Average Sunrise Time Predicts Depression Prevalence

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Abstract

- Studies of depression prevalence are plagued by striking but unexplained differences in prevalence between cities, for example:
  - EURODEP Geriatric Depression Programme (9 European cities)
  - ECA (Epidemiologic Catchment Area) Study (5 U.S. centres)
- For both studies, high correlations were found between depression prevalence and sunrise time, averaged over one year.
- Average sunrise time is determined primarily by a city's east-west position within its time zone.
- This suggests that simply shifting time-zone boundaries, or switching to Daylight Saving Time year-round, could reduce depression prevalence.

Introduction

- EURODEP Programme: Geriatric Depression in 9 European Cities[1]:
  - Striking, unexplained differences in prevalence between cities
    - *eg, for Depressive Neuroses: Iceland: 5.3%; London: 14.4%*
- Epidemiologic Catchment Area (ECA) Study of affective disorder prevalence in 5 U.S. centres[2]:
  - Similar unexplained differences in depression prevalences:
    - *eg, for one-year depression prevalence: Piedmont: 1.7%; New Haven: 3.4%*
- Overall differences in prevalence likely due to:
  - Different age groups: EURODEP: >65; ECA: >18
  - Different tools:
    - *EURODEP: Geriatric Mental State (semistructured interview)*
    - *ECA: Diagnostic Interview Schedule (structured interview)*
  - Different diagnostic criteria:
    - *EURODEP: AGECAT computerised diagnostic algorithm*
    - *ECA: DSM-III criteria*
- I explored whether the differences in depression prevalence within each study could be accounted for by differences in sunrise times from one city to another.

Method

- For each city, sunrise times, averaged over one year, were calculated as follows:
  - Obtain coordinates (latitude and longitude) for each city[3];
  - Obtain a table of daily sunrise times for each set of coordinates for a whole year (1999) [4];
  - Using a spreadsheet, convert sunrise times to decimal values, then average over the year;
- Plot each city's depression prevalence against its average sunrise time.
- Statistics: Pearson product-moment correlations

Results

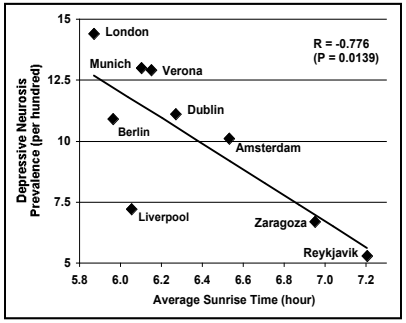
- EURODEP depressive neurosis prevalences and average sunrise times appear in Table 1 and are plotted in Figure 1:
  - Pearson product-moment correlation: -0.776 (P = 0.0139)
- Examination of figure 1 suggests that two cities, Berlin and Liverpool, are outliers. Replotting without these two cities (Figure 2) demonstrates the extent to which they are outside of the pattern formed by the other 7 cities:
  - Pearson correlation (7 cities): -0.995 (P < 0.0001)
- ECA one-year depression prevalences and average sunrise times appear in Table 2 and are plotted in Figure 3:
  - Pearson correlation: -0.977 (P = 0.0041)

Table 1. Depressive Neurosis Prevalence and Average Sunrise Time, EURODEP Programme

EURODEP Programme: Centre	Depressive Neurosis Prevalence (%)	Average Sunrise Time (hour)
Amsterdam, Netherlands	10.1	6.532
Berlin, Germany	10.9	5.965
Dublin, Ireland	11.1	6.271
Iceland[1]	5.3	7.208
Liverpool, United Kingdom	7.2	6.054
London, United Kingdom	14.4	5.871
Munich, Germany	13.0	6.104
Verona, Italy	12.9	6.151
Zaragoza, Spain	6.7	6.953

[1]Average sunrise time for Iceland's capital, Reykjavik, was used.

Figure 1. EURODEP Programme: Depressive Neurosis Prevalence vs. Average Sunrise Time



References

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Figure 2. EURODEP Programme: Depressive Neurosis Prevalence vs. Average Sunrise Time (7 cities)

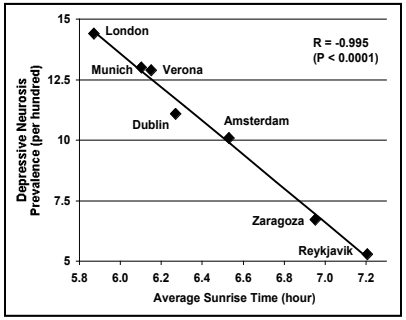
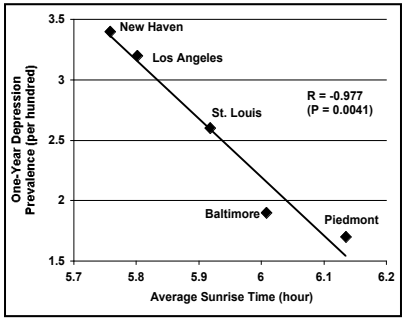


Table 2. One-year Depression Prevalence and Average Sunrise Time, ECA Study

ECA Study: Site	One-year Depression Prevalence (%)[1]	Average Sunrise Time (hour)
New Haven, Connecticut	3.4	5.758
Baltimore, Maryland	1.9	6.008
St. Louis, Missouri	2.6	5.918
Piedmont Country, North Carolina[2]	1.7	6.135
Los Angeles, California	3.2	5.802

[1]Weighted to reflect age, sex, and race characteristics of the communities surveyed.
[2]The coordinates for Kittrell, N.C. were used as the approximate centre of the five counties (Durham, Vance, Franklin, Granville, and Warren) in the study.

Figure 3. ECA Study: One-year Depression Prevalence vs. Average Sunrise Time



Discussion

- The high negative correlations between depression prevalence and average sunrise time, if not due to chance, are best explained by the well-known influence of the light/dark cycle on biological processes[5].
- Wiegand 's "Depressiogenic Theory of Sleep"[6] posits that excessive Rapid Eye Movement (REM) sleep can cause depression.
- REM sleep propensity increases through the night[7], with a peak in the morning[8].
- Thus, late sleepers will obtain more REM sleep than early risers, even with the same total amount of sleep.
- Late sleepers would thus be at higher risk for depression, according to Wiegand's theory. It also explains why getting up early can treat depression[9, 10].
- Since depression prevalence studies to date have not reported on rising times, it may be impossible to directly verify the above hypothesis without doing a new study.
- However, average sunrise time may be a useful analogue for the average rising time of city dwellers, because:
  - Individuals who live in cities typically get up by the clock, as dictated by work or school schedules or force of habit, rather than by the time of sunrise;
  - Thus, living in a city with a late average sunrise time implies getting up earlier in relation to the sunrise, than living in a location with an early average sunrise time.
- If the above is true, one would expect that the depression prevalence for a city would correlate inversely with the average sunrise time for that city, as found in the present study.
- If the correlations found in this study are not due to chance, and it is unlikely that population depression rates can influence astronomical phenomena, it suggests that average sunrise time influences depression rates in cities.
- Since average sunrise time is determined primarily by a city's east-west location within its time zone, and not by latitude, it might be possible to reduce depression prevalences by shifting time-zone boundaries.
  - For example, if London were to switch to the time zone used in continental Europe, its depressive neurosis prevalence would theoretically drop from 14.4% to 9.1%.
- Switching to Daylight Saving Time year-round might also reduce depression rates (eg, from 3.4% to 1.4% for New Haven).
- In the absence of public health initiatives such as the above, individuals might be able to reduce their own susceptibility to depression by simply getting up earlier.
- Further research is needed to verify this hypothesis, and to explain how Berlin and Liverpool differ.