THE JOURNAL OF CLINICAL PSYCHIATRY
THE OFFICIAL JOURNAL OF THE AMERICAN SOCIETY OF CLINICAL PSYCHOPHARMACOLOGY

Supplementary Material

Letter Title: Climate and Prevalence of Mood Disorders: A Cross-National Correlation Study

Author(s): Jean-Yves Rotge, MD, PhD; Philippe Fossati, MD, PhD; and Cedric Lemogne, MD, PhD

DOI Number: 10.4088/JCP.13l08810

List of Supplementary Material for the letter

1. **eAppendix 1** Supplementary Methods and Discussion

Disclaimer

This Supplementary Material has been provided by the author(s) as an enhancement to the published letter. It has been approved by peer review; however, it has undergone neither editing nor formatting by in-house editorial staff. The material is presented in the manner supplied by the author.

Climate and prevalence of mood disorders: a cross-national correlation study

Jean-Yves Rotge, Philippe Fossati, Cedric Lemogne

Supplementary Methods

In the present study, we have included all countries (n=17) for which the WHO World Mental Health Survey reported the lifetime prevalence of mood disorders, namely Belgium, Colombia, France, Germany, Israel, Italy, Japan, Lebanon, Mexico, Netherlands, New Zealand, Nigeria, PR China, South Africa, Spain, Ukraine, United States (Kessler et al., 2007).

Supplementary Discussion

To account for the relationship between climate and prevalence of mood disorders, many hypotheses, not mutually exclusive, could be posited. First of all, sun exposure is likely to be related to the climate characteristics described in the present study. Many studies have reported the efficacy of bright light therapy and dawn simulation in seasonal affective disorder and in nonseasonal mood disorders (Terman and Terman, 2005; Golden et al., 2005; Lieverse et al., 2011). Activation of the suprachiasmatic nucleus of the hypothalamus, which regulates circadian rhythms (Bunney and Bunney, 2000; Zhou et al., 2001), through the glutamatergic retinohypothalamic tract (Berson et al., 2002) may account for the effects of bright light treatment on mood and hypothalamic-pituitary axis activity. Light may also activate the raphe nucleus through subcortical projections of retinal neurons (Frazao et al., 2008). The raphe nucleus is the main source of the serotonergic inputs to limbic structures, which contributes to the pathophysiology of mood disorders (Owens and Nemeroff, 1994), but it is also involved in the

regulation of circadian systems (Ciarleglio et al., 2011). Second, high levels of rainfall and its everyday life consequences may constitute a chronic and repetitive stress factor, susceptible to affect the mood. Finally, rainfalls are usually associated with low barometric pressure, which could account for the association between rainfalls and mood disorders. Indeed, low barometric pressure could affect the human sympathetic-parasympathetic balance (Hansen and Sandner, 2003), which has been shown to be altered in mood disorders (Grippo and Johnson, 2002). Obviously, the hypothesis of such a pathophysiological mechanism requires to be properly assessed.

Conclusions

Worldwide climate types may partially explain the worldwide distribution of mood disorders. Our findings suggest that chronic exposition to a cat-and-dog weather with poor seasonal variations represents a risk factor of mood disorders. It remains to be determined whether the relationship between climate characteristics and lifetime prevalence of mood disorders could be mediated by light exposure or barometric pressures and whether climate changes to come may affect the occurrence of mood disorders.

Supplementary References

Berson DM, Dunn FA, Takao M. Phototransduction by retinal ganglion cells that set the circadian clock. *Science*. 2002;295:1070-1073.

Bunney WE, Bunney BG. Molecular clock genes in man and lower animals: possible implications for circadian abnormalities in depression. *Neuropsychopharmacology*. 2000;22:335-345.

Ciarleglio CM, Resuehr EH, McMahon DG. Interactions of the serotonin and circadian systems: nature and nurture in rhythms and blues. *Neuroscience*. 2011;197:8-16.

Frazao R, Pinato L, da Silva AV, Britto LR, Oliveira JA, Nogueira MI. Evidence of reciprocal connections between the dorsal raphe nucleus and the retina in the monkey Cebus apella. *Neurosci Lett*. 2008;430:119-123.

Golden RN, Gaynes BN, Ekstrom RD, et al. The efficacy of light therapy in the treatment of mood disorders: a review and meta-analysis of the evidence. *Am J Psychiatry*. 2005;162:656-662.

Grippo AJ, Johnson AK. Biological mechanisms in the relationship between depression and heart disease. *Neurosci Biobehav Rev*. 2002;26:941-962.

Hansen J, Sander M. Sympathetic neural overactivity in healthy humans after prolonged exposure to hypobaric hypoxia. *J Physiol*. 2003;546:921-929.

Kessler RC, Angermeyer M, Anthony JC, et al. Lifetime prevalence and age-of-onset distributions of mental disorders in the World Health Organization's World Mental Health Survey Initiative. *World Psychiatry*. 2007;6:168-176.

Lieverse R, Van Someren EJ, Nielen MM, Uitdehaag BM, Smit JH, Hoogendijk WJ. Bright light treatment in elderly patients with nonseasonal major depressive disorder: a randomized placebo-controlled trial. *Arch Gen Psychiatry*. 2011;68:61-70.

Owens MJ, Nemeroff CB. Role of serotonin in the pathophysiology of depression: focus on the serotonin transporter. *Clin Chem*. 1994;40:288-295.

Terman M, Terman JS. Light therapy for seasonal and nonseasonal depression: efficacy, protocol, safety, and side effects. *CNS Spectr*. 2005;10:647-663.

Zhou JN, Riemersma RF, Unmehopa UA, et al. Alterations in arginine vasopressin neurons in the suprachiasmatic nucleus in depression. *Arch Gen Psychiatry*. 2001;58:655-662.