

# Enhancing Women's Mood and Energy

## A Research-based Program for Subthreshold Depression Using Light, Exercise, and Vitamins

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The prevalence and clinical significance of subthreshold forms of depression with sequelae comparable to major depression have been recently described in the literature; however, research on effective treatment is rare. A new intervention program that combines a specific regimen of light, exercise, and vitamins is effective in improving women's mood and overall sense of well-being. This program is well suited to many patients who present with somatic and psychological symptoms consistent with subthreshold depression. **KEY WORDS:** *dysthymia, minor depression, subsyndromal depression, subthreshold depression, somatic, vegetative, or atypical depressive symptoms* *Holist Nurs Pract* 2005;19(6):278-284

*Joanne came into the clinic in June because she felt tired all the time. She sleeps 7 to 8 hours a night, but still does not feel refreshed. "I'm only 39, but I feel like my grandmother!" She often feels overwhelmed by the need to nap in the afternoon, which is possible because her successful business is based in her home. Her irritability with her son and her decreased interest in sex with her husband also worry her, but her recent weight gain bothers her most. "I am working hard to eat healthy, but then everything falls apart in the late afternoon," she said. Sometimes, she has periods of feeling "blah for no reason." With questioning, she realizes that her symptoms are somewhat worse premenstrually and in the winter. Joanne seems to feel good about herself and reports her work is going well, her marriage is strong, she has good social support from friends, and she is not facing any major life crises. The lengthy physical examination, depression screen, sleep disorder screen, blood work, and past medical review are all negative.*

This is a typical clinic scenario—a sincere seeker of help with vague physical and emotional complaints. Such women often think they have anemia or hypothyroidism (which indeed are common) and are

reassured when the results of common screening measures are found to be negative. Nonetheless, their distress about their symptoms remains. Unfortunately, no array of treatment options may be wholly satisfactory. Given the lack of diagnostic clarity and the increasingly rapid pace of practice, the care of patients like Joanne can be difficult to manage.

### THE CHALLENGE OF SUBTHRESHOLD DEPRESSIVE SYNDROMES

New research suggests that patients who present with this constellation of symptoms may be suffering from one of several forms of subthreshold depression. As a relatively newly described phenomenon, it appears in the literature under a variety of labels with both distinct and overlapping characteristics, including subsyndromal depression, minor depression, dysthymia, and somatic, vegetative, or atypical depressive symptoms.

Characterizations of subthreshold forms of depression reflect a clinical picture that is different from that for major depression. Patients with major depression classically present with very low mood, a feeling of hopelessness and helplessness, a flat affect, early morning waking, loss of appetite, and social withdrawal.<sup>1</sup> In contrast, patients with subthreshold depression can present with a wide range of symptoms, among which somatic symptoms often predominate. In some forms, such as minor depression, patients will

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present with the classic low mood, but only 2 to 4 of the other *Diagnostic and Statistical Manual of Mental Disorders*-specified symptoms.

In other forms, such as subsyndromal depression, low mood is not the most significant symptom patients report. Instead, they commonly present with fatigue, weight gain, slowed thinking, and sleep disturbance.<sup>2</sup> A patient may be identified as having a form of subthreshold depression without reporting sadness or a loss of pleasure in life. When there is a mood component, patients often experience it as irritability, rather than sadness. Clinically, women may describe the experience of these symptoms as "hibernation" or "jet-lag."<sup>3</sup>

Despite the use of terms like "minor" and "subsyndromal," the impact of these syndromes on patients' risk for morbidity and functional well-being is substantial.<sup>4</sup> The level of impairment is similar to that in major depression<sup>5,6</sup> and results in similar healthcare costs.<sup>7</sup> Furthermore, these subthreshold forms of depression are more prevalent than major depression.<sup>8</sup>

A new paradigm for understanding the clinical progression of depression links subthreshold symptoms with more severe episodes of major depression on a continuum.<sup>9,10</sup> Therefore, it is critical for clinicians to vigilantly assess and treat subthreshold depression, understanding that a patient's current symptoms could be residual from or the herald of a major depressive episode.

As with all forms of depression, there is a greater prevalence of subthreshold depression among women than among men.<sup>11</sup> In addition, women with depression present with more of the vegetative or somatic symptoms like fatigue, sleep disturbances, and weight gain.<sup>12</sup>

## NEUROTRANSMITTERS AND DEPRESSION

The activity of central nervous system neurotransmitters, such as serotonin, and their effect on mood, behavior, and cognition have become important as one of the underlying mechanisms of depression. Serotonin and other neurotransmitters are specific biochemicals that facilitate communication between neurons that are involved in regulating mood. Increasing serotonin levels in the brain has been shown to be one mechanism to enhance and stabilize mood.<sup>13</sup> This is accomplished by increasing the speed

of serotonin production, by slowing its breakdown, and by activating the receptors that pull serotonin into the neurons.

The gender differences in the prevalence of depression could be influenced by the way serotonin is produced and functions in the brain. There is some evidence that suggests that men have a greater number of and more effective serotonin receptors in the brain, which allows them to use the available serotonin more efficiently.<sup>14</sup> In addition, decreased or fluctuating estrogen production diminishes the serotonin activity in the brain.<sup>15,16</sup> This causal link between estrogen and serotonin further validates prior observations of heightened mood disturbance in women during times of low or falling estrogen, such as during perimenopause.<sup>17,18</sup>

## CURRENT INTERVENTIONS

Current approaches to patients like Joanne can miss the underlying cause of their distress. Recognizing that these symptoms may indicate a subthreshold depression provides a useful starting place for clinicians to address patients' concerns.

Antidepressant medications are a possible approach for these patients to improve their sense of well-being. The development of new medications, increased societal acceptance, and improved screening and treatment protocols have contributed to the increased use of antidepressants in the last decade.<sup>19,20</sup>

However, the usefulness of these medications for subthreshold forms of depression has not been well tested. In addition, women with subthreshold symptoms are often quite reluctant to use medication because they perceive their condition as not serious enough to warrant medication or because they do not want to face the perceived social stigma. While medications may relieve some symptoms, their side effects can exacerbate others, such as decreased libido and sexual responsiveness or sleep disturbances.<sup>21</sup>

Counseling about health promotion and lifestyle change is deeply embedded in nursing's philosophy. Although these interventions can potentially improve mood and general health, they are challenging to implement in the current practice environment with barriers such as reimbursement, capitation restrictions, productivity quotas, and abbreviated visit times.

Despite the growing evidence of significant distress, little is known about the best ways to treat these patients with subthreshold depression and no evidenced-based guidelines are available for

subthreshold depression. Consequently, there is an urgent need for specific prescriptive interventions, based on sound research, to guide clinicians' efforts to help patients decrease their symptoms and improve daily functioning.

## A PROMISING TREATMENT OPTION

New research has shown that a program of carefully selected and implemented lifestyle interventions can provide relief for women who present with subthreshold depressive symptoms.<sup>22</sup> The LEVITY (Light, Exercise, Vitamin Intervention TherapY) program includes a brisk outdoor walk at moderate intensity during daylight hours for 20 minutes 5 days per week and a specific combination of vitamins and minerals (Table 1). Each of the components has individually been shown to improve mood.<sup>23-26</sup> Together they form an effective daily regime requiring only a minimal time commitment.

The LEVITY program was tested in an 8-week randomized clinical trial with 112 women (aged 19-78) who were evaluated to have mild to moderate depressive symptoms. Women in the intervention group participated in the complete LEVITY program of light, exercise, and vitamins. Those in the control group received a placebo vitamin supplement.

The intervention was designed to be consistent with a nursing philosophy of practice, as well as being feasible in the clinical setting. At an initial meeting, women were educated about the research on the particular strategies to which they had been assigned. They also were coached about strategies to integrate the interventions into their daily routines. We limited additional contact to 2 brief phone calls during the study period to assist with managing barriers to adherence.

**TABLE 1.** The LEVITY (Light, Exercise, Vitamin, Intervention TherapY) program

Increased exposure to light through eyes
Natural outdoor light and bright indoor light
Brisk walking for 20 min 5 days per week
Walking paced to 60% of maximum heart rate
Daily vitamin and mineral supplement
50 mg vitamin B <sub>1</sub>
50 mg vitamin B <sub>2</sub>
50 mg vitamin B <sub>6</sub>
400 mcg folate (folic acid)
400 IU vitamin D
200 mcg selenium

Women who participated in the 3-part LEVITY program showed significantly reduced depressive symptoms and improved mood, self-esteem, and general well-being when compared to those in the control group.<sup>22</sup> The LEVITY program was well received by the women who participated in our study. They were able to integrate the new behaviors into their lives and to maintain a consistent commitment to participation.

Because of the challenges of assisting patients with lifestyle changes, a particularly appealing part of this lifestyle change program for clinicians is its specificity. The women will know exactly what activities are necessary and are less likely to be overwhelmed with a long "to-do" list. The sense of mastery can be particularly empowering as described by one of our study participants: "I'm feeling better because of something I am doing, not something I am taking."

## Rationale for the LEVITY program

Understanding why the LEVITY intervention is so effective requires a brief examination of lifestyle patterns common in American society today.<sup>3</sup> Unlike our more rural ancestors, we live indoors, out of the sun. A study in San Diego (a city known for ideal weather) found that most people spent 23 of 24 hours each day inside.<sup>27</sup> Many people experience even less light because of significant heat or cold weather.<sup>28</sup> This minimal daylight exposure is a concern because of the low light levels available in most indoor environments.<sup>29</sup> Even on a cloudy day, about 8 times more light is available outside (3000 lux) than in a brightly lit office (400 lux), or 60 times more than that in an average home (50 lux). On a sunny day, nearly 80 times more light (30,000 lux) is available outdoors than indoors. Without exposure to this high-intensity light, most people are light-deprived and are at an increased risk for depression,<sup>30</sup> fatigue, anxiety, and carbohydrate cravings.<sup>27</sup> Women are particularly vulnerable to light-deprivation, because they generally spend less time outside than do men.<sup>31</sup>

Intimately linked with our lifestyles that bring us inside are the increasingly sedentary lives we lead. Although exercise used to be a routine part of daily living, changes in labor patterns, transportation choices, entertainment selections, and household technologies have served to minimize the physical effort required to get through the day.

Increases in light exposure and moderate intensity exercise have been shown to improve a wide range of symptoms characteristic of subthreshold

depression.<sup>23-25</sup> Light and exercise enhance the activity of serotonin and other brain neurotransmitters that are essential for regulating mood.<sup>34,35</sup> Increased serotonin activity has been linked to decreased symptoms of depression and anxiety,<sup>36</sup> including improved cognitive and affective processing,<sup>37,38</sup> improved energy,<sup>39</sup> and a reduction in carbohydrate craving and overeating.<sup>40</sup> In addition to stimulating neurotransmitter production, both light and exercise increase cerebral blood flow, which enhances memory and clarity of thinking.<sup>41,42</sup>

Another hallmark of our modern society is a diet deficient in key nutrients.<sup>43,44</sup> Women on weight-loss diets and those who predominantly consume processed foods are particularly vulnerable to these deficiencies. For example, 75% of people on low-calorie diets are deficient in vitamin B<sub>6</sub>.<sup>45</sup> Furthermore, women who are exercising may require additional amounts of vitamins B<sub>1</sub>, B<sub>2</sub>, and B<sub>6</sub>.<sup>46</sup>

Maintaining an adequate nutritional status can be a key factor in psychological as well as physical well-being. Deficiencies in selenium, folic acid, and vitamins B<sub>1</sub>, B<sub>6</sub>, and D are associated with depression and other mood alterations. The availability of these nutrients can influence the development of serotonin and other neurotransmitters.<sup>26,47-52</sup>

In summary, low light levels, sedentary lifestyle, and nutritional issues are aspects of modern life that can trigger the symptoms of subthreshold depression. Instead of modifying these factors directly, it is common in our society to use food as a mood-enhancing substance. We eat foods that are psychologically comforting (particularly chocolate and other processed sweet or starchy foods) but low in beneficial nutrients. This has become a significant concern as clinicians work with patients to manage the negative sequelae of obesity in an increasing number of their patients. Interestingly, this well-known strategy of "eating to feel better" actually does have the effect of boosting neurotransmitters, particularly dopamine, which improves mood and energy.<sup>53,54</sup> The effect lasts only an hour or two, however, in contrast to more effective strategies of maintaining consistent lifestyle habits of increased light exposure, regular moderate exercise, and a diet with supplements for good nutrition.

### Implementing LEVITY into practice

After narrowing the differential diagnosis by ruling out common pathological problems and assessing that

the LEVITY program could be beneficial for a patient, the following components can be included in patient education. Our participants told us that brief education about the physiological mechanisms of the intervention helped increase their motivation and confidence in the program.

#### **Brisk walking at least 20 minutes a day 5 days a week**

Research indicates that exercise at a moderate pace (60% of maximum heart rate) is the most beneficial for improving mood<sup>55-57</sup> (60% of maximum heart rate is calculated as 220 minus the patient's age multiplied by 0.6). Based on a woman's current level of physical fitness, varying speeds of walking are required to achieve this heart rate. It will be a brisk and intentional pace, faster than average walking. Most people, however, find they can still converse at this pace without shortness of breath.

Although prolonged periods of exercise are recommended to enhance fitness and weight control, the research suggests that a period of 20 minutes is sufficient to boost mood.<sup>57,58</sup> For many women, a secondary motivation for this program may be weight management or improved cardiovascular health. Nonetheless, to maximize consistent adherence to the program, women need to know that only 20 minutes of exercise a day is necessary for mood improvement. As they gain confidence and fitness, some women may choose to increase their activity level to achieve other health goals.

Some patients will need to be instructed in how to count their pulse to monitor their heart rate. Initially, they should check their pulse several times during their walk to ensure that they are maintaining an appropriate pace. Generally, this monitoring can be discontinued once the patients have learned to walk at the appropriate pace. Popular strategies for maintaining a consistent pace include listening to music with an appropriate tempo and using a heart rate monitor.

To maximize success and adherence to the program, practitioners need to assist women to think creatively about how to fit exercise into their already busy lives. Particularly in the winter months, many people leave their homes for work before it is light outside and return after dark, so strategies may need to be developed to allow them to exercise during the work day at break or lunch time. Most study participants in this situation found that only a change of shoes was required, not showering or extensive clothing modifications. Practitioners will want to remind patients that obtaining good quality, comfortable walking shoes can prevent injuries. In fact, quality

shoes are the most significant cost of the program for patients.

### ***Increased exposure to light through eyes***

To enhance neurotransmitter activity and be effective in treating low mood, light must predominantly enter through the eyes. Additionally, exposing the skin to light improves mood through the production of endogenous opioids<sup>59</sup> and vitamin D.

The daily walk outside during daylight hours provides a significant boost in a patient's exposure to light. In addition, environmental alterations to increase light exposure could be as simple as reorienting furniture toward a window (Table 2). Light therapy devices, which provide between 3,000 to 10,000 lux, are a more expensive but readily available option for boosting high-intensity light exposure, particularly in windowless offices. Light therapy devices have been shown to increase mood, energy, alertness, and productivity.<sup>60</sup>

While maximizing light exposure into the eyes, it is important to also protect the eyes from ultraviolet (UV) light damage. UV light increases the risk of a number of serious eye conditions, including cataracts and macular degeneration.<sup>61</sup> The routine use of sunglasses is the most common way to protect eyes from UV damage. Contrary to what one might expect, however, the tint of the glasses is not related to the quality of UV blocking provided by the lenses. The

tint of the glasses simply blocks the intensity of the light (the amount of light that reaches the eyes). UV protection is provided either by the material of the lenses themselves (polycarbonate plastic lenses block 100% of UV light, glass lenses block all UVB and most UVA light) or a UV coating that is applied to the lenses. Similar UV protection is available on contact lenses. To maximize light exposure, patients can be encouraged to select sunglasses of the lightest tint that provide adequate comfort, but with UV-blocking properties to protect eye health. A diet rich in antioxidants and carotenoids will also provide additional protection against UV damage.

### ***Daily vitamin and mineral supplement***

The vitamins and minerals used in the LEVITY program are all easily obtained from common vitamin sources (pharmacy, grocery store, etc.) either individually or compounded jointly (often with other vitamins as well). The cost of the vitamins is relatively low (approximately 25 cents a day). Most of our study participants reported no problems with taking the daily supplement. If patients have not previously taken pills on a regular basis, however, they may have difficulty remembering to take a supplement. A pillbox marked for each day of the week and linked to another daily activity (such as tooth brushing) was helpful to many of our study participants. Patients who experience nausea with supplement use will benefit from taking them with food or dividing the dosage throughout the day.

**TABLE 2. Ways to lighten up your life**

- Look up toward the sky when walking outside.
- Choose a window seat on public transportation.
- Choose lightly tinted sunglasses.
- Replace low wattage light bulbs with ones of higher wattage.
- Orient furniture to the light at home and sit close to windows at work.
- Use a light therapy device (light box) at work, placed next to your computer or beside you on your desk as part of your normal work activities.
- Walk in the rain or snow with a clear umbrella.
- Sit outside to eat, read, or visit with friends.
- Open curtains and use window treatments that maximize light.
- Paint your walls a light color.
- Add larger windows, patio doors, skylights, or light tubes.
- Hang large mirrors in strategic locations to reflect more outdoor light.
- Vacation in a sunny climate.
- Choose a car with a sunroof.

### **Integration into practice**

The ability to identify and intervene with subthreshold depression is an opportunity to make a significant difference in many patients' lives. Patients are usually distressed by their symptoms and motivated to make changes to ameliorate them. They are, however, often skeptical that lifestyle intervention will be effective in making a difference in their symptom experience. Practitioners, for their part, may have tried recommending exercise and dietary changes in the past for health promotion and good cardiovascular health without being able to adequately motivate patients to adopt these behaviors. The diagnosis of subthreshold depression, combined with the LEVITY program, can give practitioners and patients a reason to try again.

Participants in our study reported that being able to give a name to their symptoms was an effective first

step to improving their lives. This aspect alone was a source of reassurance and support. "You are talking about me!" They reported that they had previously felt isolated and "crazy." Participants also benefited from understanding the research behind both the diagnosis and the treatment.

The LEVITY program offers familiar lifestyle changes in a new package. Rather than general, broad recommendations to improve health habits, practitioners can prescribe specific and limited behaviors that patients will identify as acceptable and possible. In addition, the rapid response experienced by most patients can provide a sense of hope and motivation that it is possible to effect a lasting change in their mood, with benefits to other aspects of their lives as well. Many patients will also welcome a medication-free intervention to help restore a healthy balance in their lives.

## REFERENCES

- Solnek BL, Seiter T. How to diagnose and treat depression. *Nurse Pract.* 2002;27(10):12-23.
- Judd LL, Rapaport MH, Paulus MP, Brown JL. Subsyndromal symptomatic depression: a new mood disorder? *J Clin Psychiatry.* 1994;55(4, suppl):18-28.
- Brown MA, Robinson J. *When Your Body Gets the Blues: The Clinically Proven Program for Women Who Feel Tired and Stressed and Eat Too Much.* Emmaus, Pa: Rodale; 2002.
- Wagner HR, Burns BJ, Broadhead WE, Yarnall KS, Sigmon A, Gaynes BN. Minor depression in family practice: functional morbidity, co-morbidity, service utilization and outcomes. *Psychol Med.* 2000;30(6):1377-1390.
- Sadek N, Bona J. Subsyndromal symptomatic depression: a new concept. *Depress Anxiety.* 2000;12(1):30-39.
- Rapaport MH, Judd LL, Schettler PJ, et al. A descriptive analysis of minor depression. *Am J Psychiatry.* 2002;159(4):637-643.
- Creed F, Morgan R, Fiddler M, Guthrie E, House A. Depression and anxiety impair health-related quality of life and are associated with increased costs in general medical inpatients. *Psychosomatics.* 2002;43(4):302-309.
- Rucci P, Gherardi S, Tansella M, et al. Subthreshold psychiatric disorders in primary care: prevalence and associated characteristics. *J Affect Disord.* 2003;76(1-3):171-181.
- Lewinsohn PM, Solomon A, Seeley JR, Zeiss A. Clinical implications of "subthreshold" depressive symptoms. *J Abnorm Psychol.* 2000;109(2):345-351.
- Judd LL, Schettler PJ, Akiskal HS. The prevalence, clinical relevance and public health significance of subthreshold depressions. *Psychiatr Clin North Am.* 2002;24(4):685-698.
- Pignone M, Gaynes B, Rushton J, et al. Screening for depression in adults: a summary of the evidence for the U.S. Preventive Services Task Force. *Ann Intern Med.* 2002;136(10):765-776.
- Silverstein B. Gender differences in the prevalence of somatic versus pure depression: a replication. *Am J Psychiatry.* 2002;159(6):1051-1052.
- Young SN, Leyton M. The role of serotonin in human mood and social interactions. Insight from altered tryptophan levels. *Pharmacol Biochem Behav.* 2002;71(4):857-865.
- Biver F, Lotstra F, Monclus M, et al. Sex difference in 5HT2 receptor in the living human brain. *Neurosci Lett.* 1996;204(1/2):25-28.
- Soares CN, Poitras JR, Prouty J. Effect of reproductive hormones and selective estrogen receptor modulators on mood during menopause. *Drugs Aging.* 2003;20(2):85-100.
- Bethea CL, Lu NZ, Gundlach C, Streicher JM. Diverse actions of ovarian steroids in the serotonin neural system. *Front Neuroendocrinol.* 2002;23:41-100.
- Shepherd JE. Effects of estrogen on cognition, mood, and degenerative brain diseases. *J Am Pharm Assoc (Wash).* 2001;41(2):221-228.
- Birkhauser M. Depression, menopause and estrogens: is there a correlation? *Maturitas.* 2002;41(suppl 1):S3-S8.
- Schatzberg AF. New indications for antidepressants. *J Clin Psychiatry.* 2000;61(11, suppl):9-17.
- Olfson M, Marcus SV, Druss B, Elinson L, Tanielian MA, Pincus HA. National trends in the outpatient treatment of depression. *JAMA.* 2002;287(2):203-209.
- Nemeroff CB. Improving antidepressant adherence. *J Clin Psychiatry.* 2003;64(S18):25-30.
- Brown MA, Goldstein-Shirley J, Robinson J, Casey S. The effects of a multi-modal intervention trial of light, exercise, and vitamins on women's mood. *Women Health.* 2001;34(3):93-112.
- Leppamaki S, Partonen TT, Hurme J, Haukka JK, Lonnqvist JK. Randomized trial of the efficacy of bright-light exposure and aerobic exercise on depressive symptoms and serum lipids. *J Clin Psychiatry.* 2002;63(4):316-321.
- Babyak M, Blumenthal JA, Herman S. Exercise treatment for major depression: maintenance of therapeutic benefit at 10 months. *Psychosom Med.* 2000;62(5):633-638.
- Brosse AL, Sheets ES, Lett HS, Blumenthal JA. Exercise and the treatment of clinical depression in adults: recent findings and future directions. *Sports Med.* 2002;32(12):741-760.
- Alpert M, Silva RR, Pouget ER. Prediction of treatment response in geriatric depression from baseline folate level: interaction with an SSRI or a tricyclic antidepressant. *J Clin Psychopharmacol.* 2003;23(3):309-313.
- Espíritu RC, Kripke DF, Ancoli-Israel S, et al. Low illumination experienced by San Diego adults: association with atypical depressive symptoms. *Biol Psychiatry.* 1994;35(6):403-407.
- Cole RJ, Kripke DF, Wisbey J, et al. Seasonal variation in human illumination exposure at two different latitudes. *J Biol Rhythms.* 1995;10(4):324-334.
- Kripke DF. Brighten your life. 2002:chap 1. Available at: <http://www.brightenyourlife.info.allpdf.html>. Accessed February 27, 2004.
- Kripke DF. Adult illumination exposures and some correlations with symptoms. In: Hiroshige T, Honma K, eds. *Evolution of Circadian Clock.* Sapporo, Japan: Hokkaido University Press; 1994:349-360.
- Jean-Louis G, Kripke DF, Ancoli-Israel S, Klauber MR, Sepulveda RS. Sleep duration, illumination, and activity patterns in a population sample: effects of gender and ethnicity. *Biol Psychiatry.* 2000;47:921-927.
- Partonen T, Lonnqvist J. Bright light improves vitality and alleviates distress in healthy people. *J Affect Disord.* 2000;57(1-3):55-61.
- Leppamaki S, Partonen T, Lonnqvist J. Bright-light exposure combined with physical exercise elevates mood. *J Affect Disord.* 2002;72(2):139-144.
- Lambert GW, Reid C, Kaye DM, Jennings GL, Esier MD. Effect of sunlight and season on serotonin turnover in the brain. *Lancet.* 2002;360:1840-1842.
- Weicker H, Struder HK. Influence of exercise on serotonergic neuro-modulation in the brain. *Amino Acids.* 2001;20:35-47.
- Smedh K, Spigset O, Allard P, Mjorndal T, Adolfsen R. Platelet [3H]paroxetine and [3H]lysergic acid diethylamide binding in seasonal affective disorder and the effect of bright light therapy. *Biol Psychiatry.* 1999;45:464-470.

37. Murphy FC, Smith KA, Cowen PJ, Robbins TW, Sahakian BJ. The effects of tryptophan depletion on cognitive and affective processing in healthy volunteers. *Psychopharmacology (Berl)*. 2002;163(1):42–53.
38. Rogers RD, Tunbridge EM, Bhagwagar Z, Drevets WC, Sahakian BJ, Carter CS. Tryptophan depletion alters the decision-making of healthy volunteers through altered processing of reward cues. *Neuropsychopharmacology*. 2003;28(1):153–162.
39. Clodore M, Foret J, Benoit O. Psychophysiological effects of early morning bright light exposure in young adults. *Psychoneuroendocrinology*. 1990;15(3):193–205.
40. Simansky KJ. Serotonergic control of the organization of feeding and satiety. *Behav Brain Res*. 1996;73(1/2):37–42.
41. Dani C, Bertini G, Martelli E. Effects of phototherapy on cerebral haemodynamics in preterm infants: is fibre-optic different from conventional phototherapy? *Dev Med Child Neurol*. 2004;46(2):114–118.
42. Hellstrom G, Wahlgren NG. Physical exercise increases middle cerebral artery blood flow velocity. *Neurosurg Rev*. 1993;16(2):151–156.
43. Fairfield KM, Fletcher RH. Vitamins for chronic disease prevention in adults: scientific review. *JAMA*. 2002;288(14):1720.
44. Norman AW. Sunlight, season, skin pigmentation, vitamin D, and 25-hydroxyvitamin D: integral components of the vitamin D endocrine system. *Am J Clin Nutr*. 1998;67(6):1108–1110.
45. Carbajal A, Nuñez C, Moreiras O. Energy intake as a determinant factor of vitamin status in healthy young women. *Int J Vitam Nutr Res*. 1996;66(3):227–231.
46. Manore MM. Effect of physical activity on thiamine, riboflavin, and vitamin B-6 requirements. *Am J Clin Nutr*. 2000;72(2):598S–606S.
47. Alpert M, Silva RR, Pouget ER. Prediction of treatment response in geriatric depression from baseline folate level: interaction with an SSRI or a tricyclic antidepressant. *J Clin Psychopharmacol*. 2003;23(3):309–313.
48. Whanger PD. Selenium and the brain: a review. *Nutr Neurosci*. 2001;4(2):81–97.
49. McCarty MF. High-dose pyridoxine as an “anti-stress” strategy. *Med Hypotheses*. 2000;54(5):803–807.
50. Benton D. Selenium intake, mood and other aspects of psychological functioning. *Nutr Neurosci*. 2002;5(6):363–373.
51. Benton D, Griffiths R, Haller J. Thiamine supplementation, mood, and cognitive functioning. *Psychopharmacology*. 1997;129:66–71.
52. Lansdowne AT, Provost SC. Vitamin D<sub>3</sub> enhances mood in healthy subjects during winter. *Psychopharmacology (Berl)*. 1998;135(4):319–323.
53. Benton D. Carbohydrate ingestion, blood glucose and mood. *Neurosci Behav Rev*. 2002;26:293–308.
54. Yang J, Koseki M, et al. Eating-regulated increase in dopamine concentration in the LHA with oronasal stimulation. *Am J Physiol*. 1996;27(2 pt 2):R315–R318.
55. Slentz CA, Duscha BD, Johnson JL. Effects of the amount of exercise on body weight, body composition, and measures of central obesity: STRRIDE—a randomized controlled study. *Arch Intern Med*. 2004;164(1):31–39.
56. Tate AK, Petruzzello SJ. Varying the intensity of acute exercise: implications for change in affect. *J Sports Med Phys Fitness*. 1995;35:295–302.
57. Moses J, Steptoe A, Mathews A, Edwards S. The effects of exercise training on mental well-being in the normal population: a control trial. *J Psychom Res*. 1989;33(1):47–61.
58. Hansen CJ, Stevens LC, Coast JR. Exercise duration and mood state: how much is enough to feel better? *Health Psychol*. 2001;20(4):267–275.
59. Sher L. Role of endogenous opioids in the effects of light on mood and behavior. *Med Hypotheses*. 2001;57(5):609–611.
60. Avery DH, Kizer D, Bolte MA, Hellekson C. Bright light therapy of subsyndromal seasonal affective disorder in the workplace: morning vs. afternoon exposure. *Acta Psychiatr Scand*. 2001;103(4):267–274.
61. West SK, Duncan D, Muñoz B. Sunlight exposure and risk of lens opacities in a population-based study: the Salisbury eye evaluation project. *JAMA*. 1998;280(8):714–718.

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