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Efficacy of bright light therapy in perinatal depression: A randomized, double-blind, placebo-controlled study

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A R T I C L E I N F O

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A B S T R A C T

Background: Uncertainties and difficulties associated with the current treatment modalities for perinatal depression (PND) may cause some mothers to avoid treatment. Raising awareness about the effectiveness and safety of bright light therapy (BLT) may help to alleviate the challenges of PND. The main goal of this study was to evaluate the efficacy and safety of BLT versus placebo in PND.

Method: A total of 30 women who were either pregnant or in first year postpartum and diagnosed with major depressive disorder were enrolled; 23 completed the study. Patients were randomly assigned to either the BLT (10,000 lux) or placebo (<500 lux) group. BLT and placebo light were applied for 45 min in the morning every day for a 3-week period. The Montgomery–Åsberg Depression Rating Scale (MADRS), Hamilton Depression Rating Scale (HAM-D), and Edinburgh Postnatal Depression Scale (EPDS) were administered weekly to evaluate response and remission rates and depression scores.

Results: There was no significant difference between the two groups in terms of baseline depression scores. At the end of the study, the response rates assessed according to MADRS were 75% for BLT and 18.2% for placebo ($p =$ .006), and remission rates were 41.7% vs. 0% ($p = .016$), respectively. There was no significant difference between the groups ($p > .05$) in terms of treatment-related side effects. The main limitation of this study is its small sample size, which limits the generalizability of the study's findings.

Conclusion: The results indicate that BLT is more effective than placebo and is reliable in terms of side effects in PND patients. In order to expand the use of BLT in PND, new studies with larger sample sizes are needed.

1. Introduction

It is estimated that approximately one in five to seven women experience a depressive attack in the perinatal period regardless of economic status (Howard et al., 2014; Boran et al., 2020). Poor maternal mental health is not only detrimental to mothers, it can also adversely affect children's health, as it causes several risks that begin during pregnancy and extend into the crucial stages of child development (Dunkel Schetter and Tanner, 2012; Glover, 2014).

Although there is a growing body of knowledge about the causes and consequences of perinatal depression, women with PND face unique dilemmas involving safety concerns, cost, and time management issues, as they must make difficult treatment decisions during their pregnancy as well as in the postpartum and breastfeeding stages (Pearlstein, 2008). Despite the different pharmacological and psychotherapeutic approaches available for the treatment of PND, it has been shown that most women in the perinatal period do not receive effective treatment (Kelly et al., 2001; Marcus et al., 2003). Not only are there concerns related to the side effects of psychotropic medications, but exposing the fetus and child to stress, anxiety, and untreated depression can also have serious consequences (Bonari et al., 2004). All of this leads to a series of negative implications that emerge in untreated mothers and propagate throughout the community.

Bright light therapy is a somatic treatment that involves daily exposure to bright light, which is delivered via a light box (Terman and Terman, 2005). It has been the first choice of treatment with proven efficacy and high tolerability in seasonal depressive disorder (SAD) and has yielded positive evidence in the treatment of non-seasonal affective

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disorders (Perera et al., 2016). Although the exact action mechanism of BLT remains unclear, several hypotheses have been suggested to explain how it alleviates depressive disorders (Pail et al., 2011). Disruption of circadian rhythm has been implicated in the pathophysiology of depression (Monteleone and Maj, 2008). BLT shifts the circadian rhythm, synchronizes the hypothalamus-pituitary-adrenal axis via the suprachiasmatic nucleus (SCN), which is located on the hypothalamus, and acts as a "master biological clock" (Lam and Levitan, 2000; LeGates et al., 2014; Pail et al., 2011). Light may also have direct effects on mood through the pathways from the retina that do not depend on the SCN (Kolberg et al., 2021).

Women in the perinatal period show desynchronized circadian rhythms, disturbed sleep, decreased daily activities, and decreased exposure to daylight (Krawczak et al., 2016). These factors predispose perinatal women to depression. Although it has been used for more than 35 years, only a few studies have evaluated the effectiveness of BLT in treating PND (Bais et al., 2020; Corral et al., 2000, 2007; Epperson et al., 2004; Oren et al., 2002; Wirz-Justice et al., 2011). The first was an open-label trial that investigated the effect of BLT on 16 antepartum depressive patients. It was found that 1 h of BLT for 3–5 weeks was effective in alleviating antepartum depression (Oren et al., 2002). Expanding on this, Epperson et al. (2004) conducted a randomized controlled trial among 10 patients with antepartum depression. Depression scores of the two groups were reduced at similar rates in five weeks, but with an additional five weeks, BLT was superior to placebo in terms of response rates. In a double-blind, randomized controlled trial by Wirz-Justice et al. (2011), 27 antepartum patients were exposed to either BLT or placebo for 1 h every morning for five weeks. The response and remission rates were superior in the BLT group. The latest randomized controlled trial in pregnant women included 67 participants. BLT vs. dim red light therapy (DRLT) were applied for 30 min in the morning for 6 weeks. No statistically significant differences were found between BLT and DRLT (Bais et al., 2020).

The existing studies involving the postpartum period comprise an open-label study with two participants that found significant improvement in postpartum depression after BLT (Corral et al., 2000) and a randomized BLT study by the same research team with 15 participants who were exposed to either BLT or red light for five weeks. The same improvement was seen in both the bright light and placebo groups compared with the baseline. Furthermore, there have also been studies with positive preliminary results (Garbazza et al., 2019). All of these studies have had numerous limitations and methodological differences. Nonetheless, due to heterogeneity of results and the need for more studies, BLT remains a promising research topic for the treatment of PND (Crowley and Youngstedt, 2012).

Based on all this, a 3-week randomized double-blind placebo-controlled study was conducted to assess the efficacy and safety of morning BLT exposure in PND. The primary aim of this study was to determine the response, remission rates, and side effects in patients suffering from depression in the perinatal period. As a secondary aim, the effect of BLT on sleep quality, was also evaluated.

2. Methods

2.1. Overview

We performed a 3-week, randomized, double-blind, placebo-controlled clinical study with participants who were either pregnant or in the first year postpartum and who currently had a diagnosis of major depression according to the DSM-5 criteria. BLT (10,000 lux) vs. placebo dim light (<500 lux) was administered to participants, and depression scores were analyzed by repeated measures. The study was conducted in compliance with the Declaration of Helsinki. The study protocol was approved by the Human Research Ethics Committee at Marmara University (Date: 02.06.2017 Reference ID: 09.2017.424). Written informed consent was obtained from all participants prior to the study which was conducted from July 2017 through November 2019 at Marmara University Pendik Research and Training Hospital.

2.2. Participants

Participants were recruited from among those who applied or who were referred to the psychiatric outpatient clinic at Marmara University Pendik Research and Training Hospital. All the women who were pregnant or in the postpartum first year and had depression symptoms were screened using the EPDS. Those with a score ≥12 were evaluated face-to-face by the primary investigator who is also a psychiatrist (PI). Patients who were diagnosed with major depression, according to the DSM-5 criteria, were given information on the procedures and purpose of the study. Those deemed eligible who agreed to participate were enrolled in the study. The participants' recruitment diagram is shown in Fig. 1. The participants were advised that they were free to withdraw from the study and ask for other types of treatment at any time. Over the course of the study, participants were assessed by the PI at weekly intervals and were asked to inform the research team if they had any suicidal ideation or unexpected worsening of symptoms at any time. The participants were also asked to report any adverse effects based on a checklist and manic or hypomanic symptoms based on the Young Mania Rating Scale (YMRS) at each weekly session.

- Inclusion Criteria.

- Being 18–45 years of age
- Ability to read, understand, and sign the informed consent form and understand study procedures
- Being pregnant or in the first 12 months of the postpartum period
- Meeting major depressive disorder diagnostic criteria according to DSM-5 and having a score of 12 points or higher on the EPDS.

- Exclusion Criteria.

- Depression scores lower than 12 points on the EPDS
- Having an ophthalmologic disease that may cause light sensitivity
- The presence of a chronic and/or serious medical illness that may affect the general condition
- The presence of a neurological disease that can be triggered by light, such as epilepsy or migraine
- Having psychotic symptoms
- Having a high risk of suicide
- Having had BLT previously
- Having a shiftwork job
- Having received any form of intervention (medication, psychotherapy, etc.) for depression within the past six months or any intention for co-intervention during the study
- Having no current psychiatric comorbidities
- Not having consented to participate in the study.

2.3. Randomization and procedure

Each participant was diagnosed, followed up, and rated for three weeks by the PI. Treatment allocation was concealed from the PI and patients until the end of the study. Participants were randomly assigned either to the BLT or placebo group (1:1) using a random number sequence. Because being pregnant or being in the postpartum period could be a factor in predicting the outcome, randomization was stratified in pregnant and postpartum women in separate sequences according to the above criteria. The non-blind researcher (NY) who conducted the randomization distributed the light devices and delivered instructions to the participants. A one-to-one placebo and bright light demo administration were performed for each participant. All the instructions were given individually. Light devices identical in shape and appearance, including the packaging, were distributed to the participants (Beurer TL100 daylight therapy lamp; Beurer, Ulm, Germany).

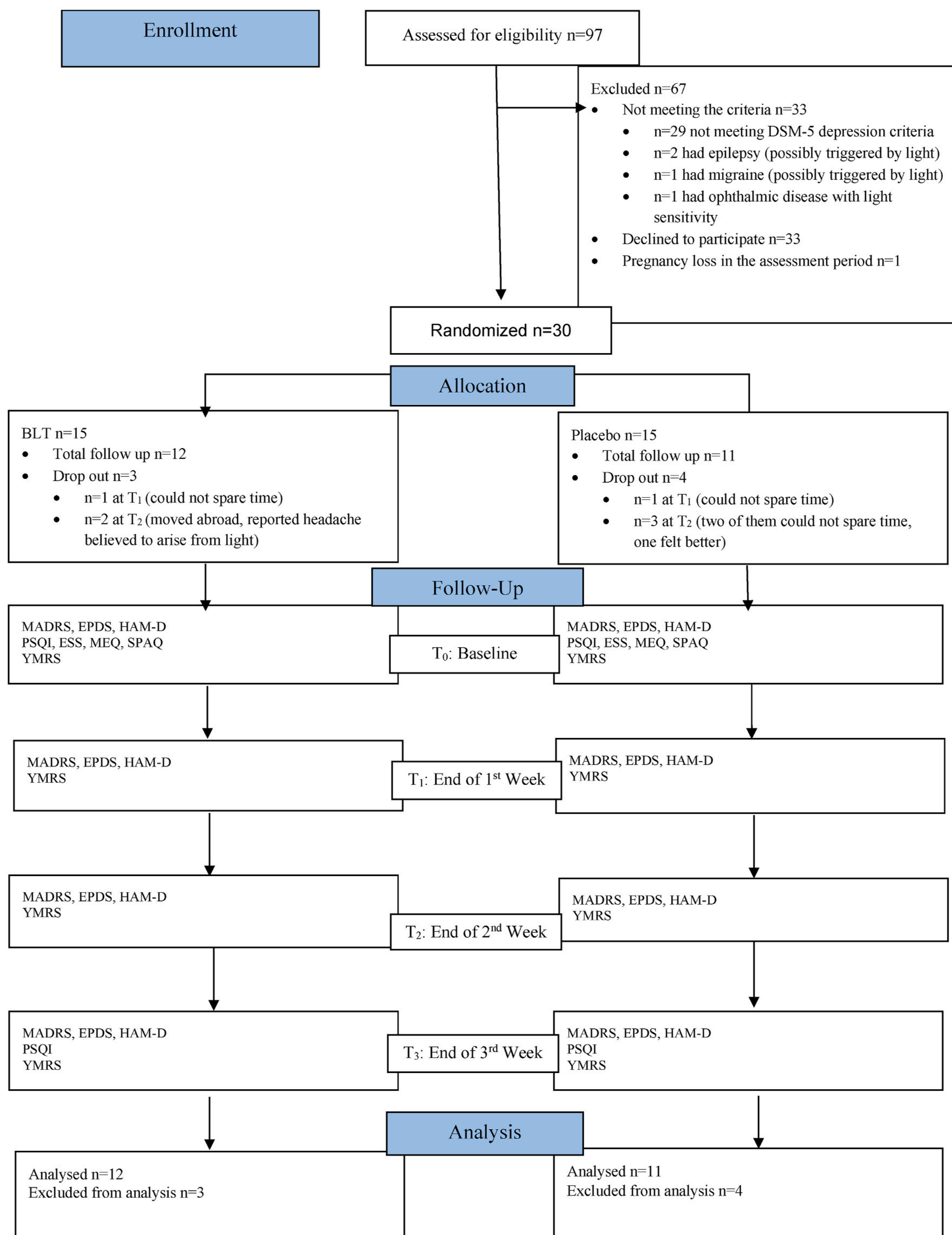

Fig. 1. Participants flow chart.

The light devices given to the placebo group were set at <500 lux; those given to the BLT intervention group were set at 10,000 lux. A light box was given for participants to take home for their use. Participants were instructed to sit at a table or desk on which the light box was positioned directly facing them and 40–45 cm from the box. They were told to place their heads in the middle of the light box and avoid staring at the light source. Neutral activities such as reading, knitting, and breastfeeding were allowed during the session. They were asked to use the devices for 45 min first hour awakening, adhering to a fixed wake-up time (same time every day, preferably before 10 a.m.) and ensure the device was used consistently in a dimly lit room. To monitor adherence and check daily administration, the participants were called by the NY on a daily basis. Participants in both groups were told that the efficacy of two different light therapy devices would be evaluated, and the study would investigate the effectiveness of the devices. Patients brought their light devices with them to every clinic visit, and the NY checked whether they were working properly.

At the end of the 3-week intervention, other treatment options were offered to participants of both groups who had continuing depressive complaints, and appropriate guidance was given to those who requested

alternative treatment.

To determine an adequate sample size, G*Power 3.1.9 was used (Faul et al., 2007). Based on the study of Wirz-Justice et al. (2011), a sample size of 16 participants in each of the two groups was required to fulfill the statistical criteria of 80% power with a 5% alpha and a 20% loss rate.

2.4. Measures

The primary outcome scales used for measuring depression levels were the MADRS, HAM-D, and the EPDS. Each was applied at baseline and at the end of every week (see Fig. 1). The secondary outcome scale was the Pittsburgh Sleep Quality Index (PSQI), which was applied at baseline and at the end of the third week. To show the chronotype patterns and seasonality of the patients, they were analyzed before the intervention with the Morningness-Eveningness Questionnaire (MEQ) and the Seasonal Pattern Assessment Questionnaire (SPAQ).

The participants' baseline expectancy and credibility were assessed to see whether there was any contributory bias. The evaluation was made using a self-report 6-item questionnaire (scoring 1–36) developed by the researchers and based on Devilly and Borkovec's (2000) questionnaire, which asked how believable the therapy was to them and how much improvement they expected from the treatment.. There was no difference in the mean scores between the groups (BLT 10.8 vs. placebo 11.8, $p > .05$). Participants were asked to notice the common side effects and report on them using a checklist at the end of every week. In addition, YMRS was used to detect any manic or hypomanic switches.

2.5. Statistical analysis

Data were analyzed by using IBM® SPSS® version 22 (IBM, Armonk, NY, USA). Descriptive statistics were used to describe the groups' characteristics. Baseline differences in demographic and clinical variables between the two groups were analyzed using the Student's *t*-test for continuous variables or Pearson's chi-squared test for categorical variables. The Shapiro–Wilk test was used to examine the normality of the parameters. Normally distributed variables were presented as *mean* and *standard deviation* (*SD*), while those with categorical variables were presented as number and percentage. Primary outcomes were analyzed for time (baseline, week 1, week 2, week 3) and treatment (BLT and placebo) effects using a mixed repeated-measures analysis of variance (ANOVA). Assumptions of homogeneity were assessed between group measures using Levene's test, and assumptions of sphericity were checked for repeated measures using Mauchly's test. Homogeneity was not violated in any of the ANOVAs reported, and where violations of sphericity were found, the Greenhouse–Geisser adjustment was applied to the degree of freedom. The significance level was set at $p < .05$ for all tests.

3. Results

3.1. Demographics and baseline assessments of participants

A total of 97 patients were assessed for eligibility, and 30 patients were enrolled in the study. Of the 30, 23 completed the 3-week study. The participant flowchart and details are summarized in Fig. 1. There was no significant difference in dropout rates between the groups. Three dropouts occurred in the BLT group, and four occurred in the placebo group (χ 2 (1, $N = 30$) = 0.186 $p = .666$). As shown in Table 1, there were no significant differences between the groups in any demographic variables at baseline.

The underlying clinical factors did not significantly vary between the two groups. All participants were diagnosed with major depression, and there was no current diagnosis of any psychiatric or major medical comorbidity. Participants' past psychiatric and medical histories were evaluated: somatization disorder ($n = 1$), obsessive-compulsive disorder ($n = 1$), major depression ($n = 3$), generalized anxiety disorder ($n = 1$), and panic disorder ($n = 1$) were reported. There were three participants with a history of psychiatric disease in the BLT group, while there were four in the placebo group (χ 2 (1, $N = 30$) = 0.186 $p = .666$).

Table 1
Demographic variables of participants.

	BLT (n = 15)	Placebo (n = 15)	Total (n = 30)	Test statistics t/ χ^2 (df)	p
Age, mean ± SD	29.73 ± 6.57	28 ± 3.8	28.87 ± 5.35	0.884 (22.4)	.386
Pregnant/ Postpartum, n (%)	5(33.3)/ 10(66.7)	4(26.7)/ 11(73.3)	9(30)/21 (70)	0.159 (1)	.690
Breastfeeding	10/10 (100)	11/11 (100)	21(100)/ 21(100)		
Education Level, n (%)					
Primary School	5(33.3)	8(53.3)	13(43.3)	1.936 (2)	.423
High School	5(33.3)	5(33.3)	10(33.3)		
University	5(33.3)	2(13.3)	7(23.3)		
Marital status, n (%)					
Married	14(93.3)	15(100)	29(96.7)	1.034 (1)	.309
Divorced	1(6.7)	0(0)	1(3.3)		
Number of children, mean ± SD	1.27 ± 0.96	2 ± 1.2	1.63 ± 1.1	−1.852 (28)	.075
Gestational week, mean ± SD	19.4 ± 9.89	17.75 ± 8.66	18.67 ± 8.82	0.262 (7)	.801
Postpartum month, mean ± SD	5.8 ± 3.22	4.27 ± 2.49	5 ± 2.9	1.221 (19)	.237
Parity, n (%)					
Nulliparous	3(20)	2(13.3)	5(16.7)	2.195 (2)	.388
Primiparous	6(40)	3(20)	9(30)		
Multiparous	6(40)	10(66.7)	16(53.3)		

3.2. Primary outcomes

The severity of depression at the beginning of the study (T0) was evaluated via both the HAM-D and MADRS administered by the PI, and the EPDS scales were filled out by the participants. No significant difference was found in the severity of depression between the two groups under any of the scales. Table 2 shows the primary outcome means at baseline and follow-up.

The interaction of treatment and time was statistically significant, according to EPDS score, indicating that reduction in depression scores was statistically significant in the BLT group compared with the placebo group during the intervention.

Weekly pairwise comparisons revealed that the BLT group had significantly lower depression scores than the placebo group at the end of the third week, according to EPDS.

There were also significant main effects of time for the BLT and placebo groups in all of the scales. This indicated that the reduction in depression scores by the effect of time was significant for both groups.

The MADRS and EPDS results demonstrated a statistically significant improvement with scores of 14.67 ($t(21) = 1.88$ $p = .022$) and 10.08 ($t(21) = 2.90$ $p = .009$) points, respectively, while the improvement in the placebo group was 7.36 and 4.82 points at the end of the third week. The total score change graphic in the groups is given inFig. 2a, 2b, 2c.

A reduction of at least 50% in scale scores was considered a "response" to treatment. While it was observed that the number of participants who responded to treatment in the BLT group, according to HAM-D, MADRS, and EPDS, was 7–9–5, it was 2–2–1 in the placebo group, respectively. Remission, which was determined as the number of people falling below the scales' cutoff values at the end of the study, occurred as 8–5–8 vs. 2–0–1 in the BLT and placebo groups, respectively, according to HAM-D, MADRS, and EPDS. Remission and response rates were both higher in the BLT group, and statistical significance was

Table 2
Mean outcome scores at weekly intervals.

	N	Baseline T_0	1st week T_1	2nd week T_2	3rd week T_3	Time effect
HAM-D						
BLT	12	19.83 ± 9.32	13.25 ± 9.04	13.75 ± 10.39	10.17 ± 9.61	*F(3, 33) = 12.91, p < .001**
Placebo	11	19.82 ± 6.32	15.55 ± 6.41	14.55 ± 6.35	14.09 ± 6.99	*F(1.5,15.3) = 8.74,p = .005**
t (df)/p		0.005(21), p = .996	−0.697(21), p = .494	−0.219(21), p = .829	−1.111(21), p = .279	
*Treatment*Time Interaction: F(3, 63) = 1.43, p = .241, partial η2 = 0.064*						
MADRS						
BLT	12	27.25 ± 8.72	18.67 ± 7.98	16.83 ± 11.66	12.58 ± 9.51	*F(3, 33) = 17.94, p < .001**
Placebo	11	26.18 ± 8.69	20.09 ± 8.53	17.82 ± 5.72	18.82 ± 5.72	*F(3, 30) = 8.65, p < .001**
t (df)/p		0.294(21), p = .772	−0.414(21), p = .683	−0.253(21), p = .803	−1.882(21), p = .074	
*Treatment*Time Interaction: F(3, 63) = 2.51, p = .067, partial η2 = 0.107*						
EPDS						
BLT	12	20.75 ± 4.59	15.75 ± 5.67	14.25 ± 7.41	10.67 ± 5.42	*F(3, 33) = 20.15, p < .001**
Placebo	11	22.18 ± 3.52	17.64 ± 5.82	17.09 ± 5.32	17.36 ± 5.01	*F(3, 30) = 5.14, p = .006**
t (df)/p		−0.833(21), p = .414	−0.787(21), p = .440	−1.047(21), p = .307	−3.071(21), p = .006**	
*Treatment*Time Interaction: F(3, 63) = 2.88, p = .043*, partial η2 = 0.121*						

Values are presented as mean ± *SD*.
*statistically significant difference ($p < .05$).
**statistically significant difference ($p < .05$) from placebo group at the same time point.

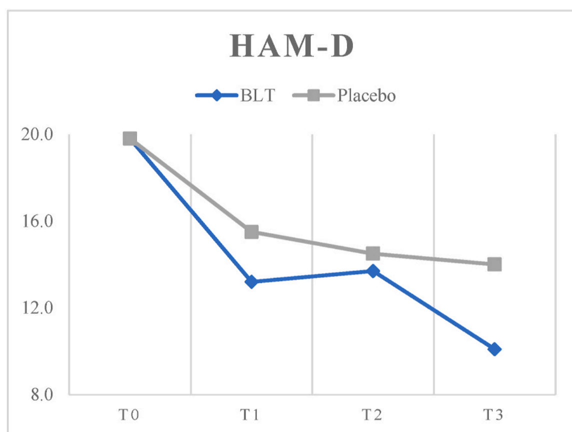

Fig. 2a. Overall change in primary outcome measures (HAM-D).

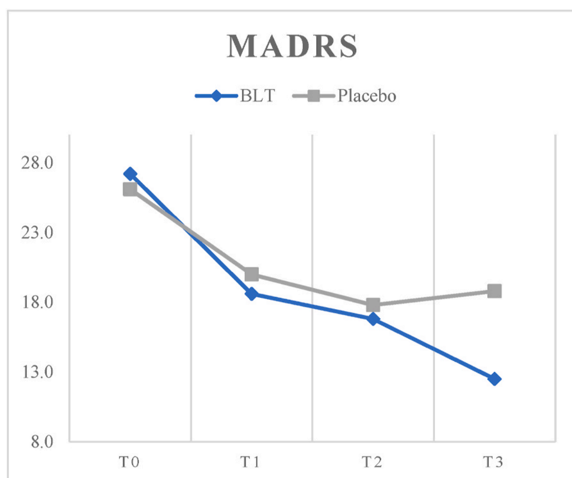

Fig. 2b. Overall change in primary outcome measures (MADRS).

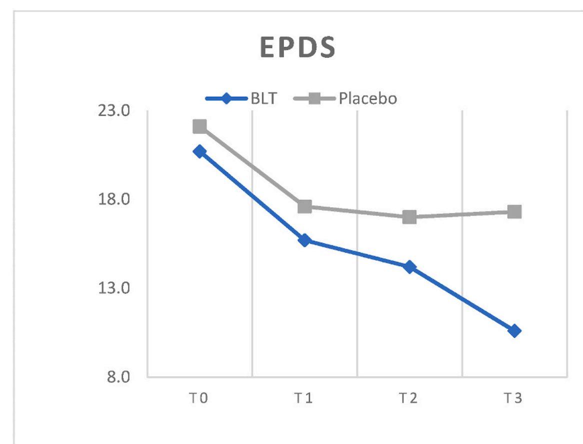

Fig. 2c. Overall change in primary outcome measures (EPDS).

Table 3
Response and remission rates.

		BLT (n = 12)	Placebo (n = 11)	χ^2(df)	p
Response n (%)	HAM-D % 50ꜜ	7 (58.3%)	2 (18.2%)	2.382 (1)	.123
	MADRS % 50ꜜ	9 (75.0%)	2 (18.2%)	7.425 (1)	**.006***
	EPDS %50ꜜ	5 (41.7%)	1 (9.1%)	1.695 (1)	.193
Remission n (%)	HAM-D <8	8 (66.7%)	2 (18.2%)	5.490 (1)	**.019***
	MADRS <10	5 (41.7%)	0 (0%)	5.856 (1)	**.016***
	EPDS <12	8 (66.6%)	1 (9.1%)	5.753 (1)	**.016***

* = statistically significant difference ($p < .05$).

Table 4
Changes in sleep quality.

PSQI	BLT (n = 12)	Placebo (n = 11)	t (df)	p*
Baseline, mean ± SD	7.2 ± 2	9 ± 2.8	−1.825 (21)	.082
T3, mean ± SD	5.25 ± 2.4	8.6 ± 2.5	−3.211 (21)	.004**
Score change between 0 and 3 weeks %, mean ± SD	−24.9 ± 28	−4.3 ± 10.4	−2.368 (14.2)	.033**

**statistically significant difference ($p < .05$).
**t*-test.

observed in all scales except in response in HAM-D and EPDS (see Table 3).

3.3. Secondary outcomes

3.3.1. Sleep quality

In total, 90% of the participants ($n = 27$) reported shorter sleep time during or after pregnancy. Changes in sleep quality were evaluated by using PSQI at baseline and at the end of the study. Sleep quality of the participants in the BLT group significantly increased. The change in the mean sleep quality scores of the participants is shown in Table 4.

3.3.2. Other factors

Since the effectiveness of BLT can vary in individuals with different chronotypes and due to seasonality, all participants were evaluated at the beginning of the treatment to show that the groups were homogenous in terms of seasonality and chronotype and to avoid any favoritism between the groups (Baldessarini et al., 2008; Dallaspezia et al., 2018). The Morningness–Eveningness Questionnaire (MEQ) was applied to assess the chronotype of the patients. Mean scores were not significantly different in the two groups (BLT (mean ± *SD*) 51.50 ± 4.9 placebo 50.27 ± 7.4, $p = .476$). In addition, according to the MEQ, three participants were found to be in the morning chronotype (BLT = 1, placebo = 2) and three in the evening chronotype (BLT = 1, placebo = 2). All remaining participants were of intermediate chronotypes. The seasonality of the participants was assessed according to the SPAQ. There was no significant difference between groups ($p = .49$). The mean score of the BLT group was 6.2 (±2.5), and the placebo group was 6.4 (±1.5). It was understood that none of the participants had SAD or the winter blues.

3.4. Adverse events

All the participants were asked weekly about the most common side effects (such as headache, visual disturbances, and nausea) via a checklist. Headache was the most frequently reported complaint throughout the study. Six of the participants in the BLT group reported headaches as a side effect; five completed the study expressing that it did not significantly affect their lives and that it was very mild; and only one participant could not tolerate it and dropped out of the study at the end of the second week. In the placebo group, one participant reported insomnia and one reported headache, which did not significantly affect their functionality. There was no significant difference between the groups in terms of side effects. Participants were followed weekly via the YMRS in terms of manic switches from the beginning of the treatment; none reported any signs of mania at any time point.

4. Discussion

In this randomized, controlled, double-blind study investigating the efficacy and safety of BLT in perinatal depression, we found that BLT applied in the morning for a period of three weeks was more effective than the placebo in terms of treatment response and remission rates, and side effects were similar to placebo.

The current literature contains very few studies investigating BLT in either pregnancy or postpartum depressive patients, and there is heterogeneity in the results. This is mainly due to the methodological differences in the administration of light and recruiting patients in various stages of the perinatal period. Most of our patients were in the postpartum period; however, the only other study conducted in the postpartum period included a total of 15 patients, and both active treatment and placebo groups improved by 49% with no statistical difference (Corral et al., 2007). Besides the duration of daily exposure and length of the intervention difference in the studies, relatively small sample sizes also limit the generalizability of the results. Although Bais et al. (2020) had the largest sample size among studies, they reported that nearly 50% of the participants in both groups missed six sessions, whereas none of the participants in our study reported any missing sessions. All of these factors may play a role in explaining the heterogenicity of the results.

When the score changes in depression scales were examined in our study, it was seen that the most striking change in both the BLT and placebo groups occurred during the first week. In the following weeks, this effect disappeared in the placebo group. BLT is a treatment method that acts faster than other treatment modalities, and the effect usually starts within the first days (Levitan, 2005). Thanks to its rapid onset of action, it is thought that light therapy is a more time-efficient solution for clinicians when compared with antidepressant treatments (Yorguner Kupeli et al., 2018).

Placebo light was set at <500 lux in our study. The difficulty of creating a valid placebo condition is one of the main difficulties in light treatment trials, and it is a limitation for blindness. Thus, 500 lux was considered low enough to be relatively inactive and viewed as a credible placebo at the same time. There is no clear evidence that demonstrates the antidepressant effect of light therapy alone at such low levels; however, 500 lux might have an impact on the placebo response. The antidepressant effect that was initially observed and then later disappeared in the placebo group might also be attributed to the placebo effect, which was the case in a previous randomized trial (Wirz-Justice et al., 2011). Some of the factors that could have played a role in the placebo effect might include people starting a new treatment and being evaluated by a health professional.

Available evidence suggests an association between sleep problems and maternal depression (Dennis and Ross, 2005). This was supported by our study where 90% of the participants reported shorter sleep times compared with that in the pre-perinatal period. The evaluations made by using the PSQI showed that the improvement in sleep quality of the BLT group at the end of the study was significantly higher than in the placebo group. The pregnancy and postpartum periods may also lead to reduced mobility, which results in more time spent indoors and less exposure to light. These factors can be amplified in the existence of PND, where fatigue and anhedonia are common symptoms (Ross et al., 2005). Moreover, there are reasons to suspect that women with PND might have circadian mal-synchronization (Parry et al., 2008). This can be an explanation for the effect of bright light that re-synchronizes the biological clock and circadian rhythm, and thus improves sleep quality, fatigue, and PND (Lam and Levitan, 2000; Pail et al., 2011; Shirani and St. Louis, 2009).

The average post-pregnancy period of the 21 patients in our study was five months. The DSM-5 defines perinatal depression as depression with its onset occurring during pregnancy or within the first four weeks postpartum. Although biological factors that affect mood in the postpartum period gradually decrease after giving birth, the first year after childbirth is full of psychosocial stressors. In addition, the available data suggest that the peak period of postpartum depression is the first six months after childbirth (Gaynes et al., 2005; O'hara and Swain, 1996; O'Hara and Wisner, 2014; Stuart-Parrigon and Stuart, 2014; Wisner et al., 2010). In line with the growing knowledge base regarding potential risks and the importance of early interventions in maternal mental health, the former designation of "postpartum depression"

evolved to "depressive disorder in the perinatal period," which extends from pregnancy to the postpartum first year (Austin, 2004). Therefore, it is more encompassing to include pregnancy and the postpartum first year when investigating the effect of depression in the perinatal period.

Our study indicated that BLT was similar to placebo in terms of side effects. Headache, which was mild and had no effect on participants' daily activities, was the most frequently reported side effect in both groups. As in our study, previous light therapy studies found the frequency of side effects in patients with bright light to be 6%–16%, and it was reported that these side effects mostly disappeared at the end of the first week (Terman and Terman, 2005). Since most of the participants were in the postpartum period and the relationship between postpartum depression and bipolar disorder is well known, one of the conditions that should be considered in light treatment is the presence of a risk of manic switch. This side effect was not encountered in our study. Also, as in our study, there was no manic switch in other studies on perinatal depression (Corral et al., 2007; Wirz-Justice et al., 2011).

The strengths of our study are as follows. It evaluated the efficacy and safety of BLT by including patients who were in the antenatal and postpartum periods. It was conducted in a double-blind and placebo-controlled design, and the results were evaluated based on different scales rated by the clinician and the patient at certain time points. Furthermore, changes in sleep quality were assessed concurrently with depressive symptoms.

A limitation of the study is its small sample size, mainly due to the difficulties in recruiting participants from this population. Treatment adherence poses a challenge in this population because of their specific circumstances (e.g., having a newborn, or being pregnant). Almost all of the patients who refused to participate stated that they would wish to participate if they had enough time every day. Also, the planned time schedule for the study did not allow us to recruit more participants.

Although the available data in the current literature suggest that the 3-week intervening period is sufficient for starting to see the antidepressant effect of light, we think that a longer duration may help to better demonstrate the effect of BLT, as the difference in depression scores was observed especially in the third week. A previous BLT study showed a statistically significant improvement trend after the fifth week, and significance was attained at the tenth week (Epperson et al., 2004). We may thus deduce that studies with longer durations may reveal the efficacy of BLT more clearly.

Our study has shown that BLT has superior efficacy to placebo, and it is safe in terms of side effects in PND. The perinatal patient population with well-known limitations and difficulties in treatment options seems to be an important target group that will benefit from BLT. BLT has not yet reached the place it deserves in the current treatment algorithms. Thus, for BLT to be more prevalently used in PND in the future, there is a need for new studies with larger scales and standardized applications.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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