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Bright light therapy of subsyndromal seasonal affective disorder in the workplace: morning vs. afternoon exposure


Objective: Bright light therapy in seasonal affective disorder (SAD) has been studied extensively. However, little attention has been given to subsyndromal seasonal affective disorder (SSAD) or the use of bright light in the workplace. Many patients using bright light boxes complain of the inconvenience of use. Much of this inconvenience involves the often-recommended early timing of the bright light therapy. Patients, who already have difficulty awakening, often have difficulty using the bright light therapy soon after awakening before going to work. If bright light could be used effectively in the workplace, the treatment would be more convenient; the improved convenience would probably improve compliance. In this study, we studied the effectiveness of bright light therapy in subjects with SSAD in the workplace, comparing morning bright light with afternoon bright light.

Method: Morning and afternoon bright light treatment (2500 lux) were compared in 30 subsyndromal seasonal affective disorder patients using the bright light therapy in the workplace. Hamilton Depression Ratings and subjective measures of mood, energy, alertness and productivity were assessed before and after 2 weeks of light therapy.

Results: Both morning and evening bright light significantly decreased the depression ratings and improved the subjective mood, energy, alertness and productivity scores. However, there were no significant differences between the two times of administration of the bright light treatment. Both bright light treatments were well tolerated.

Conclusion: Bright light given in the workplace improves subjective ratings of mood, energy, alertness and productivity in SSAD subjects. Morning and afternoon bright lights resulted in similar levels of improvement.

Key words: light; seasonal affective disorder; depression; subsyndromal

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Introduction

Bright light therapy in seasonal affective disorder (SAD) (1–4) has been studied extensively. However, little attention has been given to subsyndromal seasonal affective disorder (SSAD) (5) or the use of bright light in the workplace. Many patients using bright light boxes complain of the inconvenience of use (6). Much of this inconvenience involves the often-recommended early timing of the bright light therapy. Patients, who already have difficulty awakening, often have difficulty using the bright light therapy soon after awakening before going to work. If bright light could be used effectively in the workplace, the treatment would be more convenient; the improved convenience would probably improve compliance. In this study, we study
the effectiveness of bright light therapy in subjects with SSAD in the workplace, comparing morning bright light with afternoon bright light.

SSAD is a milder form of SAD. Like SAD patients, SSAD patients experience symptoms such as low mood, low energy, increased sleep, increased appetite, weight gain and decreased social activity each fall–winter but, unlike SAD, SSAD patients do not fulfill criteria for major depression. A continuum of symptom severity exists between those who are not seasonally affected and those who have SAD (7, 8). SSAD is much more common than SAD; Rosenthal (9) estimates that for the United States about 6.1% (10.8 million) have SAD and about 14.3% (25.3 million) have SSAD. The prevalence of SAD and the prevalence of SSAD are greater at higher latitudes (10, 11), especially at very northern latitudes such as in Finland where the prevalence of SAD is 9.5% and of SSAD, 18.4% (12). Even small decrements in mood, productivity or alertness in such a large proportion of the population in northern latitudes could have a significant impact in terms of safety, economics and personal suffering.

Bright light therapy (2500–10 000 lux) has been found effective in treating SAD (3, 4, 13–15), but some data suggest that bright light therapy may be helpful for people even without SAD, especially those with SSAD (16) (5, 17–19).

Most studies show that morning light is superior to evening light (7–12, 13–15, 20–23) and many investigators have emphasized the importance of using the light soon after awakening. This recommendation was based in part on our knowledge about the effect of lights on circadian rhythms. Although some data are not consistent with the phase-shift hypothesis (24), many patients with SAD have phase-delayed circadian rhythms, and early morning light is the most effective in phase advancing (shifting counter-clockwise) those rhythms (20, 25). Even dawn simulation, a low illuminance light gradually increasing in illuminance prior to awakening, has been found effective in SSAD subjects (26). Many investigators thought that light during the late morning and afternoon was not effective in shifting circadian rhythms. However, recent data from Jewett et al. (27) show that even bright light during the day, e.g. from 800 to 1400 can phase advance circadian rhythms. Bright light also may have immediate activating effects that are non-circadian (28). Furthermore, some investigators have found that bright light at midday was helpful in treating SAD. Wehr et al. (29) found that a short skeleton photoperiod (900–1200 and 1400–1700) of bright light (2500 lux) was as effective in treating SAD as a long skeleton photoperiod (730–1030 and 2000–2300). Jacobsen et al. (30) found that midday (1200–1400) bright light (2500 lux) was as effective as early morning bright light (600–800) in treating SAD. Thus, bright light administration during usual work hours may be effective in treating SAD.

The typical workplace has an illuminance that is about one-tenth to one-hundredth of the illuminance outside, even on a cloudy day. Some studies have shown that bright light in the workplace may be beneficial to workers (31, 32).

Thus, there are both theoretical reasons and empirical data suggesting that light during the usual workday might be effective in treating SSAD symptoms, but theoretically morning light would be predicted to be more effective than afternoon light.

Hypotheses

Because SSAD subjects appear to respond to bright light and because bright light during the working hours may be effective and convenient, we assessed the efficacy of bright light in the workplace during the daytime (between 0700 and 1700) in treating subjects with SSAD. We compared 2 hours of bright light exposure in the morning (between 0700 and 1200) and 2 hours of exposure in the afternoon (between 1200 and 1700). From the recent circadian rhythm studies, this timing of morning bright light theoretically would phase advance circadian rhythms and theoretically would be more helpful for subjects with SSAD than the afternoon exposure, but this hypothesis should be empirically verified. The design would answer two questions:

1) Is bright light used in the workplace effective in improving the mood, energy and alertness of SSAD subjects?
2) What is the better time of bright light administration, morning or afternoon?

Material and methods

We advertised for people with seasonal problems and conducted a telephone interview to determine that there was a high probability that they would fulfill entry criteria. They had to have a regular daytime work schedule and be able to use the bright light at work. The subjects were assessed using the Seasonal Pattern Assessment Scale (SPAQ) (33). This instrument includes an assessment the seasonality of six items, mood, appetite, weight, sleep, energy and socializing. The seasonality of each item was rated by the subject on a 0–4 scale; the total score gave the Global Seasonality Score (GSS).
At the screening interview in our clinic, we administered the Structured Interview Guide for the Hamilton Depression Rating Scale—Seasonal Affective Disorders Version (SIGH-SAD) (34) that is comprised of the 21-item Hamilton Depression Rating Scale (HDRS-21) and eight supplementary items (SAD Subscale) concerning the atypical symptoms seen commonly in winter depression such as hypersomnia, increased appetite and weight gain. Our entry criteria for this study were a minimum GSS score of 6, a minimum SIGH-SAD score of 12 and subjects who would not be diagnosed as having a major depression and therefore would not fulfill criteria for SAD. In addition, subjects were excluded if they had significant medical problems such as cardiac, hepatic, renal, respiratory, endocrinological, neurological, hematological or other psychiatric disorders. A physical examination and laboratory tests confirmed the absence of any medical problem including thyroid disease. They did not have any eye problems that might explain their seasonality or that might be aggravated by bright light therapy. There was no family history of blindness or retinal degeneration. Patients undergoing a major psychosocial stress such as bereavement were also excluded. Subjects were considered for study entry if free from psychiatric medication for 1 or more months before the study. Subjects who routinely took antihistamines, decongestants, aspirin, appetite suppressants or sleeping medication were excluded. All subjects gave their informed consent after the procedures, and possible side-effects were fully explained.

During the first week there was no light treatment. At the end of the first week, the subjects were assigned randomly to 2 weeks of bright light treatment: either 2 hours of bright light in the morning (during the first 2 available hours between 0700 and 1200) or 2 hours of bright light in the afternoon (between the last 2 available hours between 1200 to 1700). The bright light source was the Philips Bright Light, which produces 2500 lux at 60 cm. The bright light box had a string attached to it; the end of the string identified a point 60 cm from the box. Thus, subjects could position themselves so that their eyes were the proper distance from the light box. Subjects took the light box to their workplace and used the light for 2 hours each day at the times indicated by the randomization and also used the light box in their homes on their days off work. The subjects recorded the times that they used the light box each day on a log sheet.

At the end of both the baseline week and the second treatment week, the subjects were assessed blindly by a psychiatrist using the SIGH-SAD, the primary measure of improvement. Secondary measures of improvement were also used. At the end of the baseline week and after the 2 weeks of bright light treatment, the subjects rated themselves on a visual analog scale (VAS) for the following items: mood, energy, alertness, productivity and quality of awakening. One end of a 100-mm line represented the typical winter level of the item (e.g. ‘typical winter mood’=0 mm); the other end of the line represented the typical summer level of the item (e.g. ‘typical summer mood’=100 mm). In addition, difficulty awakening was assessed by the psychiatrist using a five-point rating scale: 0 = wakes up without an alarm; 1 = needs an alarm to wake up on time; 2 = moderate drowsiness upon awakening; 3 = severe drowsiness when the alarm goes off, major effort needed to get out of bed; and 4 = often falls back to sleep after the alarm goes off. Expectations of response were assessed at the end of the baseline week using a clinical global improvement (CGI) scale (1 = worse, 2 = no change, 3 = slight improvement, 4 = much improvement 5 = very much improvement); at the end of the light treatment subjects rated their own response to light treatment on the same CGI. At baseline subjects completed the Horne–Ostberg Morningness–Eveningness Scale (MEQ) (35) which assesses the tendency for a subject to be a ‘morning person’ or an ‘evening person’. Questions were asked about side-effects from the use of the light.

The statistical analyses include unpaired t-tests, Fisher’s exact test and Spearman’s correlations. The two treatment groups were compared using a repeated-measure analysis of variance using scores at the baseline and after 2 weeks and analysis of covariance. Because multiple outcome variables were assessed, a P value of <0.01 was considered significant.

Results
Of the 31 patients who entered the study, 16 were randomly assigned to morning light and 15 to afternoon light. One patient assigned to afternoon light used the light in the afternoon during the first week, but mistakenly used the bright light in the morning during the second week. His data are excluded from the analyses. The GSS ranged from 6 to 17 with a mean (±SD) of 11.0±2.85. Those receiving morning light and afternoon light were similar in age (a.m., 37±11 vs. p.m., 43±9, t=1.638, P=NS), gender (a.m., 16 women vs. p.m., 12 women and two men, Fisher’s exact test NS), GSS scores (a.m., 10.8±2.8 vs. p.m.,
11.2 ± 3.0, \( t = 0.439, P = NS \), the MEQ scores (a.m., 51.0 ± 7.5 vs. p.m., 52.5 ± 12.1, \( t = 0.411, P = NS \)) and baseline severity as measured by the SIGH-SAD (see Table 1, \( t = 0.849, P = NS \)). The expectations for the treatment received as measured by the CGI tended to be slightly greater for the a.m. light group (a.m., 2.50 ± 0.63 vs. p.m., 2.00 ± 0.88, \( t = 1.81, P = 0.08 \)). Fourteen of the 16 randomized to the morning light and 13 of the 14 randomized to the afternoon light recorded their bright light box use. The average time for the bright light therapy for the morning group was 0926 ± 48 min significantly \( (t = 19.67, P < 0.001) \) earlier than for the afternoon group, 1520 ± 43 min. The total number of hours of bright light therapy during in the study did not differ significantly \( (t = 0.935, P = NS) \) during the study: 25.2 ± 3.7 hours of morning light compared to 23.8 ± 4.2 hours of the afternoon light.

The repeated measures analysis of variance showed that the primary measure of improvement, the SIGH-SAD, showed a clear improvement with bright light treatment, but neither a significant difference between treatment conditions nor a significant interaction effect (Table 1).

As noted in Table 1, both a.m. and p.m. groups improved significantly in nearly all the other secondary outcome measures, including the subscales of the SIGH-SAD, after 2 weeks of bright light treatment. However, the a.m. and p.m. groups did not differ significantly in their responses according the repeated measures ANOVAs of these measures. The VAS scales were missing baseline values for two subjects in the a.m. group and five in the p.m. group, but still showed clear evidence of improvement over time.

The CGI was assessed using an ANCOVA with the baseline expectations as the covariate. The two treatment groups had similar responses (a.m., 3.6 ± 0.9 vs. p.m., 3.4 ± 1.1, group \( F = 0.103, P = NS \)). Of the 16 receiving a.m. light, nine reported more than slight improvement; of the 14 receiving p.m. light 7 of 14 reported more than slight improvement (Fisher’s exact test, \( P = NS \)).

A greater proportion of patients who received morning light had at least a 50% reduction of the SIGH-SAD score after 2 weeks compared those who received afternoon bright light (11/16, 69% vs. 6/14, 43%, Fisher’s exact test, one-tailed \( P < 0.15 \)). In the total sample, 57% (17/30) had at least a 50% reduction of the SIGH-SAD score. In a post-hoc analysis, those who tended to be evening people (MEQ < 47) had a differential response to morning and afternoon light; four of four who received morning light had a greater than 50% response while none of four who received afternoon light had a greater than 50% response (Fisher’s exact test, \( P < 0.05 \)).

There were no significant correlations between expectations for response to morning light therapy and the actual response to morning light therapy as measured by the percentage improvement in the SIGH-SAD \( (r = 0.36, P = NS) \) or between expectations for afternoon light and actual response to afternoon light \( (r = 0.18, P = NS) \).

The subjects entered the study in January, February and March; the last post-light treatment
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The percentage improvement in the SIGH-SAD did not correlate with the time of entry into the study \((r = 0.08, P = NS)\). The percentage improvement did not correlate with the actual time of administration of the bright light therapy \((r = 0.10, P = NS)\) or the total number of hours of actual light therapy use \((r = 0.26, P = NS)\).

The GSS score correlated significantly with the screening SIGH-SAD score \((r = 0.51, P < 0.01)\). Those four subjects with GSS scores of 6 and 7 had SIGH-SAD scores with a mean of 20.5 ± 4.9, which was not significantly different from the rest of the sample \((23.5 ± 6.4, t = 1.09, P = NS)\). There was a trend for the percentage improvement in the SIGH-SAD to be greater in those with a higher initial severity of symptoms as measured by the SIGH-SAD \((r = 0.32, P = 0.09)\). The percentage improvement in SIGH-SAD did not correlate with the MEQ score \((r = 0.11, P = NS)\) or the degree of degree of seasonality as measured by the GSS \((r = 0.02, P = NS)\). Even in patients who demonstrated hypersomnia \((n = 25)\), the repeated measures ANOVA showed no interaction effect between the change in the SIGH-SAD scores and treatment \((F = 0.00, P = NS)\) were similar in both the morning and afternoon groups.

The validity of the VAS items was supported by significant correlations with the VAS score of each item after light treatment and the SIGH-SAD score after light treatment: mood, Spearman’s \(r = 0.75, P < 0.01\); energy, \(r = 0.65, P < 0.01\); alertness, \(r = 0.50, P < 0.05\); productivity, \(r = 0.75, P < 0.01\); quality of awakening, \(r = 0.58, P < 0.01\).

No major side-effects occurred. Two of the p.m. group reported a slight problem with glare from the bright light, one of those mentioned a slight very transient problem focusing immediately after using the light. One subject in the a.m. group has slight eyestrain when using the light. Emergent symptoms, all of which were rated as slight, which occurred in the study included early morning awakening (p.m.: 1 subject), headache (a.m.: 2; p.m.: 1); agitation (a.m.: 1); irritability (p.m.: 1); anxiety (p.m.: 1); tremor (p.m.: 1); dizziness (a.m.: 1); fatigue (p.m.: 1); dyspepsia (p.m.: 1); viral infection (a.m.: 1); and nasal congestion (p.m.: 1).

Discussion

The present study

The data suggest that bright light in the workplace either in the morning or afternoon is effective in improving mood, energy, alertness, productivity and the quality of awakening, and that the timing of the light is not important for the therapeutic response.

The initial severity of symptoms as measured by the SIGH-SAD was similar to SIGH-SAD scores seen in light therapy studies of SAD patients, suggesting that this sample was relatively severely affected in spite of not fulfilling criteria for a major depression. There was a wide range of severity and self-reported seasonality, but neither variable correlated with the clinical response.

The SIGH-SAD scores significantly decreased compared to baseline levels. In the total group, over half the sample had a greater than 50% reduction in the SIGH-SAD score. These changes were not only statistically significant, but clinically significant.

We had predicted that a.m. light would be more effective than p.m. light based on the studies showing morning light superior to evening light, but no statistically significant differences in efficacy between a.m. and p.m. lights were found. The heterogeneity of the sample may have obscured true differences between a.m. and p.m. light. At least one study found that morning light is superior to evening light only in hypersomnic SAD patients (21). In the present study, even those patients who had hypersomnia responded to a similar degree to a.m. and p.m. bright light. However, those who tended to be evening people had a better response to morning light than to afternoon light. Non-light factors such as positive and negative life events and the small sample size may have obscured differences between the groups.

The bright light therapy was well tolerated with only minimal side-effects with three subjects reporting slight problems with glare or eyestrain. Subjects may differ in their sensitivity to light. In this ‘fixed-dose’ study, a few individuals might be expected to experience some subjective discomfort with the light. However, in actual application of bright light therapy, the illuminance or the time of exposure could be reduced and the side-effects minimized or eliminated. The uncommon emergent events that occurred may have occurred by chance alone; the use of an inactive control condition in future studies would resolve this issue.

The present study is limited in that it lacks an inactive control group, and expectations for response (especially given the subjects’ general knowledge of SAD and light therapy) or other factors may have influenced the improvement. However, expectations at baseline did not correlate with clinical responses either for the sample as a whole or for each group. In addition, the decrease in depression ratings was probably greater than would be expected with a placebo control in this sample. In a study by Kasper et al. (18), 2 hours of a dim (300
lux) light was administered to a predominantly SSAD group for 1 week, and resulted in a reduction of the HDRS-21 score by a mean of only 3.2 points compared to a mean reduction of 6.7 points in the present study. Subjects entered the study in January, February and March. The increasing rate of change of photoperiod of spring may have caused some improvement; however, there was no correlation between the time of entry into the study and the degree of improvement.

Overall, our data indicate that bright light therapy is well tolerated and can be beneficial in the workplace. The time of bright light administration does not appear critical in our study.

The results suggest that bright light therapy may be helpful even for those with SSAD.

**Bright light use in the workplace**

Other investigators have used bright light in the workplace. For workers on the midnight to 8 a.m. shift, a high illuminance (2800 lux) condition resulted in better performance in workers than a low illuminance condition (250 lux) (37). In Finland during the winter, Partonen et al. (31) randomized 120 employees to exercise in a gym 2–3 times per week for 8 weeks in 400–600 lux of light or the same exercise regimen with 2500–4000 lux of light. Those exposed to the bright light reported greater relief from atypical depressive symptoms and more vitality than in the ordinary room light.

In a recent field study, Partonen and Lönnqvist (32) found that exposure to 1 hour of bright light (2500 lux) during the day improved vitality and reduced symptoms of depression and hostility in a group of unselected office workers in Finland during the winter. Although the study suggests a beneficial effect, the investigators did not conduct diagnostic interview of the subjects, did not have interviewer ratings of the subjects and did not examine the impact of the time of day of administration of the bright light. Improvements in energy, physical activity, socialization and quality of sleep with the bright light correlated significantly with the GSS; that is, those who had more symptoms during the winter had a better response to bright light therapy. However, when the authors categorized the subjects into non-SSAD and SSAD subjects according to the criteria of Bartko and Kasper (38), they found that the improvement did not differ between these two groups. The Bartko and Kasper criteria for defining SSAD may be too narrow; many people who do not fit these criteria respond to bright light.

**Pathophysiology of SAD**

The fact that morning and afternoon bright lights were equally effective in the present study could be viewed as evidence against the phase-shift hypothesis. However, because no phase markers of circadian rhythms were assessed in this study and the sample size was small, the lack of time-of-day effect should be regarded as weak evidence. The sample may have been heterogeneous concerning circadian phase, with some subjects being phase delayed and others phase advanced. Evening people have phase-delayed circadian rhythms (35); the fact that evening people had a better response to morning light than to afternoon light is consistent with the phase-shift hypothesis.
Because the group assigned to afternoon light could use the light as early as 1200 hours, it is possible that some phase advances occurred when light was given between 1200 and 1400 hours (27), but any phase advance would have been very weak. In addition, the mean time of administration of the bright light for the afternoon group was 1520 hours, and none of the subjects had a mean time of light administration before 1400 hours. In a study of clinical response, non-light effects, such as life stresses, may also influence depression ratings. Although most studies have found that morning bright light is superior to evening bright light (13–15, 20–23), some studies have found no morning–evening differences (24, 39).

Together, these studies provide promising data suggesting that addition of bright light may be beneficial to those in the workplace, especially to those with SSAD symptoms. Seasonality variation of mood, energy, sleep, appetite, weight and social activity are common in northern latitudes. About 56% of a random Copenhagen sample (8) and 53% of a Maryland (7) sample have a GSS score of 6 or greater. Increasing the illuminance in the workplace could lessen seasonal symptoms for a large proportion of the population.

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