Seasonal depression pattern influenced more by location, daily shifts in sunlight than average seasonal changes

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In Nashville, the shortest day of the year has 9 hours and 41 minutes of sunlight, while the longest day has 14 hours and 37 minutes. Those five

extra hours have a profound impact on circadian rhythm, daily habits and mood, especially for those people who have a major depressive disorder with a seasonal pattern.

But new research from Sandra Rosenthal, Jack and Pamela Egan Professor of Chemistry and professor of pharmacology and chemical and biomolecular engineering, suggests that the rate of change in solar insolation—that is, the amount of solar radiation that reaches the ground over a specified time in a given location—has a greater impact on these depressive disorders than routine seasonal changes in sunlight.

The research is personal for Rosenthal, who has experience with seasonal shifts in her bipolar disorder symptoms. "In the third week of August, I always went to the doctor because I always felt sick, like I had mono," she says. "Once I started paying attention to these precise dates, and after an enlightening conversation with bipolar disorder expert Kay Jamison, I realized just how common this seasonal pattern is."

What has been less clear in past research is how to quantify the seasonality of bipolar disorder. With resources from Immersion Vanderbilt, Rosenthal and collaborators began examining NASA's data on solar insolation for specific areas, focusing on the change from one month to the next, rather than the absolute amount of solar insolation.

Daily rates of change tend to build up dramatically and peak around the spring and fall equinoxes, while staying fairly consistent around the summer and winter solstices. Previous research has confirmed a correlation between bipolar disorder onset and time of year, especially for those who live farther from the equator and therefore experience a greater difference in solar insolation throughout the year.

By zooming in on areas of 11 square miles—half the size of the island of Manhattan—the team was able to identify which month had the highest

rate of change in solar radiation for 51 locations across the Northern and Southern hemispheres. Using small areas was important to the research, because even cities on the same latitude—for example, Oslo, Norway, and Helsinki, Finland—can have very different solar insolation levels at the same time of year. Factors such as cloud cover, humidity levels, level of atmospheric pollutants, altitude and even natural disaster events such as wildfires and volcanic eruptions can affect how much solar radiation actually reaches the ground.

From the data, Rosenthal and her colleagues predict a link between the brain's suprachiasmatic nucleus and bipolar disorder symptoms. The SCN functions as a sensor of seasonal changes in daylight and also as a regulator of melatonin secretion from the pineal gland. Rosenthal and her colleagues argue that the SCN plays a key role in measuring specifically the rate of change of solar insolation, which then affects downstream pathways related to bipolar disorder.

The seasonal pattern related to changes in sunlight is not entirely surprising, based on past research of bipolar disorder. Many patients with bipolar disorder experience disruptions in their sleep-wake cycle, altered melatonin secretion and disturbances to their stress response as it relates to the body's natural circadian rhythm. Even the common treatment of lithium for people with bipolar disorder suggests a connection to circadian rhythm because lithium is also known to affect core clock genes.

Rosenthal suggests that health care providers should begin to study the correlations of incidence of bipolar disorder symptoms with the solar insolation data of a specific location, instead of just the season. Cities such as Los Angeles underscore the importance of this because their solar insolation paradoxically increases in the month of October as the Santa Ana winds push the marine cloud layer out to sea.

While there is certainly variability in seasonal effects on bipolar disorder among patients, the new findings can enable them to track their symptoms over the year and look for clues about the sunlight's impact. "Recognizing symptom patterns and their associations with annual changes in solar insolation may enhance self-management and also destigmatize the illness," Rosenthal says. "Our hope is that this information will be useful in education and self-management in many bipolar patients."

Provided by Vanderbilt University

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