

Seasonal Affective Disorder and Circadian Rhythms: Do You Get the Wintertime Blues?

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Introduction

It's late November, coming up to exams, you have early morning classes, and you won't be finished until 7 p.m. It's still dark when you drag yourself out of bed in the morning, and the moon is high when you leave school that night. "Where did the day go?" you ask yourself when you get home, not having seen a sliver of sunlight that day; you know the next day will be the same (see photo A and B). How do you feel? If you're depressed, have no energy, want to sleep all the time, and are putting on weight because you just can't seem to stop eating, you may have a case of the wintertime blues. For some, the onset of winter brings on a period of depression called **seasonal affective disorder (SAD)**. Females of childbearing age appear to be the most susceptible population. The severity of the symptoms ranges from feeling a little down to major depression, and in most cases the symptoms disappear completely in the spring and summer months. What is it about the winter that triggers SAD? Other than temperature, the obvious difference between the summer and winter is the length of the day (at least, away from the equator). It is no surprise that SAD is most prevalent (affecting 2 to 5 percent of the population) in places where the change in day length from summer to winter is most pronounced. What is the relationship between the length of the day and physiological processes that can lead to feelings of depression?

KEY CONCEPTS

- The change in day length in the winter can trigger changes in brain function.
- Circadian rhythms are affected by day length.

Abnormalities of Circadian Rhythms Lead to the Development of SAD

Daily rhythms known as **circadian rhythms** play a prominent role in everything from sleep-wake cycles, body temperature, and hormone release, to cognition, attention, and mood. These rhythms cycle independently roughly every 24 hours. However, their cyclic activity is strongly influenced by a molecular clock that uses environmental cues, such as light, to determine the period of the cycle. The master biological molecular clock is a group of neurons in the hypothalamus in the **suprachiasmatic nucleus (SCN)**. Photoreceptors in the eyes convey information about the amount of light in the surroundings by sending neural signals to SCN neurons. Light information regulates the expression of various clock genes in SCN cells, causing protein transcription to be

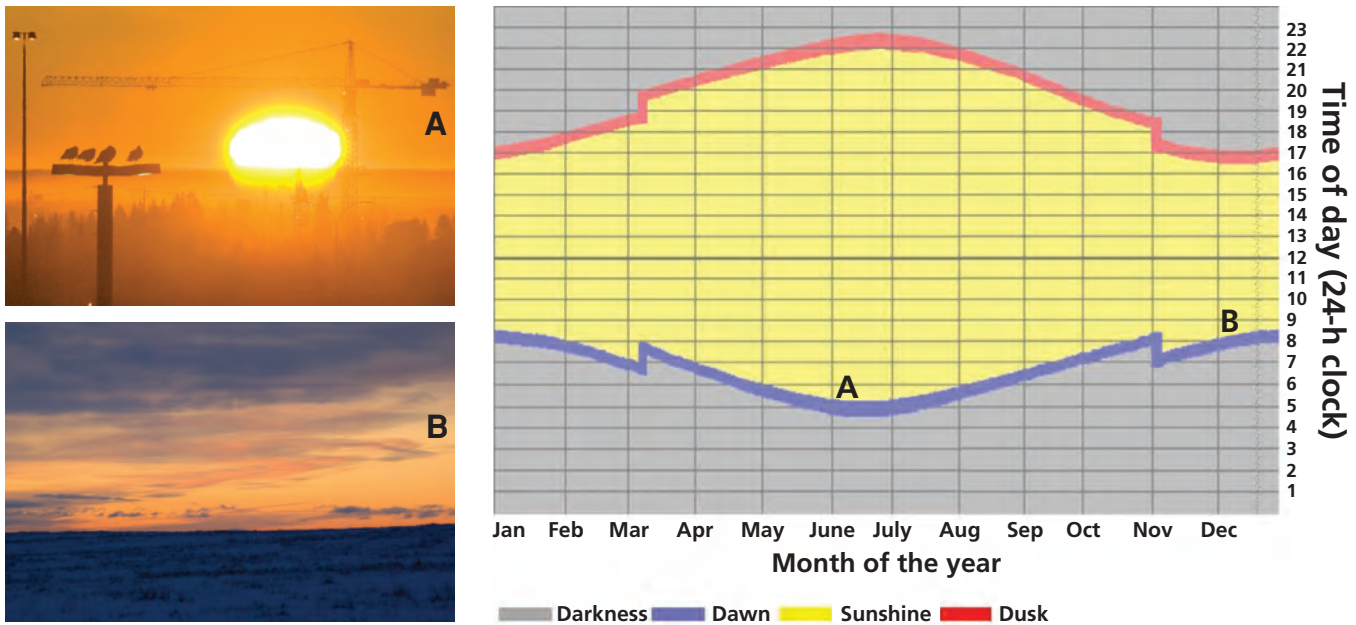


FIGURE 1. The change in day length from summer to winter in Calgary, Alberta.

The graph shows the approximate time of the sunrise and sunset in Calgary throughout the year. The photographs were taken in and near Calgary at (A) 6:30 a. m. at the beginning of June and (B) at 8:15 a. m. in early December. They clearly show the delayed onset of the dawn during the winter months.

Source: Photos by Dr. Evelyn Field. Graph based on <http://www.gaisma.com/en/graphicalcalgary/png>, accessed December 16, 2009.

turned on or off. This allows the SCN to function as the pacemaker for biological cycles, synchronizing the cycles to the length of the day.

Serotonin, dopamine, and norepinephrine are the major neurotransmitters that regulate mood. They all exhibit a circadian pattern in which their levels fluctuate according to the time of day. An abnormality in the circadian rhythm alters the normal levels of these neurotransmitters. In fact, the disruption of circadian cycles has been implicated in a number of mood disorders, including SAD, and these disorders all benefit from treatments that affect circadian cycles.

SAD arises from the failure of the circadian cycles to properly adapt to the change in the length of the day as the seasons progress. One hypothesis, called the circadian phase-shift hypothesis, proposes that the later onset of dawn during the winter causes the disruption of circadian rhythms (see Figure 1).

Treatments for SAD

Light Therapy

Light therapy is the most common treatment for SAD, and many people report a substantial improvement in mood and energy after only a few treatments. This treatment is more beneficial when used early in the morning than later in the day. If the delayed onset of the dawn is causing the phase delay in the circadian rhythm, the phase-shift hypothesis, then this result is exactly what you would expect. Therefore, mimicking dawn with bright light in the morning alleviates the symptoms by helping to shift circadian patterns.

To treat SAD effectively, it is important to use a light that has some of the same properties as natural sunlight. Specific types of lights have been manufactured to satisfy

the requirements, and other lights may not have the appropriate brightness or the correct ultraviolet filtration. The optimal regimen appears to be sitting in front of the light for half an hour a day before 8 a.m. Because of the seasonal nature of the symptoms, this treatment need be used only when the symptoms appear. It is not used as a preventative measure.

Intriguingly, even people who do not report any symptoms of SAD benefit from improved mood, energy, and alertness when they are given light treatments. Some companies in Finland, which has a particularly high rate of SAD, have applied this observation in the workplace. From November to February, these companies provide bright-light treatments for all their employees, regardless of whether they have SAD, and the businesses report improvements in mood and productivity in *all* their workers.

Although light therapy helps many people, its success varies. People who experience complete withdrawal of symptoms in the summer months are the most likely to benefit from light therapy. In contrast, people who have chronic forms of depression and do not experience summer remission may not see as much improvement. Most people tolerate light therapy very well, though headache, nausea, and agitation are the most common side effects.

Antidepressants

Treatments for SAD also include the use of antidepressants. Mood disorders, such as depression, bipolar disorder, and SAD, are characterized by irregular levels of neurotransmitters, an effect linked to altered circadian rhythms. Commonly used antidepressants, such as lithium and fluoxetine, have been shown to alter the circadian period. A Canadian study in 2006 found no difference in the effectiveness of light therapy or antidepressants over eight weeks of treatment for SAD (see Figure 2). However, light therapy may be preferable because it generally has fewer side effects than antidepressants.

Currently, light therapy and antidepressants are the most effective treatments for SAD. Other treatment methods have had mixed results. Exercise, for instance, shows mood-enhancing effects for people with SAD. People reported feeling happier, having more vitality, and being more productive following an exercise period in the middle of the workday. Doing exercise in bright light enhanced these benefits even further, but the question then is whether these effects were due to the exercise or exposure to light, or if a break from work in the afternoon makes everyone happy!

Conclusions

Advances in the treatment of mood disorders are certain to occur as new antidepressants arrive on the market. But with effective treatments as simple as light and exercise available, perhaps pharmaceuticals should not always be the first line of defence. The next time you are on your way to class on another dark winter day, keep in mind that a mid-morning stroll outside might do your brain more good than staying inside to study without a break.

Critical Thinking Questions

1. What makes SAD different from other types of depression? What are the similarities?
2. How does light therapy work in the treatment of SAD?
3. Why might mood disorders other than SAD be treatable with light therapy?

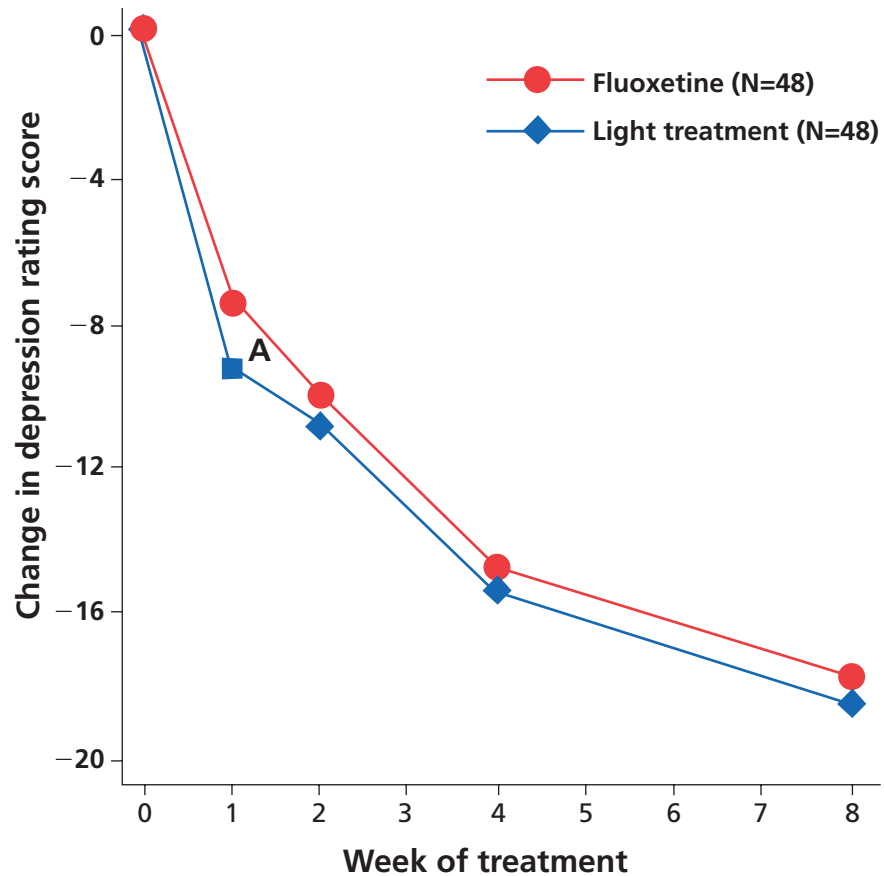


FIGURE 2. Treatment with light therapy or the antidepressant fluoxetine improves the depression rating scores in patients with SAD.

This graph shows that depression ratings start to improve soon after starting treatment with either fluoxetine or light therapy. At point A in the figure, light therapy provided significantly greater improvement than fluoxetine, but overall, there is no difference between the two therapies. Depression was measured by using the Hamilton Depression Scale, a questionnaire that measures the severity of depression symptoms and is commonly used in research to evaluate the effectiveness of depression treatments.

Source: Adapted from: Lam RW, Levitt AJ, Levitan RD, Enns MW, Morehouse R, Michalak EE, Tam EM. 2006. The Can-SAD study: a randomized controlled trial of the effectiveness of light therapy and fluoxetine in patients with winter seasonal affective disorder. *American Journal of Psychiatry* 163 (May): 805–812, Fig. 2, p. 809. Permission conveyed through Copyright Clearance Center, Inc.

Further Research Question

Other treatments for SAD include vitamin D and melatonin supplements. Why might these be considered viable targets? What is the current thinking about their effectiveness as treatments?

References

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