availability statement. Study data are available from the corresponding author upon reasonable request.

Declarations

Conflict of interest. J. Ottersbach, A.-L. Eich, K. Ringeisen, T.C. Wetter and R.F. J. Popp declare that they have no competing interests.

Statement for ethical guidelines. The study was conducted in accordance with the World Medical Association Declaration of Helsinki and its later amendmends and was approved by the ethics committee of the University of Regensburg (reference number: 20-1835-101). All participants gave informed written consent.

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Zusammenfassung

Lichttherapiebrillen während der Nachtschicht: eine Feldstudie

Hintergrund: Nachtschichtarbeit geht mit negativen Auswirkungen auf Wachheit, Aufmerksamkeit und Vigilanz sowie erhöhtem Unfallrisiko einher.
Fragestellung: Die vorliegende Studie untersucht, ob eine aktivierende Lichtbrille mit blau angereichertem Licht die Schläfrigkeit, Aufmerksamkeit und Vigilanz von Nachtschichtarbeitenden am Ende der Nacht verbessern kann.
Material und Methoden: Die Feldstudie beinhaltete ein einfachblindes, sham-kontrolliertes Messwiederholungsdesign. Während zweier dienstplankonformer Nachtschichten eines Schlaflabors wurde von 05:00 bis 05:30 Uhr von den 21 Teilnehmenden randomisiert die Luminette® 3 (Fa. Lucimed SA, Wavre, Belgien) oder eine rotes Licht emittierende Sham-Lichtbrille getragen. Die subjektive Schläfrigkeit wurde stündlich mit der Karolinska-Schläfrigkeitsskala gemessen. Daueraufmerksamkeit und Vigilanz wurden mit dem PC Psychomotor Vigilance Task direkt vor und nach der Lichtintervention sowie dem computerisierten Mackworth Clock Test am Ende der Schicht beurteilt. Die statistische Überprüfung der Hypothesen erfolgte durch Wilcoxon-Rangkorrelationstests für verbundene Stichproben und Friedman-Tests.
Ergebnisse: Die subjektive Schläfrigkeit stieg im Laufe der Nacht signifikant an und wurde durch die Intervention mit blau angereichertem Licht länger, jedoch nicht signifikant verringert. Hinsichtlich Aufmerksamkeit und Vigilanz wurden keine signifikanten Vorteile der aktivierenden Lichtbrille ersichtlich, wobei diese tendenziell etwas besser akzeptiert wurde sowie keine Nebenwirkungen auslöste.
Schlussfolgerung: Den negativen Effekten von Nachtschichtarbeit konnte in der vorliegenden Studie nicht eindeutig durch die Anwendung einer aktivierenden Lichtbrille im Vergleich zu einer Sham-Brille entgegengewirkt werden. Trotz einiger Limitationen der Studie wird die einfache, alltagstaugliche Anwendung und Akzeptanz der Lichtbrille ersichtlich.

Schlüsselwörter
Blau angereichertes Licht-emittierende Brillen · Schichtarbeit · Schläfrigkeit · Aufmerksamkeit · Arbeitssicherheit

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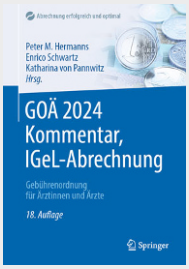

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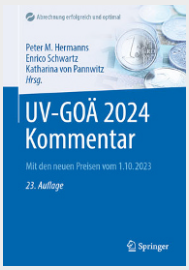

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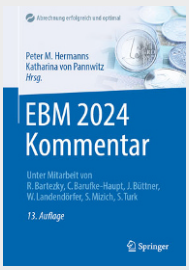

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