

INCIDENCE OF WINTER DEPRESSION VARIES WITHIN TIME ZONES

T.M. White¹, M. Terman^{2,3}, G.J. Musa^{2,3}, D.H. Avery⁴

¹New York State Office of Mental Health, Albany, NY, USA; ²New York State Psychiatric Institute, New York, NY; ³Columbia University Dept. of Psychiatry, New York, NY; ⁴University of Washington Dept. of Psychiatry, Seattle, WA.

BACKGROUND

We wanted to ascertain whether the risk of SAD increases with later sunrise in winter, longer night length, both or neither. At higher latitudes in winter, the sun rises later than at lower latitudes and night length is longer. Studies on latitude have had mixed results. Within Canada, no latitude cline was detectable,¹ while within the US, prevalence was higher in the north than in the south.²

At any latitude, the sun also rises later the farther west you go within a time zone – *but at the same latitude, night length does not change*. For the typical time zone spanning 15° longitude, there is a 60-minute delay in sunrise from the eastern to western tier of the zone. Across 20° of continental US latitude at the winter solstice, the delay is also about 60 minutes from the far south to the far north.

Is SAD more prevalent in the western tier of time zones? Do latitude and time zone effects summate or interact?

¹Levitt AJ, Boyle MH. The impact of latitude on the prevalence of seasonal depression. *Can J Psychiatry*. 2002;47:361-367.

²Rosen LN, Targum SD, Terman M, Bryant MJ, Hoffman H, Kasper SF, Hamovit JR, Docherty JP, Welch B, Rosenthal NE. Prevalence of seasonal affective disorder at four latitudes. *Psychiatry Res*. 1990;31:131-44.

METHOD

The Center for Environmental Therapeutics website (cet.org) includes two questionnaires, the *Automated Personal Inventory for Depression and SAD* (PIDS) and the *Automated Morningness-Eveningness Questionnaire* (MEQ). The PIDS ascertains (a) DSM-IV features of major depressive episode in the past year, (b) Global Seasonality Score (GSS), (c) worst and best months of the year, and (d) winter worsening of atypical neurovegetative symptoms. The MEQ ascertains chronotype: the score finely differentiates “larks” from “owls,” and those in between. We defined winter seasonal major depression as (a) meeting DSM-IV criteria, (b) $GSS \geq 11$, and (c) ≥ 4 winter months consistently worst, with no summer months worst.

The website provides respondents individualized feedback and invites them to contribute their results anonymously to a research database. US subjects enter their mail Zip code, for which we know the latitude and longitude. We also query age, gender, sleep pattern, etc. More than 20,000 people have used the PIDS and MEQ at cet.org, and more than 6000 people have contributed data. The present analysis is for US subjects, 22-70 years old. Approximately 75% were women.

RESULTS

Latitude effects. The proportion of respondents reporting winter seasonal major depression rises monotonically from the south to north of the US by approximately 0.12 to 0.28. The rise is linear up to approximately 39° N, and then levels off (**Figure 1**). At the same time, MEQ score, sleep phase and sleep duration hardly vary (**Figure 2**).

Longitude effects. We concentrated on the geographic band above 39° N, where SAD is most prevalent and the latitude effect washes out. The independent variable was distance from the eastern edge of the time zones (Eastern, Central, Mountain, Pacific). The proportion of respondents reporting winter season seasonal major depression rose from approximately 0.25 in the eastern tiers to 0.33 in the western tiers (**Figure 3**). Again, MEQ score, sleep phase and sleep duration were invariant (**Figure 4**).

All the defining features of winter seasonal major depressive disorder were entered into a stepwise multiple regression on distance within time zone. The positive longitude cline was significant ($P < .05$) for depressed mood, diminished interest/pleasure, weight loss/gain, insomnia/hypersomnia, agitation/retardation, fatigue/energy loss, worthlessness/guilt, and impaired thinking/concentration/decisiveness. Suicidality was nearly significant ($P = .051$). Similarly, the atypical neurovegetative symptoms of SAD (hypersomnia, carbohydrate craving, etc.) all showed positive latitude clines. **Figure 5** shows examples of the parallel longitude clines for DSM-IV fatigue/energy loss, PIDS difficulty awakening, DSM-IV agitation/retardation, and PIDS carbohydrate eating.

Combination of latitude and longitude effects. Latitude, longitude, age and sex were entered into a stepwise multiple regression on winter seasonal major depression. For the whole US, latitude and longitude were significant additive factors (without an interaction), women were more affected, and age didn't matter. For the northern half of the US, where SAD is most prevalent, the only significant factors were longitude and sex.

CONCLUSIONS

1. Both latitude and longitude within time zones are significant determinants of SAD. Odds ratio analysis of symptom exacerbation per hour of delayed sunrise produces nearly equivalent effects from either source.
2. The time zone effect demonstrates that later sunrise per se – in distinction from night length – is a significant risk factor for SAD.
3. People who live in the western tier of time zones suffer more than their neighbors just a few miles away in the eastern tier of adjacent time zones – a disruptive quantum effect of the time zone artifice.
4. The US Congress is considering extending Daylight Saving Time (or Summer Time) from April-October to March-November. *This will exacerbate SAD throughout the country, with an additional 60-minute delay in sunrise during critical months of the year. People living in the western tier of time zones will suffer the most, with a 2-hour delay in sunrise relative to their eastern counterparts under Standard Time.*
5. *Caveat.* The utility of this study lies in detecting trends across latitude and longitude. It does not provide population prevalence estimates of SAD or associated symptoms. This is not a random sample survey, and undoubtedly visitors to the website are more likely than the population-as-a-whole to suffer winter seasonal major depression. However, there is no reason to expect a reporting bias within time zones or across latitudes.