



Sleep, Serotonin, and Suicide

PDF (Size:273KB) PP. 471-478 DOI: 10.4236/jbbs.2012.24055

Author(s)

Jun Kohyama

ABSTRACT

The author hypothesizes that sleep loss associated with a decrease in serotonergic activity plays a significant role in attempted suicide. Recent research has emphasized the role of the economic recession on the occurrence of suicide, but with no attention paid to possible biological aspects. In this brief review, the association between sleep, the serotonergic system, and suicide is initially introduced. Then, with consideration of recent research, a hypothesis regarding the occurrence of suicide is proposed. Finally, based on that hypothesis, three factors possibly germane to reducing suicides (sufficient sleep duration, activation of the serotonergic system, and activation of the prefrontal cortex) are discussed.

KEYWORDS

Economic Crisis; Prefrontal Cortex; C-Fiber; Yomikikase; Dakko

Cite this paper

J. Kohyama, "Sleep, Serotonin, and Suicide," *Journal of Behavioral and Brain Science*, Vol. 2 No. 4, 2012, pp. 471-478. doi: 10.4236/jbbs.2012.24055.

References

- [1] Y. Conwell, P. R. Duberstein, C. Cox, J. H. Herrmann, N. T. Forbes and E. D. Caine, " Relationships of Age and Axis I Diagnoses in Victims of Completed Suicide: A Psychological Autopsy Study," *American Journal of Psychiatry*, Vol. 153, No. 8, 1996, pp. 1001-1008.
- [2] %M. Nakao, T. Takeuchi and K. Yoshimasu, " A Proposed Approach to Suicide Prevention in Japan: The Use of Self-Perceived Symptoms as Indicators of Depression and Suicidal Ideation," *Environmental Health and Preventive Medicine*, Vol. 13, No. 6, 2008, pp. 313-321. doi:10.1007/s12199-008-0048-7
- [3] %J. Kohyama, " More Sleep Will Bring More Serotonin and Less Suicide in Japan," *Medical Hypotheses*, Vol. 75, No. 3, 2010, pp. 340. doi:10.1016/j.mehy.2010.03.035
- [4] %J. Kohyama, " Sleep, Serotonin and Suicide in Japan," *Journal of Physiological Anthropology*, Vol. 30, No. 1, 2011, pp. 1-8. doi:10.2114/jpa.2.30.1
- [5] %B. Barr, D. Taylor-Robinson, A. Scott-Samuel, M. McKee and D. Stuckler, " Suicides Associated with the 2008-10 Economic Recession in England: Time Trend Analysis," *British Medical Journal*, Vol. 345, 2012, pp. e5142. doi:10.1136/bmj.e5142
- [6] %J. Kohyama, " Re: Suicides Associated with the 2008-10 Economic Recession in England: Time Trend Analysis," <http://www.bmjjournals.org/content/345/bmj.e5142/rr/598967>.
- [7] %D. Gunnell, D. Irvine, L. Wise, C. Davies and R. M. Martin, " Varenicline and Suicidal Behaviour: A Cohort Study Based on Data from the General Practice Research Database," *British medical Journal*, Vol. 339, 2009, pp. 3805. doi:10.1136/bmjjournals.03393805
- [8] %J. D. Bremner and P. McCaffery, " The Neurobiology of Retinoic Acid in Affective Disorders," *Progress in Neuro- Psychopharmacology and Biological Psychiatry*, Vol. 32, No. 2, 2008, pp. 315-331. doi:10.1016/j.pnpbp.2007.07.001

JBBS Subscription

Most popular papers in JBBS

About JBBS News

Frequently Asked Questions

Recommend to Peers

Recommend to Library

Contact Us

Downloads: 53,100

Visits: 176,270

Sponsors >>

- [9] %V. M. Linnoila and M. Virkkunen, " Aggression, Suicidality, and Serotonin," *Journal of Clinical Psychiatry*, Vol. 53, Suppl. 10, 1992, pp. 46-51.
- [10] %J. J. Mann and V. Arango, " Integration of Neurobiology and Psychopathology in a Unified Model of Suicidal Behavior," *Journal of Clinical Psychopharmacology*, Vol. 12, Suppl. 2, 1992, pp. 2S-7S.
- [11] %V. Arango, M. D. Underwood, A. V. Gubbi and J. J. Mann, " Localized Alterations in Preand Postsynaptic Serotonin Binding Sites in the Ventrolateral Prefrontal Cortex of Suicide Victims," *Brain Research*, Vol. 688, No. 1-2, 1995, pp. 121-133. doi:10.1016/0006-8993(95)00523-S
- [12] %H. Arita, " Brain Mechanisms of Poor Anger Management," *Japan Medical Association Journal*, Vol. 52, No. 3, 2009, pp.184-90.
- [13] %H. Arita, " The Neuroscience of Suicide (in Japanese)," *Brain and Nerve*, Vol. 64, 2012, No. 8, pp. 929-935.
- [14] %S. Chiavegatto, I. M. Quadros, G. Ambar and K. A. Miczek, " Individual Vulnerability to Escalated Aggressive Behavior by a Low Dose of Alcohol: Decreased Serotonin Receptor mRNA in the Prefrontal Cortex of Male Mice," *Genes, Brain and Behavior*, Vol. 9, No. 1, 2010, pp. 110-119. doi:10.1111/j.1601-183X.2009.00544.x
- [15] %M. Leyton, V. Paquette, P. Gravel, P. Rosa-Neto, F. Weston, M. Diksic and C. Benkelfat, " Alpha-[¹¹C]methyl-Ltryptophan Trapping in the Orbital and Ventral Medial Prefrontal Cortex of Suicide Attempters," *European Neuropsychopharmacology*, Vol. 16, No. 3, 2006, 220-223. doi:10.1016/j.euroneuro.2005.09.006
- [16] %C. A. Stockmeier, L. A. Shapiro, G. E. Dilley, T. N. Kolli, L. Friedman and G. Rajkowska, " Increase in Serotonin- 1A Autoreceptors in the Midbrain of Suicide Victims with Major Depression-Postmortem Evidence for Decreased Serotonin Activity," *Journal of Neuroscience*, Vol. 18, No. 18, 1998, pp. 7394-7401.
- [17] %J. S. Sprouse and G. K. Aghajanian, " (-)-Propranolol Blocks the Inhibition of Serotonergic Dorsal Raphe Cell Firing by 5-HT1A Selective Agonists," *European Journal of Pharmacology*, Vol. 128, No. 3, 1986, pp. 295-298. doi:10.1016/0014-2999(86)90782-X
- [18] %M. Boldrini, M. D. Underwood, J. J. Mann and V. Arango, " Serotonin-1A Autoreceptor Binding in the Dorsal Raphe Nucleus of Depressed Suicides," *Journal of Psychiatric Research*, Vol. 42, No. 6, 2008, pp. 433-442. doi:10.1016/j.jpsychires.2007.05.004
- [19] %M. Pompili, G. Serafini, M. Innamorati, A. M. M?ller- Leimk?hler, G. Giupponi, P. Girardi, R. Tatarelli and D. Lester, " The Hypothalamic-Pituitary-Adrenal Axis and Serotonin Abnormalities: A Selective Overview for the Implications of Suicide Prevention," *European Archives of Psychiatry and Clinical Neuroscience*, Vol. 260, No. 8, 2010, pp. 583-600. doi:10.1007/s00406-010-0108-z
- [20] %K. M. Carlin, W. W. Vale and T. L. Bale, " Vital Functions of Corticotropin-Releasing Factor (CRF) Pathways in Maintenance and Regulation of Energy Homeostasis," *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 103, No. 9, 2006, pp. 3462- 3467. doi:10.1073/pnas.0511320103
- [21] %M. Waselus, R. J. Valentino and E. J. Van Bockstaele, " Ultrastructural Evidence for a Role of Gamma-Aminobutyric Acid in Mediating the Effects of Corticotropin- Releasing Factor on the Rat Dorsal Raphe Serotonin System," *Journal of Comparative Neurology*, Vol. 482, No. 2, 2005, pp. 155-165. doi:10.1002/cne.20360
- [22] %L. G. Kirby, E. Freeman-Daniels, J. C. Lemos, J. D. Nunan, C. Lamy, A. Akanwa and S. G. Beck, " Corticotropin-Releasing Factor Increases GABA Synaptic Activity and Induces Inward Current in 5-Hydroxytryptamine Dorsal Raphe Neurons," *The Journal of Neuroscience*, Vol. 28, No. 48, 2008, pp. 12927-12937. doi:10.1523/JNEUROSCI.2887-08.2008
- [23] %E. G. Meloni, A. V. Jackson, B. M. Cohen and W. A. Carlezon, Jr, " Corticotropin-Releasing Factor from the Rat Brain Measured by Protein Immunoblot," *Peptides*, Vol. 26, No. 11, 2005, pp. 2252-2256. doi:10.1016/j.peptides.2005.04.011
- [24] %J. C. Geerling, J.-W. Shin, P. C. Chimenti and A. D. Loewy, " Paraventricular Hypothalamic Nucleus: Axonal Projections to the Brainstem," *Journal of Comparative Neurology*, Vol. 518, No. 9, 2010, pp. 1460-1499. doi:10.1002/cne.22283
- [25] %G. E. Alexander, M. R. DeLong and P. L. Strick, " Parallel Organization of Functionally Segregated Circuits Linking Basal Ganglia and Cortex," *Annual Review of Neuroscience*, Vol. 9, 1986, pp. 357-

- [26] %S. Tekin and J. L. Cummings, " Frontal-Subcortical Neuronal Circuits and Clinical Neuropsychiatry: An Update," *Journal of Psychosomatic Research*, Vol. 53, No. 2, 2002, pp. 647-654. doi:10.1016/S0022-3999(02)00428-2
- [27] %N. Schweighofer, M. Bertin, K. Shishida, Y. Okamoto, S. C. Tanaka, S. Yamawaki and K. Doya, " Low-Serotonin Levels Increase Delayed Reward Discounting in Humans," *The Journal of Neuroscience*, Vol. 28, No. 17, 2008, pp. 4528-4532. doi:10.1523/JNEUROSCI.4982-07.2008
- [28] %A. R. Smith, T. K. Witte, N. E. Teale, S. L. King, T. W. Bender and T. E. Joiner, " Revisiting Impulsivity In Suicide: Implications for Civil Liability of Third Parties," *Behavioral Sciences & the Law*, Vol. 26, No. 6, 2008, pp. 779-797. doi:10.1002/bsl.848
- [29] %D. M. Dougherty, C. W. Mathias, D. M. Marsh, T. D. Papageorgiou, A. C. Swann and F. G. Moeller, " Laboratory Measured Behavioral Impulsivity Relates to Suicide Attempt History," *Suicide and Life-Threatening Behavior*, Vol. 34, No. 4, 2004, pp. 374-385. doi:10.1521/suli.34.4.374.53738
- [30] %S. C. Tanaka, K. Doya, G. Okada, K. Ueda, Y. Okamoto and S. Yamawaki, " Prediction of Immediate and Future Rewards Differentially Recruits Cortico-Basal Ganglia Loops," *Nature Neuroscience*, Vol. 7, No. 8, 2004, pp. 887-893. doi:10.1038/nn1279
- [31] %V. Roman, I. Walstra, P. G. Luiten and P. Meerlo, " Too Little Sleep Gradually Desensitizes the Serotonin 1A Receptor System," *Sleep*, Vol. 28, No. 12, 2005, pp. 1505- 1510.
- [32] %V. Roman, R. Hagewoud, P. G. M. Luiten and P. Meerlo, " Differential Effects of Chronic Partial Sleep Deprivation and Stress on Serotonin-1A and Muscarinic Acetylcholine Receptor Sensitivity," *Journal of Sleep Research*, Vol. 15, No. 4, 2006, pp. 386-394. doi:10.1111/j.1365-2869.2006.00555.x
- [33] %A. Novati, V. Roman, T. Cetin, R. Hagewoud, J. A. den Boer, P. G. Luiten and P. Meerlo, " Chronically Restricted Sleep Leads to Depression-Like Changes in Neurotransmitter Receptor Sensitivity and Neuroendocrine Stress Reactivity in Rats," *Sleep*, Vol. 31, No. 11, 2008, pp. 1579- 1585.
- [34] %J. P. Gardner, C. A. Fornal and B. L. Jacobs, " Effects of Sleep Deprivation on Serotonergic Neuronal Activity in the Dorsal Raphe Nucleus of the Freely Moving Cat," *Neuropsychopharmacology*, Vol. 17, No. 2, 1997, pp. 72-81. doi:10.1016/S0893-133X(97)00025-0
- [35] %R. B. Machado, S. Tufik and D. Sacheck, " Chronic Stress during Paradoxical Sleep Deprivation Increases Paradoxical Sleep Rebound: Association with Prolactin Plasma Levels and Brain Serotonin Content," *Psychoneuroendocrinology*, Vol. 33, No. 9, 2008, pp. 1211-1224. doi:10.1016/j.psyneuen.2008.06.007
- [36] %C. M. Portas, B. Bjorvatn and R. Ursin, " Serotonin and the Sleep/Wake Cycle: Special Emphasis on Microdialysis Studies," *Progress in Neurobiology*, Vol. 60, No. 1, 2000, pp. 13-35. doi:10.1016/S0301-0082(98)00097-5
- [37] %F. R. Cagampang, S. Yamazaki, Y. Otori and S. I. Inouye, " Serotonin in the Raphe Nuclei: Regulation by Light and an Endogenous Pacemaker," *Neuroreport*, Vol. 5, No. 1, 1993, pp. 49-52. doi:10.1097/00001756-199310000-00012
- [38] %B. L. Jacobs and E. C. Azmitia, " Structure and Function of the Brain Serotonin System," *Physiological Reviews*, Vol. 72, No. 1, 1992, pp. 165-229
- [39] %American Academy of Sleep Medicine, " The International Classification of Sleep Disorder," 2nd Edition, American Academy of Sleep Medicine, Westchester, 2005.
- [40] %C. L. Turvey, Y. Conwell, M. P. Jones, C. Phillips, E. Simonsick, J. L. Pearson and R. Wallace, " Risk Factors for Late-Life Suicide: A Prospective, Community-Based Study," *American Journal of Geriatric Psychiatry*, Vol. 10, No. 4, 2002, pp. 398-406. doi:10.1176/appi.ajgp.10.4.398
- [41] %Y. Fujino, T. Mizoue, N. Tokui and T. Yoshimura, " Prospective Cohort Study of Stress, Life Satisfaction, Self- Rated Health, Insomnia, and Suicide Death in Japan," *Suicide and Life-Threatening Behavior*, Vol. 35, No. 2, 2005, pp. 227-237. doi:10.1521/suli.35.2.227.62876
- [42] %R. A. Bernert and T. E. Joiner, " Sleep Disturbances and Suicide Risk: A Review of the Literature," *Neuropsychiatric disease and treatment*, Vol. 3, No. 6, 2007, pp. 735- 743
- [43] %M. Y. Agargun, A. S. Cilli, H. Kara, N. Tarhan, N. T. Kincir and H. Oz, " Repetitive and Frightening Dreams and Suicidal Behavior in Patients with Major Depression," *Comprehensive Psychiatry*, Vol. 39, No. 4, 1998, pp. 198-202. doi:10.1016/S0010-440X(98)90060-8

- [44] %M. Y. Agargun and H. Kara, " Recurrent Sleep Panic, Insomnia, and Suicidal Behavior in Patients with Panic Disorder," *Comprehensive Psychiatry*, Vol. 39, No. 3, 1998, pp. 149-151. doi:10.1016/S0010-440X(98)90074-8
- [45] %R. K. Singareddy and R. Balon, " Sleep and Suicide in Psychiatric Patients," *Annals of Clinical Psychiatry*, Vol. 13, No. 2, 2001, pp. 93-101. doi:10.3109/10401230109148954
- [46] %M. Wojnar, M. A. Ilgen, J. Wojnar, R. J. McCommon, M. Valenstein and K. J. Brower, " Sleep Problems and Suicidality in the National Comorbidity Survey Replication," *Journal of Psychiatric Research*, Vol. 43, No. 5, 2009, pp. 526-531. doi:10.1016/j.jpsychires.2008.07.006
- [47] %X. Liu, " Sleep and Adolescent Suicidal Behavior," *Sleep*, Vol. 27, No. 7, 2004, pp. 1351-1358.
- [48] %S. S. Yoo, N. Gujar, P. Hu, F. A. Jolesz and M. P. Walker, " The Human Emotional Brain without Sleep—A Prefrontal Amygdala Disconnect. Sleep-Deprivation Causes an Emotional Brain ' Disconnect' , " *Current Biology*, Vol. 17, No. 20, 2007, pp. R877-R878. doi:10.1016/j.cub.2007.08.007
- [49] %W. R. Pigeon, M. Pinquart and K. Conner, " Meta-Analysis of Sleep Disturbance and Suicidal Thoughts and Behavior," *Journal of Clinical Psychiatry*, Vol. 73, No. 9, pp. e1160-e1167. doi:10.4088/JCP.11r07586
- [50] %D. Stuckler, S. Basu, M. Suhrcke, A. Coutts and M. McKee, " Effects of the 2008 Recession on Health: A First Look at European Data," *Lancet*, Vol. 378, No. 9786, 2011, pp. 124-125. doi:10.1016/S0140-6736(11)61079-9
- [51] %M. Economou, M. Madianos, C. Theleritis, L. E. Peppou and C. N. Stefanis, " Increased Suicidality amid Economic Crisis in Greece," *Lancet*, Vol. 378, No. 9801, 2011, p. 1459. doi:10.1016/S0140-6736(11)61638-3
- [52] %K. N. Fountoulakis, I. A. Grammatikopoulos, S. A. Koupidis, M. Siamouli and P. N. Theodorakis, " Health and the Financial Crisis in Greece," *Lancet*, Vol. 379, No. 9820, 2012, pp. 1001-1002. doi:10.1016/S0140-6736(12)60422-X
- [53] %Y. Honkawa, " Number of Suicide by Occupation," 2012, <http://www2.ttcn.ne.jp/honkawa/2740-2.html>
- [54] %Y. Honkawa, " Alteration of Rate of Unemployed," 2012. <http://www2.ttcn.ne.jp/honkawa/3080.html>
- [55] %OECD, " Better Life Index," 2012. <http://www.oecdbetterlifeindex.org/>
- [56] %Japan Productivity Center, " International Comparison on Labor Productivity," 2011. http://www.jpc-net.jp/intl_comparison/intl_comparison_2011.pdf
- [57] %Broadcasting Culture Research Institute, " Basic Survey on Social Life in Japan, 2010," 2011. <http://www.nhk.or.jp/bunken/summary/yoron/lifetime/pdf/110223.pdf>
- [58] %J. Kohyama, T. Shiiki, J. O. Sugimoto and T. Hasegawa, " Potentially Harmful Sleep Habits of 3-Year-Old Children in Japan," *Journal of Developmental and Behavioral Pediatrics*, Vol. 23, No. 2, 2002, pp. 67-70. doi:10.1097/00004703-200204000-00001
- [59] %J. Kohyama, " Neurochemical and Neuropharmacological Aspects of Circadian Disruptions: An Introduction to Asynchronization," *Current Neuropharmacology*, Vol. 9, No. 2, 2011, pp. 330-341. doi:10.2174/157015911795596522
- [60] %M. A. Carskadon and W. C. Dement, " Normal Human Sleep: An Overview," In: M. H. Kryger, T. Roth and W. C. Dement, Eds., *Principles and Practice of Sleep Medicine*, Elsevier Saunders, Philadelphia, 2005, pp. 13-23. doi:10.1016/B0-72-160797-7/50009-4
- [61] %P. Lavie, " Ultradian Rhythms: Gates of Sleep and Wakefulness," In: H. Schulz and P. Lavie, Eds., *Ultradian Rhythms in Physiology and Behavior*, Springer-Verlag, New York, 1985, pp. 148-164. doi:10.1007/978-3-642-70483-3_11
- [62] %S. N. Young, " How to Increase Serotonin in the Human Brain without Drugs," *Journal of Psychiatry and Neuroscience*, Vol. 32, No. 6, 2007, pp. 394-399.
- [63] %N. Shiota, N. Narikiyo, A. Masuda, T. Tsuruoka and S. Aou, " Neural Mechanisms of Self-Care Behavior: Grooming-Related Changes in Serotonin and Dopamine in the Rat Prefrontal Cortex,"

- [64] %O. Petre-Quadens, " Sleep in Mental Retardation," In: C. D. Clemente, D. P. Purpura and F. E. Mayer, Eds., *Sleep and maturing nervous system*, Academic Press, New York, 1972, pp. 384-417.
- [65] %L. Curzi-Dascalova, " Developmental Trend of Sleep Characteristics in Premature and Full-Term Newborns," In: O. P. Mathew, Ed., *Respiratory Control and Disorders in the Newborn*, Marcel Dekker, New York, 2002, pp. 149-181.
- [66] %E. Werth, P. Achermann and A. A. Borbely, " Selective REM Sleep Deprivation during Daytime II.