Shedding Light on SAD: The Effects of Light Therapy in the Treatment of Seasonal Affective Disorder

Claire Kim* and Rayhan Pitigala*

*Interdisciplinary School of Health Sciences, University of Ottawa, Ottawa, Ontario, Canada

Abstract

Background: Seasonal Affective Disorder (SAD) consists of recurrent depressive episodes in the fall/winter with summer remission and symptoms that include hypersomnia, fatigue, increased appetite for carbohydrates, weight gain. The estimated prevalence of SAD is 1.7-2.9% in Canada and is most common in women of reproductive age. Light therapy (LT) is an effective, evidence-based treatment for SAD, despite economic and lifestyle burdens. There is a critical need to better understand and evaluate current LT application to determine an optimal treatment strategy for SAD in the future. **Objective:** To explore the relevant literature regarding the efficacy and physiological and behavioural impacts of light therapy in the treatment of Seasonal Affective Disorder among the Canadian adult population. **Methodology:** Relevant literature was identified using key terms "Seasonal Affective Disorder" and "Phototherapy" or "Light therapy" to search four online databases PubMed, PsycINFO, Web of Science, and Scopus. Results were limited to Canadian publications from 2006 and only included English journal articles, clinical trials, meta-analyses, RCTs, and systematic reviews. Titles and abstracts were evaluated for relevancy to the objective and inclusion criteria; 7 articles based on Canadian study populations were then subject to analysis. **Results:** The results were categorized into three themes (efficacy of LT, physiological effects, and behavioural effects) and indicated that LT is an effective treatment option for SAD, normalizing physiological SAD symptoms and decreasing SIGH-SAD scores. **Conclusions:** LT is an effective treatment for SAD with physiological and behavioural effects. Further research needs to establish Canadian incidence and morbidity statistics, in addition to indicators/biomarkers for SAD diagnosis and links to symptomatology. Future studies should compare different SAD therapies and develop a standard for efficient LT with long-term and preventative applications as well as optimal compliance.

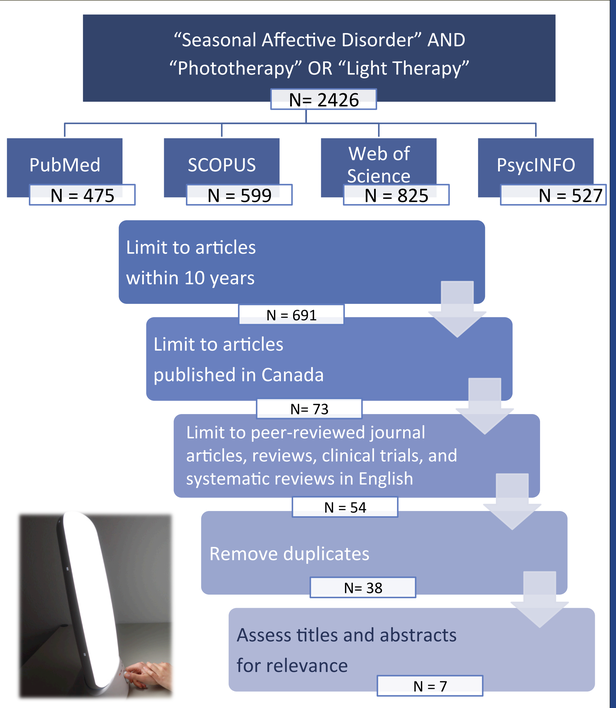
Background

First systematically described in 1984, Seasonal Affective Disorder (SAD) is a subtype of Major Depressive Disorder that consists of recurrent depressive episodes in the fall/winter with summer remission[1,2] and symptoms that include hypersomnia, fatigue, increased appetite for carbohydrates, weight gain, and loss of interest in socialization.[3,4] SAD patients also have significant morbidity and psychosocial impairment.[5] Although SAD etiology is currently unknown,[4,5] the estimated prevalence of SAD is 1.7-2.9% in Canada[5] and 0.4%-9.7% in North America.[3] Most common in women of reproductive age,[3] SAD prevalence increases with greater latitude.[6] Light therapy (LT) is an effective first-line evidence-based treatment for SAD,[2,6] although it presents economic and lifestyle burdens.[7,8] There is a critical need to better understand and evaluate current LT application to determine an optimal treatment strategy for SAD in the future.

Objective

To explore the relevant literature regarding the efficacy and physiological and behavioural impacts of light therapy in the treatment of Seasonal Affective Disorder among the Canadian adult population.

Methodology



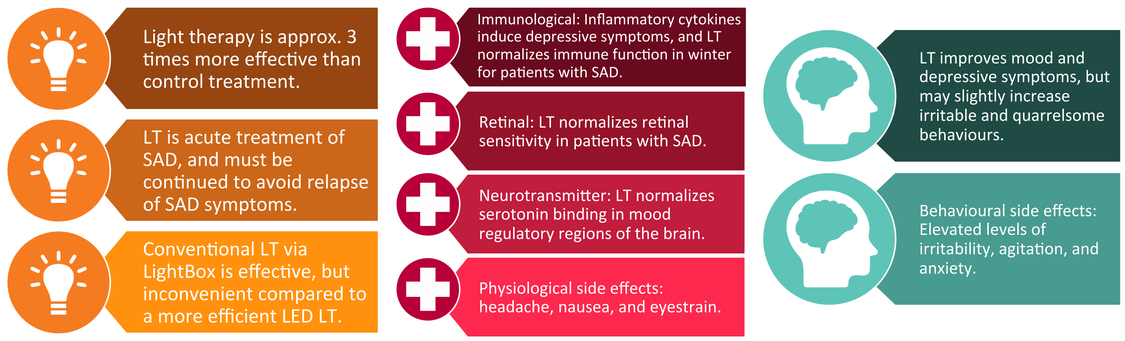
Results

Table 1. Summary of analyzed Seasonal Affective Disorder (SAD) studies. The objective, sample size, study design, and key findings in regards to light therapy (LT) of each analyzed study were summarized and evaluated for comparison. Relevant studies were extracted from online databases PubMed, Scopus, Web of Science, and PsycINFO and only studies in the English language pertaining to Canadian populations and published in Canada between 2006 and 2016 were included.

Study	Objective	Sample Size	Study Design	Key Findings
Desan et al[8]	To determine whether LEDs are a more convenient and effective mode of LT for SAD than standard LightBox Therapy.	N = 23	Randomized, double-blind, placebo-controlled, multicenter trial	30 minutes of daily Litebook LED exposure is efficacious treatment of SAD. Mean SIGH-SAD scores were significantly lower for the experimental group than the control group.
Hsu et al[3]	To determine the influence of LT on interpersonal behavior and its effect in people with mild to moderate seasonality.	N = 38	Cross-Over study	Three weeks of LT improved mood, but also slightly increased irritable and quarrelsome behaviours and decreased submissiveness.
Lavoie et al[1]	To investigate a biological effect of LT on the retina of patients with SAD.	N = 38	Clinical trial; retinal sensitivity measured by ERG	Patients with SAD showed significantly lower retinal sensitivity compared with healthy participants. After 4 weeks of LT, retinal function was normalized.
Song et al[4]	To investigate if the shorter photoperiod of winter leads to an increase in SAD-inducing, pro-inflammatory cytokines and whether LT will normalize these immune changes.	N = 41	Clinical trial	Inflammatory response in winter was higher in SAD patients. The shorter photoperiod in winter, mediated by increased melatonin, enhances inflammatory response and induces seasonal depression. LT normalized immune functions and depressive symptoms, suggesting immunomodulatory role of LT in SAD.
Tyrer et al[6]	To investigate the effect of LT on serotonin transporter binding in the anterior cingulate and prefrontal cortices in SAD during winter.	N = 11	Clinical trial; serotonin binding measured by PET	Winter increase in serotonin binding is a biomarker of SAD in the brain. Serotonin transporter binding was significantly reduced in the anterior cingulate cortex and prefrontal frontal cortex (mood regulation regions of brain) following LT in SAD.
Westrin & Lam[5]	To investigate literature relating to long-term and prophylactic treatment of SAD.	N = 46	Systematic review	Few studies study the effect of LT for more than 8 weeks (long-term treatment). Lack of evidence that a brief course of LT can prevent relapse, therefore LT should be continued throughout the winter season and discontinued during spring and summer.
Westrin & Lam[2]	To investigate studies relating to clinical management of SAD.	N = 68	Literature review	Odds ratio = 2.83 and effect size = 0.83 when comparing treatment response of LT vs. control group. LT therapeutic onset is rapid (1-2 weeks), but may be longer for clear response. Most SAD patients relapse upon LT discontinuation.

Thematic Analysis

Figure 1. Thematic analysis of analyzed Seasonal Affective Disorder (SAD) studies. The outcomes of the summarized studies (please refer to **Table 1**) were categorized into three themes: [1] Light Therapy (LT) efficacy; [2] Physiological effects of LT; [3] Behavioural effects of LT.



Discussion

- This study investigated the Canadian literature pertaining to LT treatment of SAD and conducted a thematic analysis of the efficacy, physiological effects, and behavioural impacts of LT.
- Past research has established that LT is an effective treatment for SAD, therefore more current studies are focused on establishing the biological mechanisms for SAD treatment and SAD etiology.
- The Canadian articles included in this study identify novel physiological mechanisms to inform more accurate and targeted approaches to LT delivery, but do not conclusively determine a link between the mechanisms and depressive symptoms. It is evident in the thematic analysis that the breadth of articles were more dense regarding physiology and less so for behavioural aspects including the outward symptoms of SAD.
- The results are consistent with what is known in the Canadian context, but also identifies novel biomarkers and suggests critiquing the status quo modes of LT delivery in order to optimize future treatment.
- The limitations of this study are the inclusion of only Canadian publications and study populations (which excluded international SAD and LT research data) and the exclusion of all articles not written in English. Small sample sizes of clinical trials is also a limitation of the studies that were reviewed.

Conclusion

Though the efficacy of LT in treating SAD has been established, current research is aimed towards identifying physiological mechanisms to better understand and optimize targeted application of LT. This study examined the most current Canadian data to understand LT as the first-line treatment for SAD, which is a prevalent condition in Canada. This study found that most of the Canadian research is focused on physiological implications, behavioural impacts, and efficacy of comparative modes of light therapy.

Future Directions

- Establishment of a conclusive pathophysiological mechanism for the etiology of SAD due to shorter photoperiods at greater latitudes
- Identification of SAD incidence and morbidity statistics (QALYs, DALYs) in Canada, as well as other indicators and biomarkers for SAD diagnosis and progression
- Further links between LT effects and SAD symptomatology
- Comparison between different SAD therapies (LT vs. pharmacotherapy vs. cognitive behavioural therapy)
- Development of a standard for effective LT treatment (duration and intensity)
- Research of long-term and preventative applications of LT as well as optimal adherence and compliance

Acknowledgements

We would like to acknowledge and extend our gratitude to our professor, Dr. James Gomes; our TA, Alexander Maisonneuve; the Canadian Society for Epidemiology and Biostatistics; the Interdisciplinary School of Health Sciences at the University of Ottawa.

References

1. Lavoie, M. P., Lam, R. W., Bouchard, G., Sasseville, A., Charron, M. C., Gagne, A. M., . . . Hebert, M. (2009). Evidence of a Biological Effect of Light Therapy on the Retina of Patients with Seasonal Affective Disorder. Biological Psychiatry, 66(3), 253-258. doi:10.1016/j.biopsych.2008.11.020
2. Westrin, Å., & Lam, R. W. (2007). Seasonal affective disorder: A clinical update. Annals of Clinical Psychiatry, 19(4), 239-246. doi:10.1080/10401230701653476
3. Hsu, Z. Y., Moskowitz, D. S., & Young, S. N. (2014). The influence of light administration on interpersonal behavior and affect in people with mild to moderate seasonality. Prog Neuropsychopharmacol Biol Psychiatry, 48, 92-101. doi:10.1016/j.pnpbp.2013.09.004
4. Song, C., Luchtman, D., Kang, Z., Tam, E. M., Yatham, L. N., Su, K. P., & Lam, R. W. (2015). Enhanced inflammatory and T-helper-1 type responses but suppressed lymphocyte proliferation in patients with seasonal affective disorder and treated by light therapy. J Affect Disord, 185, 90-96. doi:10.1016/j.jad.2015.06.003
5. Westrin, Å., & Lam, R. W. (2007). Long-term and preventative treatment for seasonal affective disorder. Cns Drugs, 21(11), 901-909. doi:10.2165/00023210-200721110-00003
6. Tyrer, A. E., Levitan, R. D., Houle, S., Wilson, A. A., Nobrega, J. N., Rusjan, P. M., & Meyer, J. H. (2016). Serotonin transporter binding is reduced in seasonal affective disorder following light therapy. Acta Psychiatrica Scandinavica, 134(5), 410-419. doi:10.1111/acps.12632
7. Cheung, A., Dewa, C., Michalak, E. E., Browne, G., Levitt, A., Levitan, R. D., . . . Lam, R. W. (2012). Direct health care costs of treating seasonal affective disorder: A comparison of light therapy and fluoxetine. Depression Research and Treatment, 2012. doi:10.1155/2012/628434
8. Desan, P. H., Weinstein, A. J., Michalak, E. E., Tam, E. M., Meesters, Y., Ruiter, M. J., . . . Lam, R. W. (2007). A controlled trial of the litebook light-emitting diode (LED) light therapy device for treatment of Seasonal Affective Disorder (SAD). BMC Psychiatry Vol 7 2007, ArtID 38, 7. doi:10.1186/1471-244X-7-38