**Supplementary Files**

**eFigure 1. Timeline of Intervention**

A screenshot of a cell phone

Description automatically generated

BLTL: Bright light therapy group; DRL: Dim red light group; TAU: Treatment as usual

**eTable 1. Light therapy and adherence in dim red light (DRL) and bright light therapy (BLT) groups, (mean ± standard deviation)**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Week 1 | Week 2 | Week 3 | Week 4 | Week 5 | Time effect | Group effect | Group\*time interaction |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  | p-valuea | | |
| Prescribed LT start  time, HH:MM | DRL  BLT | 10:35±02:27  10:32±02:17 | 10:30±02:23  10:17±02:14 | 10:00±02:23  09:53±02:01 | 9:45±02:09  09:33±01:52 | 09:32±02:01  09:30±01:50 | <0.001 | 0.59 | 0.54 |
| LT Start time recorded by sleep diary, HH:MM | DRL  BLT | 10:59±02:26  10:31±02:04 | 11:13±02:14  09:58±02:04 | 10:38±02:14  09:51±02:02 | 10:28±02:05  09:43±01:49 | 10:15±02:05  09:46±01:47 | <0.001 | 0.069 | 0.028 |
| Weekly total duration of light therapy, min (%) | DRL  BLT | 156 (74)  161 (76) | 141 (67)  162 (77) | 120 (57)  158 (75) | 129 (61)  147 (70) | 125 (59)  137 (65) | 0.021 | 0.16 | 0.14 |
| Weekly appropriately-  timed LTb , min (%) | DRL  BLT | 99 (47)  130 (62) | 96 (46)  104 (50) | 70 (33)  95 (45) | 84 (40)  84 (40) | 74 (35)  78 (37) | 0.001 | 0.20 | 0.24 |

a By linear mixed model; b Weekly appropriately-timed LT was defined as “total duration of light therapy carried out over the past treatment week that overlap with or earlier than the prescribed light therapy time”.

**eTable 2. Sensitivity analysis**

**Comparison of secondary outcomes between the dim red light (DRL) and bright light therapy (BLT) group in participants who had total duration of LT performed >50% of the total 5-week treatment duration (mean ± standard deviation)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| N=70 |  | Baseline | Week1 | Week2 | Week3 | Week4 | Week5 | Post-1w | Post-1m | Post-2m | Post-5m | | Time effect | Group  effect | Time x Group interaction |
|  |  |  |  |  |  |  |  |  |  |  |  | | p-valuea | | |
| HAM-A | DRL | 23.2±10.6 | 20.4±11.4 | 17.8±10.4 | 20.5±11.1 | 19.3±10.2 | 18.4±9.8 | 18.5±11.3 | 20.3±10.8 | 20.5±11.9 | 18.3±11.4 | | 0.001 | 0.055 | 0.32 |
| BLT | 20.5±11.9 | 19.4±11.2 | 14.4±11.6 | 14.7±10.6 | 15.7±10.8 | 14.8±10.4 | 13.6±9.1 | 13.1±9.0 | 16.4±10.6 | 16.6±10.8 | |  |  |  |
| HADS | DRL | 22.6±6.6 | 22.3±6.8 | 22.8±7.2 | 22.1±6.6 | 20.8±7.5 | 20.4±7.2 | 21.6±7.5 | 22.3±8.3 | 21.9±7.6 | 22.2±7.3 | | <0.001 | 0.004 | 0.10 |
| BLT | 20.3±5.8 | 19.0±7.7 | 18.5±6.6 | 18.0±7.6 | 16.8±7.8 | 16.8±7.7 | 16.4±7.8 | 15.7±7.5 | 16.2±7.6 | 17.9±8.7 | |  |  |  |
| ISI | DRL | 17.7±5.2 | 18.1±6.2 | 17.1±5.4 | 16.6±6.5 | 15.9±6.9 | 16.6±7.0 | 16.3±7.7 | 16.2±6.4 | 15.7±6.5 | 16.1±7.0 | | 0.008 | 0.224 | 0.092 |
| BLT | 17.7±5.8 | 17.0±5.8 | 15.8±6.2 | 14.8±5.6 | 15.5±5.5 | 13.7±6.5 | 14.1±6.2 | 13.1±6.2 | 14.7±6.6 | 13.7±5.6 | |  |  |  |
| BSSI | DRL | 11.3±7.1 | 10.3±7.0 | 9.7±6.9 | 10.4±6.7 | 9.4±6.2 | 8.5±6.5 | 10.2±6.7 | 8.9±6.6 | 9.4±6.9 | 9.0±6.5 | | <0.001 | 0.925 | 0.13 |
|  | BLT | 12.3±5.4 | 10.8±5.7 | 10.4±5.5 | 9.1±5.7 | 8.8±5.8 | 8.6±6.1 | 8.7±5.9 | 8.5±6.6 | 8.6±5.9 | 9.6±5.9 | |  |  |  |
| CFS | DRL | 21.2±6.1 | NA | NA | NA | NA | 18.9±7.8 | NA | 19.3±7.2 | 18.7±7.5 | 18.8±7.8 | | 0.001 | 0.100 | 0.075 |
|  | BLT | 20.7±6.6 |  |  |  |  | 16.6±7.3 |  | 14.9±6.5 | 17.4±7.4 | 15.6±5.9 | |  |  |  |
| SF-36 | DRL | 245±103 | NA | NA | NA | NA | 270±114 | NA | 273±156 | 268±128 | 276±145 | 0.016 | | 0.007 | 0.28 |
|  | BLT | 313±108 |  |  |  |  | 367±147 |  | 341±130 | 331±142 | 357±158 |  | |  |  |
| YMRS | DRL | 0.8±1.6 | 0.9±1.5 | 0.6±1.3 | 0.8±1.4 | 0.8±1.3 | 0.9±1.7 | 0.9±2.2 | 0.6±1.4 | 1.1±2.6 | 1.1±2.0 | | 0.635 | 0.815 | 0.89 |
| BLT | 0.9±1.6 | 0.6±1.1 | 0.7±2.2 | 0.7±1.6 | 0.7±1.3 | 1.1±2.7 | 0.8±1.1 | 0.7±1.2 | 0.8±1.1 | 0.7±1.6 | |  |  |  |

a By Linear mixed model

NA: CFS and SF-36 enquires symptoms over the past 1 month, thus were administered at the baseline, fifth treatment week, P1m, P2m, and P5m only

Abbreviations: HAM-A: Hamilton Anxiety Rating Scale; HADS: Hospital Anxiety Depression Scale; ISI: Insomnia Severity Index; BSSI: Beck Scale for Suicidal Ideation; CFS: Chadler Fatigue Scale; SF-36: 36-item Short Form Health Survey ; YMRS: Young Mania Rating Scale

**eTable 3. Summary of sleep parameters by sleep diary (mean ± standard deviation)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| N=93 |  | Baseline | Week1 | Week2 | Week3 | Week4 | Week5 | Post-1w | Post-1m | Post-2m | Post-5m | Time effect | Group  effect | Time x Group interaction |
|  |  |  |  |  |  |  |  |  |  |  |  | p-valuea | | |
| Bedtime, | DRL | 01:25±01:58 | 01:27±01:51 | 01:23±01:58 | 01:24±01:58 | 01:19±02:02 | 01:17±01:48 | 01:10±01:49 | 01:03±01:32 | 01:23±02:18 | 00:16±01:30 | 0.003 | 0.42 | 0.25 |
| HH:MM | BLT | 01:18±01:38 | 01:11±01:32 | 01:13±01:47 | 01:07±01:26 | 00:59±01:17 | 00:58±01:06 | 00:59±01:32 | 01:07±01:22 | 01:15±01:34 | 01:13±01:34 |  |  |  |
| Time to fall  sleep, HH:MM | DRL | 02:01±01:56 | 02:02±01:47 | 02:04±01:53 | 01:57±01:53 | 01:42 ±01:53 | 01:47±01:50 | 01:41±01:43 | 01:35±01:35 | 02:00±02:10 | 00:53±01:29 | 0.009 | 0.21 | 0.25 |
| BLT | 01:55±01:29 | 01:41±01:25 | 01:41±01:34 | 01:35±01:23 | 01:25±01:25 | 01:20±01:10 | 01:23±01:33 | 01:34±01:32 | 01:39±01:31 | 01:40±01:28 |  |  |  |
| Wake time,  HH:MM | DRL | 09:32±02:22 | 09:45±02:31 | 09:33±02:17 | 09:22±02:24 | 09:20±02:15 | 09:22±02:28 | 09:15±02:09 | 09:03±02:00 | 09:04±01:52 | 08:46±01:50 | 0.150 | 0.66 | 0.64 |
| BLT | 09:33±02:20 | 09:22±02:17 | 09:21±02:05 | 09:21±02:03 | 09:13±01:39 | 09:09±01:36 | 09:32±01:47 | 09:39±01:58 | 09:39±01:42 | 09:19±01:56 |  |  |  |
| Rise time, HH:MM | DRL | 10:24±02:03 | 10:19±02:25 | 09:57±02:08 | 09:52±02:17 | 09:46±02:19 | 09:45±02:23 | 09:36±02:08 | 09:32±01:51 | 09:25±01:50 | 09:14±01:45 | 0.009 | 0.97 | 0.66 |
| BLT | 10:25±02:04 | 10:07±02:00 | 09:57±01:50 | 09:51±01:53 | 09:34±01:33 | 09:35±01:27 | 10:06±01:39 | 10:13±01:52 | 10:11±01:34 | 09:59±01:49 |  |  |  |
| Time in bed, | DRL | 08:58±01:36 | 08:51±01:57 | 08:33±01:37 | 08:27±01:32 | 08:26±01:25 | 08:31±01:38 | 08:26±01:32 | 08:30±01:35 | 08:01±02:12 | 08:58±02:04 | 0.057 | 0.16 | 0.57 |
| HH:MM | BLT | 09:07±01:44 | 08:55±01:27 | 08:44±01:27 | 08:44±01:30 | 08:35±01:06 | 08:36±01:10 | 09:09±01:39 | 09:05±01:57 | 08:55±01:19 | 08:47±01:32 |  |  |  |
| WASO, | DRL | 00:32±00:38 | 00:27±00:29 | 00:21±00:30 | 00:21±00:28 | 00:18±00:23 | 00:15±00:17 | 00:17±00:18 | 00:19±00:20 | 00:16±00:19 | 00:16±00:21 | 0.001 | 0.99 | 0.85 |
| HH:MM | BLT | 00:32±00:38 | 00:26±00:36 | 00:26± 00:34 | 00:25±00:39 | 00:19±00:38 | 00:22±00:34 | 00:19±00:25 | 00:15±00:15 | 00:16±00:22 | 00:16±00:17 |  |  |  |
| Actual sleep | DRL | 07:31±01:38 | 07:51±01:52 | 07:38±01:42 | 07:30±01:38 | 07:34±01:25 | 07:38±01:46 | 07:37±01:29 | 07:31±01:37 | 07:37±01:31 | 07:58±02:21 | 0.008 | 0.48 | 0.36 |
| duration, HH:MM | BLT | 07:43±01:36 | 07:45±01:26 | 07:46±01:28 | 07:49±01:34 | 07:54±01:19 | 07:47±01:24 | 08:14±01:16 | 08:13±02:00 | 08:03± 01:13 | 07:40± 01:25 |  |  |  |
| Sleep efficiency | DRL | 0.84 ± 0.12 | 0.89 ± 0.12 | 0.89 ± 0.11 | 0.88 ± 0.09 | 0.90 ± 0.08 | 0.89 ± 0.08 | 0.91 ±0.12 | 0.89 ± 0.10 | 0.87± 0.13 | 0.89 ± 0.07 | 0.001 | 0.60 | 0.54 |
| BLT | 0.85 ± 0.11 | 0.87 ± 0.11 | 0.90 ± 0.15 | 0.89 ± 0.11 | 0.92 ± 0.10 | 0.90 ± 0.10 | 0.91 ±0.16 | 0.91 ± 0.12 | 0.90± 0.09 | 0.88 ± 0.12 |  |  |  |
| Sleep | DRL | 05:46±02:01 | 05:50±01:58 | 05:44±01:51 | 05:38±02:00 | 05:22±01:48 | 05:25±01:47 | 05:17±01:46 | 05:16±01:37 | 05:27±01:48 | 04:46±01:14 | 0.021 | 0.61 | 0.59 |
| midpoint,HH:MM | BLT | 05:44±01:47 | 05:28±01:42 | 05:29±01:47 | 05:27±01:34 | 05:17±01:23 | 05:14±01:13 | 05:25±01:33 | 05:33±01:24 | 05:42±01:36 | 05:31±01:39 |  |  |  |

a By Linear mixed model

**eTable 4. Treatment-emergent adverse events from dim red light (DRL) and bright light therapy (BLT) groups** **(Percentages)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Side effect | Group | Intervention Period | | | | |
|  |  | Week 1 | Week 2 | Week 3 | Week 4 | Week 5 |
| Eye irritation | DRL | 0 | 0 | 6 | 6 | 6 |
| BLT | 0 | 0 | 5 | 0 | 0 |
| Excessive tears | DRL | 0 | 6 | 11 | 9 | 9 |
| BLT | 0 | 0 | 3 | 3 | 3 |
| Eye grittiness | DRL | 0 | 6 | 11 | 6 | 9 |
| BLT | 0 | 0 | 3 | 0 | 6 |
| Blurring of vision | DRL | 5 | 14 | 6 | 14 | 18\* |
| BLT | 2 | 3 | 5 | 3 | 3 |
| Dry eye | DRL | 5 | 6 | 8 | 3 | 6 |
| BLT | 2 | 0 | 3 | 3 | 0 |
| Nausea | DRL | 0 | 3 | 3 | 6 | 3 |
| BLT | 0 | 5 | 5 | 3 | 6 |
| Vomiting | DRL | 2 | 0 | 3 | 0 | 0 |
| BLT | 2 | 3 | 0 | 3 | 0 |
| Headache | DRL | 7 | 14 | 6 | 9 | 9 |
| BLT | 7 | 8 | 3 | 3 | 9 |
| Fatigue | DRL | 17 | 11 | 11 | 11 | 18 |
| BLT | 7 | 5 | 8 | 8 | 6 |
| Loss of appetite | DRL | 7 | 8 | 6 | 6 | 6 |
| BLT | 2 | 5 | 5 | 5 | 3 |
| Chest discomfort | DRL | 12 | 8 | 6 | 0 | 3 |
| BLT | 2 | 5 | 8 | 5 | 6 |
| Anxiety | DRL | 5 | 8 | 6 | 9 | 12 |
| BLT | 2 | 0 | 3 | 3 | 6 |
| Restlessness | DRL | 12\* | 11 | 11 | 6 | 9 |
| BLT | 0 | 5 | 5 | 5 | 6 |
| Sleepiness | DRL | 10 | 8 | 11 | 9 | 6 |
| BLT | 14 | 8 | 11 | 11 | 6 |
| Dizziness | DRL | 8 | 5 | 6 | 6 | 12 |
| BLT | 2 | 2 | 11 | 5 | 6 |

\* p<0.05 by Fisher exact test or Chi Square test

Previous presentation: Part of the study has been presented as an abstract in the World Sleep 2019, Vancouver, Canada, September 20–25, 2019.

Chan W.Y.J., Zhang J., Li X.S., Lam S.P, Chan N.Y., Yu W.M.M., Wing Y.K. Adjunctive light treatment in major depressive disorder patients with evening chronotype – a randomized controlled trial. Sleep Medicine, Volume 64, Supplement 12019, Pages S61-S62.