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Research report

Bright light improves vitality and alleviates distress in healthy people

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Abstract

Background: The relative shortage of light during the decreasing photoperiod may compromise well-being. Earlier studies suggest that bright-light exposure may be of help to alleviate winter-bound symptoms. *Methods:* We carried out a field study with exposure to bright light on office employees during winter. *Results:* Repeated bright-light exposure improved vitality and reduced depressive symptoms. The benefit was observed not only in healthy subjects with season-dependent symptoms but also in those not having the seasonal variation. *Conclusions:* Bright-light exposure during winter appears to be effective at improving the health-related quality of life and alleviating distress in healthy subjects. *Clinical implications:* Administration of bright light is a useful option to improve vitality and mood among subjects working indoors in wintertime. Limitations of study: Our field setting used self-reports, not interviews, for the assessment of outcome.

Keywords: Mood; Phototherapy; Quality of life; Seasons

1. Introduction

Seasonal changes in mood and behaviour are frequent in the general population and affect predominantly women of reproductive age (Schlager et al., 1993). Ten to 15 percent of primary care patients in industrialised countries routinely complain of some difficulties in particular during winter. Whereas about 10% in a cohort of young adults suffer from low mood in winter over consecutive years (Wicki et al., 1992), only 0.2% of all patients and 3% of the depressed consulting their family doctor are diagnosed to have seasonal affective disorder (SAD) over one year (Blacker et al., 1997). Seasonal variation in well-being seems to decline with age, but still to persist into older age to a significant extent (Eagles et al., 1997; for review, see Partonen and Lönnqvist, 1998).

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Atypical depressive symptoms (carbohydrate craving, prolonged sleep, weight gain, and increased appetite) can emerge in association with low illumination to which people are ordinarily exposed indoors, or even outdoors at high latitudes in wintertime, and compromise well-being in healthy subjects (Espiritu et al., 1994). Less consistent resetting of the circadian clock by light is thought to cause the associated circadian disturbances which tend to intensify with ageing.

Earlier studies suggest that exposure to bright light would alleviate the winter-bound symptoms (Kasper et al., 1988, 1989). The objectives of our study were to measure the intensity of symptoms suffered by office workers during winter, and to analyse the effects of bright-light exposure on health-related quality of life and psychological distress.

2. Method

Our target population consisted of healthy adults working office hours. Subjects were recruited in October 1996 from three companies, yielding a study population of approximately 1250 persons. All subjects were naive to the explored intervention. We explained the study to the staff of the occupational health care centre of each workplace in a face-to-face meeting. A leaflet describing only the basic protocol was then delivered to all employees by the occupational health care centre staff. They were asked to fill in a short form inquiring about their health and work, and return it directly to the researchers. On the basis of the self-reports, we informed the staff at each occupational health care centre of the subjects who were qualified for the study. The chief physician at each occupational health care centre then confirmed the eligibility of each subject on the basis of medical records. The exclusion criteria were progressive eye disease, any severe general medical condition, currently prescribed psychotropic medication, current alcohol or substance abuse, and psychiatric disorders such as psychosis and severe personality disorder requiring specialist attention. After given written informed consent, the subjects were each supplied with a light therapy box along with written instructions.

A total of 160 consecutive eligible subjects were enrolled. Those who decided to participate were asked to take some interest in use of bright light, so some selection must have occurred and our results cannot necessarily be generalised to the whole population. All the subjects were working while engaged in the study, which took place in southern Finland between 1 November 1996 and 28 February 1997. On these dates, the length of daylight was 8 h 40 min and 10 h 23 min respectively at 60° North. We employed a crossover ABAB design in which two four-week periods of using the light box (A) alternated with two four-week periods of not using it (B). Subjects were instructed to use the lights, at work or home, for at least one hour a day on at least five days a week. They were asked to sit within 70 cm of the device, where the illumination was approximately 2500 lx at eye level after the lamps had warmed up. The subject was asked to face the lights but not to look directly into them while reading or working. Six 15-watt cool-white (6500 K) fluorescent lamps (TLD 15/865, Philips) were used as the light source.

At baseline the subjects were asked to fill in a 6-item Pre-intervention Expectations Questionnaire (PEQ) and the Seasonal Pattern Assessment Questionnaire (SPAQ; Rosenthal et al., 1987a). The subjective expectations of improvement by either exposure to bright light or ordinary lighting conditions (the latter included to balance the questionnaire) at any time of day, in the morning, or in the evening were assessed with the PEQ, ranging from ''very much worse'' (score 1) to ''very much better'' (score 7). The SPAQ instrument measures mood and behavioural changes with the seasons and has been used for identifying both SAD and subsyndromal SAD (Magnusson, 1996; Raheja et al., 1996; Magnusson et al., 1997). It includes the 6-item scale measuring seasonal variations in mood, appetite, weight, sleep, energy, and socialising. The sum of this scale gives the Global Seasonality Score (GSS). The SPAQ criteria for subsyndromal SAD require that subjects have a GSS of 10 or more and experience seasonal change as no more than a mild problem, or a GSS of 8 or 9 and experience seasonal change as at least a mild problem (Bartko and Kasper, 1989). Subjects with subsyndromal SAD regard themselves as normal, have no serious medical condition nor history of major affective disorder in winter, but do have routinely a history of some

difficulties during the winter months (Kasper et al., 1989).

The Symptom Distress Checklist 90 (SCL-90; Derogatis et al., 1973) and the RAND 36-item Health Survey 1,0 (RAND; Hays et al., 1993) were also administered at baseline and immediately after each of the four periods of intervention. The SCL-90 is used for measuring psychological symptom profile or distress. It is comprised of 90 items that reflect nine symptom dimensions: somatisation, obsessive-compulsive symptoms, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism. An additional scale refers primarily to disturbances in appetite and sleep. Its power to discriminate between the scores of patient and community samples is good (Holi et al., 1998). The RAND provides measures of general health and generates eight dimensions of functioning: physical and social functioning, role limitations caused by physical and emotional problems, vitality, general mental health, general health perceptions, and pain. It is sensitive to changes in health among general populations (Hemingway et al., 1997).

Finally, the changes since baseline in ten items, including those six in the GSS were assessed with the self rated format of the Clinical Global Impressions–Global Improvement (CGI–GI) scale, with seven possible choices from ''very much better'' (score 1) to ''very much worse'' (score 7). The efficacy of light exposure was rated with a scale anchored with ''beneficial effects'' (score +2) and ''adverse effects which outweigh the benefits'' (score −3).

Those who did not return the questionnaires received a follow up letter encouraging them to respond. All the questionnaires had been translated from English into Finnish and then back again to verify the translation.

2.1. Ethics

The ethics committee of the institution approved the study. All subjects gave their informed consent to participation.

2.2. Statistics

To estimate the effect of the four periods of intervention, analysis of covariance was computed for each of the outcome measures, the covariate being the baseline score on the dependent variable. If these analyses showed a significant effect, the data were examined to determine which scores differed significantly from each other by comparing the means and their 95% confidence interval (95% CI). The distributions of the outcome measures were analysed using the Kolmogorov-Smirnov test of normality with Lilliefors significance correction. We compared all subsidiary variables using the paired samples t-test and analysis of variance for parametric data, or the Wilcoxon signed ranks test for non-parametric data when appropriate. The chi-square test was used for analysis of the categorised data. The associations with the outcome measures and baseline characteristics were investigated by calculating Kendall's correlation coefficients. A separate general linear model using a general factorial analysis of variance was computed for each outcome measure with allowance for the preceding score as a covariate. The error variances were analysed using the Levene's test of equality. The overall test of an intervention effect was supplemented by using custom hypothesis tests with a simple contrast to test for the effect of subjective expectations of improvement. The changes in the absolute scores on the SCL-90 and the RAND were chosen as the main outcome measures.

3. Results

Of the 160 enrolled subjects, 145 (91%) returned their questionnaires and entered the trial. Their mean (SD) age was 41.2 (9.0) years (range 22 to 62). Ninety-one (63%) of the respondents were women. Of the 145 respondents, 120 (83%) completed 4 weeks of intervention, 108 (74%) 8 weeks, 94 (65%) 12 weeks and 91 (63%) 16 weeks. Complete data on the outcome measures were received from 87 subjects. There was no significant difference in the baseline intensity of symptoms of psychological distress or health-related quality of life between the subjects who completed the study and those who dropped out. Since there were no marked difference between the ratings of the subjects recruited from the three firms, their data were combined for further analysis.

Of the 145 healthy respondents, 71 (49%) did not

meet (group 1) and 70 (48%) met (group 2) the criteria for subsyndromal SAD. Data on the seasonal change in mood and behaviour were incomplete in 4 (3%) subjects. There were 39 (55%) and 48 (69%) women in groups 1 and 2 respectively. There was no significant difference in age, weight, years of education, or marital status between the two groups.

In all the respondents, the bright-light exposure reduced the intensity of depressive symptoms scored on the SCL-90 and improved vitality scored on the RAND significantly and repeatedly after both periods (A's), as rated at weeks 4 ($t = 9.76$, $df = 119$, $P < 0.001$; $t = -8.03$, $df = 117$, $P < 0.001$; respectively) and 12 ($t = 5.54$, $df = 89$, $P < 0.001$; $t = -5.16$, $df = 87$, $P < 0.001$; respectively). There was a rebound of depressive symptoms scored on the SCL-90 after the first of the two periods without the bright-light exposure (B's), as rated at week 8 ($t = -3.91$, $df = 100$, $P < 0.001$).

The data of group 1 and group 2 are presented separately in Tables 1–4. There was no significant difference in the main outcome measures between the two groups. None of the main outcome measures was significantly associated with the allocated group. There were no significant correlations of the GSS with the main outcome measures assessed at both weeks 4 and 12, except with the reduced obsessive-compulsive symptoms scored on the SCL-90 ($r = -0.21$, $p = 0.002$; $r = -0.16$, $p = 0.04$; respectively).

The subjective improvement in energy was significantly greater in group 2 than group 1, as scored on the CGI–GI ($F = 8.33$, $df = 1$, $p = 0.005$). In addition, there were correlations of the GSS with the subjective improvement in the quality of sleep, physical activity, energy, and socialising scored on the CGI–GI ($r = -0.22$, $p = 0.01$; $r = -0.20$, $p = 0.02$; $r = -0.19$, $p = 0.03$; $r = -0.18$, $p = 0.04$; respectively).

Table 1
Psychological distress in group 1

Variable[a]	Baseline ($n = 71$) mean (95% CI)	Week 4 ($n = 55$) mean (95% CI)	Week 8 ($n = 49$) mean (95% CI)	Week 12 ($n = 47$) mean (95% CI)	Week 16 ($n = 43$) mean (95% CI)
ANX	14.8 (13.9–15.7)	13.0 (12.1–13.9)	13.7 (12.6–14.9)	12.4 (11.5–13.4)	12.8 (11.7–14.0)
DEP	23.7 (21.8–25.6)	20.2 (18.4–22.0)	20.9 (18.9–23.0)	18.4 (16.8–20.1)	19.4 (17.3–21.5)
HOS	9.3 (8.7–9.9)	8.2 (7.7–8.7)	8.4 (7.8–9.1)	7.6 (7.1–8.1)	8.1 (7.4–8.8)
IPS	14.5 (13.4–15.5)	12.8 (11.8–13.8)	13.0 (11.9–14.2)	12.1 (11.1–13.1)	12.7 (11.5–14.0)
OCS	19.2 (17.6–20.8)	16.8 (15.2–18.4)	16.5 (14.8–18.2)	15.2 (13.8–16.6)	15.4 (13.7–17.0)
PAR	9.5 (8.6–10.3)	8.3 (7.5–9.0)	8.3 (7.5–9.0)	7.7 (7.1–8.4)	8.0 (7.1–8.9)
PHO	7.8 (7.4–8.1)	7.6 (7.3–8.0)	7.5 (7.2–7.8)	7.3 (7.0–7.7)	7.4 (7.0–7.8)
PSY	13.1 (12.2–13.9)	12.3 (11.3–13.2)	12.3 (11.3–13.3)	11.8 (11.0–12.7)	12.0 (11.1–13.0)
SOM	18.8 (17.4–20.3)	17.6 (16.0–19.3)	18.5 (16.6–20.5)	16.6 (15.0–18.1)	16.8 (15.2–18.5)
ADD	12.1 (11.1–13.2)	11.0 (10.0–11.9)	11.4 (10.3–12.5)	10.2 (9.2–11.1)	10.5 (9.5–11.4)

[a] Abbreviations: ANX = Anxiety, DEP = Depression, HOS = Hostility, IPS = Interpersonal sensitivity, OCS = Obsessive-compulsive symptoms, PAR = Paranoid ideation, PHO = Phobic anxiety, PSY = Psychoticism, SOM = Somatisation, ADD = Additional scale.

Table 2
The health-related quality of life in group 1

Variable	Baseline ($n = 70$) mean (95% CI)	Week 4 ($n = 56$) mean (95% CI)	Week 8 ($n = 49$) mean (95% CI)	Week 12 ($n = 47$) mean (95% CI)	Week 16 ($n = 44$) mean (95% CI)
Physical functioning	94.4 (92.2–96.5)	95.1 (92.6–97.6)	92.9 (89.0–96.9)	94.0 (91.2–96.9)	95.5 (93.2–97.7)
Social functioning	83.0 (77.9–88.1)	85.5 (80.3–90.7)	86.5 (81.3–91.7)	90.4 (85.3–95.5)	88.4 (83.6–93.1)
Physical problems	86.4 (79.9–93.0)	90.2 (83.8–96.5)	87.6 (79.4–95.8)	91.0 (83.9–98.0)	89.2 (81.4–97.0)
Emotional problems	69.0 (59.9–78.2)	83.3 (75.5–91.1)	85.0 (76.3–93.8)	89.4 (81.7–97.0)	81.8 (71.7–91.9)
Vitality	56.2 (51.8–60.6)	66.4 (61.4–71.5)	65.6 (60.1–71.2)	72.0 (67.3–76.8)	68.9 (63.3–74.4)
General mental health	71.1 (67.6–74.6)	76.4 (72.5–80.4)	77.7 (73.4–82.0)	80.9 (77.4–84.3)	78.7 (74.7–82.7)
General health perceptions	75.0 (70.6–79.4)	76.4 (71.5–81.3)	75.9 (70.7–81.0)	78.8 (74.3–83.2)	77.0 (71.4–82.5)
Pain	84.7 (79.6–89.8)	85.0 (79.9–90.1)	83.6 (77.6–89.7)	85.5 (79.9–91.1)	88.2 (84.1–92.3)

Table 3
Psychological distress in group 2

Variable[a]	Baseline ($n = 69$) mean (95% CI)	Week 4 ($n = 61$) mean (95% CI)	Week 8 ($n = 56$) mean (95% CI)	Week 12 ($n = 45$) mean (95% CI)	Week 16 ($n = 44$) mean (95% CI)
ANX	16.4 (15.4–17.5)	14.2 (13.2–15.1)	14.8 (13.8–15.8)	13.3 (12.2–14.3)	13.5 (12.3–14.8)
DEP	28.7 (26.8–30.6)	22.7 (20.8–24.5)	25.5 (23.0–27.9)	21.4 (18.7–24.0)	21.6 (18.9–24.3)
HOS	10.8 (9.9–11.6)	8.9 (8.3–9.5)	9.5 (8.7–10.2)	8.2 (7.6–8.9)	8.5 (7.8–9.3)
IPS	16.0 (14.9–17.2)	13.8 (12.7–14.8)	14.5 (13.1–15.9)	12.9 (11.6–14.1)	13.0 (11.8–14.3)
OCS	22.1 (20.7–23.6)	17.8 (16.4–19.2)	18.9 (17.3–20.5)	16.3 (15.0–17.7)	15.9 (14.4–17.4)
PAR	10.3 (9.4–11.2)	8.9 (8.1–9.7)	9.1 (8.2–10.1)	8.2 (7.2–9.1)	8.1 (7.3–8.9)
PHO	8.6 (8.1–9.1)	8.1 (7.6–8.5)	8.5 (7.9–9.2)	7.7 (7.3–8.1)	8.2 (7.4–8.9)
PSY	13.7 (12.8–14.6)	12.2 (11.4–13.0)	12.6 (11.7–13.5)	11.6 (10.8–12.4)	11.5 (10.7–12.4)
SOM	21.1 (19.7–22.5)	18.3 (16.8–19.8)	19.7 (18.1–21.3)	17.4 (15.7–19.0)	17.6 (15.8–19.5)
ADD	13.5 (12.6–14.5)	12.0 (11.0–13.0)	12.4 (11.3–13.6)	11.3 (10.2–12.4)	10.8 (9.7–11.8)

[a] Abbreviations: ANX = Anxiety, DEP = Depression, HOS = Hostility, IPS = Interpersonal sensitivity, OCS = Obsessive-compulsive symptoms, PAR = Paranoid ideation, PHO = Phobic anxiety, PSY = Psychoticism, SOM = Somatisation, ADD = Additional scale.

Table 4
The health-related quality of life in group 2

Variable	Baseline ($n = 69$) mean (95% CI)	Week 4 ($n = 58$) mean (95% CI)	Week 8 ($n = 55$) mean (95% CI)	Week 12 ($n = 44$) mean (95% CI)	Week 16 ($n = 44$) mean (95% CI)
Physical functioning	91.9 (89.4–94.4)	92.5 (90.0–95.0)	91.5 (87.7–95.2)	94.3 (91.9–96.7)	93.3 (89.6–97.0)
Social functioning	70.8 (65.2–76.4)	82.5 (77.4–87.7)	73.6 (67.5–79.8)	83.5 (77.3–89.8)	82.7 (76.7–88.6)
Physical problems	77.9 (70.1–85.7)	78.9 (70.3–87.5)	72.7 (62.6–82.8)	86.4 (78.1–94.6)	81.8 (72.2–91.4)
Emotional problems	56.0 (46.9–65.2)	75.3 (67.5–83.1)	63.0 (52.3–73.7)	81.1 (71.9–90.2)	70.5 (58.6–82.3)
Vitality	43.9 (39.2–48.6)	60.6 (55.8–65.5)	53.6 (47.8–59.5)	64.5 (58.1–71.0)	65.8 (59.3–72.3)
General mental health	59.9 (55.6–64.2)	72.0 (68.0–76.0)	66.4 (61.3–71.5)	73.5 (68.3–78.8)	75.2 (69.6–80.7)
General health perceptions	68.6 (64.0–73.3)	72.2 (67.4–77.0)	70.5 (64.9–76.2)	73.9 (68.3–79.6)	76.3 (71.0–81.5)
Pain	78.2 (73.5–82.8)	80.2 (75.0–85.4)	78.0 (71.8–84.2)	83.6 (78.0–89.2)	82.5 (76.8–88.2)

The means of expectation of improvement by exposure to bright light at any time of day, in the morning, or in the evening did not differ between the two groups, but there were significant relationships between the PEQ scores of bright-light exposure and the GSS ($r = 0.22$ and $p = 0.002$ for any time of day, $r = 0.26$ and $p < 0.001$ for morning, and $r = 0.19$ and $p = 0.006$ for evening). The expected benefit from exposure to bright light scored on the PEQ was not significantly associated with the reduction of symptoms of depression or hostility nor with the improvement in vitality rated at week 4 ($F = 0.3$, $p = 0.83$, adjusted R^2 of 0.21; $F = 0.19$, $p = 0.9$, adjusted R^2 of 0.47; $F = 1.4$, $p = 0.24$, adjusted R^2 of 0.31; respectively). There was a significant interaction between the PEQ score and the covariate in each of the general linear models used for analysis of the reduction of symptoms of depression or hostility rated at week 12. The expected benefit from exposure to bright light scored on the PEQ was not significantly associated with the improvement in vitality rated at week 12 ($F = 0.15$, $p = 0.93$, adjusted R^2 of 0.12).

Adverse effects attributed to the use of bright-light exposure were reported by eight (12%) respondents, and they were given as the reason for drop out by two (3%).

4. Discussion

Our key finding was that repeated systematic exposure to bright light reduced the intensity of depressive symptoms among healthy subjects. Preliminary results from earlier studies have been disappointing, since the administration of bright light did not improve mood in three trials on 53 healthy subjects (Rosenthal et al., 1987b; Kasper et al., 1988,

1990), or produced troublesome adverse effects in two trials on 29 subjects (Genhart et al., 1993; Bauer et al., 1994). Here, in contrast, we were able to show that exposure to bright light did have a beneficial effect on mood in healthy adults working in an office environment. The response was observed not only in subjects with the retrospectively reported history of season-dependent symptoms, but also in those without it, suggesting that exposure to bright light may benefit healthy people at large.

Relatively little has been known about the influence of seasonal changes in mood and behaviour on the health-related quality of life. An earlier report on 303 patients in primary care came to the conclusion that the impairment of functioning due to season-dependent symptoms exceeded the disadvantage related to most of the common general medical conditions (Schlager et al., 1995). To our knowledge, no-one has yet investigated whether the health-related quality of life is influenced by exposure to bright light. Our results suggest that repeated exposure to bright light may be able to improve certain aspects of the health-related quality of life, in specific, vitality in the present study. The assessment of vitality corresponds closely with that of mood, and the increased vitality is suggested above all to reflect the improvement in mood.

The strengths of our study are the relatively large sample size and the long and alternating periods of intervention. The reduction of depressive symptoms and the improvement in vitality were not significantly explained by the pre-intervention expectations, arguing against a marked placebo effect in this study. Our sample comprised subjects who were naive to the explored intervention, and we tried to reduce the reporting bias by recording their pre-intervention expectations and subjective benefit in detail. Although the number of subjects complaining of seasonal difficulties we report here is in agreement with earlier surveys, great care must be taken in its interpretation. Data on seasonal variation obtained by retrospective instruments such as the SPAQ have only limited reliability. The method used in most of the previous studies tends to overestimate seasonal symptoms as a problem and consequently to overdiagnose both SAD and subsyndromal SAD. The difference between those ratings assessed in winter and summer is also likely to be exaggerated from retrospective data (Nayyar and Cochrane, 1996).

Another shortcoming of our study is that we did not perform structured clinical interviews for diagnosis. A third one is the absence of a control for possible placebo or non-specific effects of the intervention. The preponderance of women in our sample is a fourth shortcoming, although it is unlikely that the gender distribution compromised our findings, since menstrual cycle stage and menopausal state do not influence the reliability of mood assessment nor symptom reporting (Schwartz et al., 1997; Slaven and Lee, 1997).

In conclusion, repeated systematic exposure to bright light during winter in office workers appears to be effective in improving certain aspects of the health-related quality of life and alleviating psychological distress. Further studies are required to discover whether light administration in wintertime is a useful option for improving vitality and mood in people at large.

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