

# Pilot studies to find measurable effects of meditation

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**Abstract** Most chronic disease is caused by poor nutrition, even stressful thoughts. Besides the free radical theory of aging proposed by Denham Harman, inflammation is the second major mechanism by which poor nutrition generates age-associated disease. Stress can also be a major cause of chronic inflammation. The ongoing study described here seeks measurable indices through which meditation can reduce stress. Meditation may direct one’s consciousness to the present moment. Functional MRI is revealing how meditation affects the brain in ways that may decrease stress. Many simple tests have been tried with classes of students who were trained and meditated for 10 weeks. In a first class tested, pulse rate, balance, reaction time, calculation rate and accuracy, and memory were measured. In the next class, a control group was added and each participant evaluated the quality of their meditation experience each time. For the future, a questionnaire and a blood protocol are being developed to evaluate stress and inflammation levels.

In parallel with the meditation study, it is also possible to evaluate participants’ decisions about nutrition that may contribute to inflammation. Increasing psychological stress in childcare has been shown to be associated with shorter telomeres in humans, while decreasing nutritional stress with multivitamins and perhaps vitamin C and E is associated with longer telomeres. Consumption of 4-legged animal products has been shown to generate chronic inflammation in humans. In order to evaluate the effect of meditation on stress, we will evaluate behavioral characteristics and nutritional choices of participants throughout the study. Among the parameters of interest are dietary choices such as consumption of trans-fats and 4-legged meat, and behavioral characteristics such as response to stress. Blood measurements will also be taken, including telomere length, blood levels of vitamins C and E, c-reactive protein, glucocorticoids, LDL, HDL, and measures of reactive oxygen species such as 8-OH-deoxyguanosine, protein carbonyls, thiobarbituric reactive substances, and Heinz body formation in red blood cells.

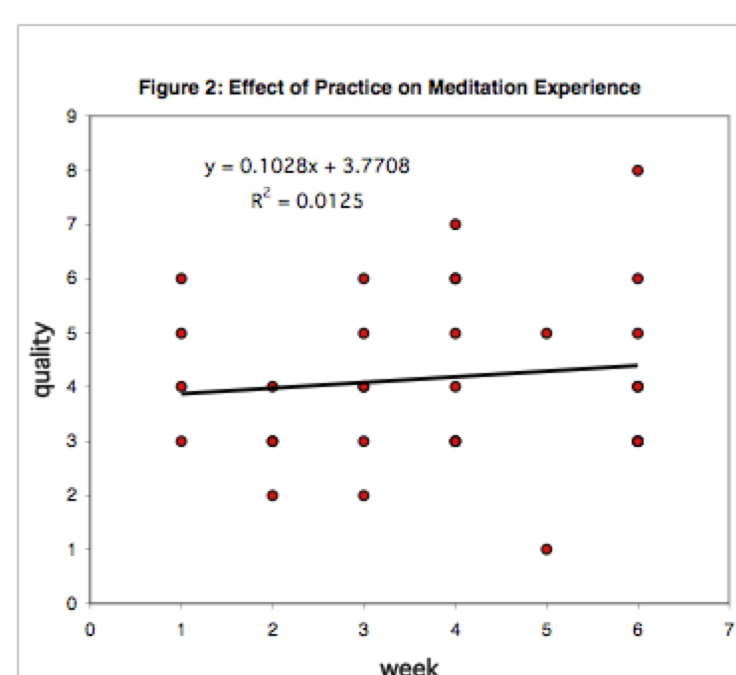
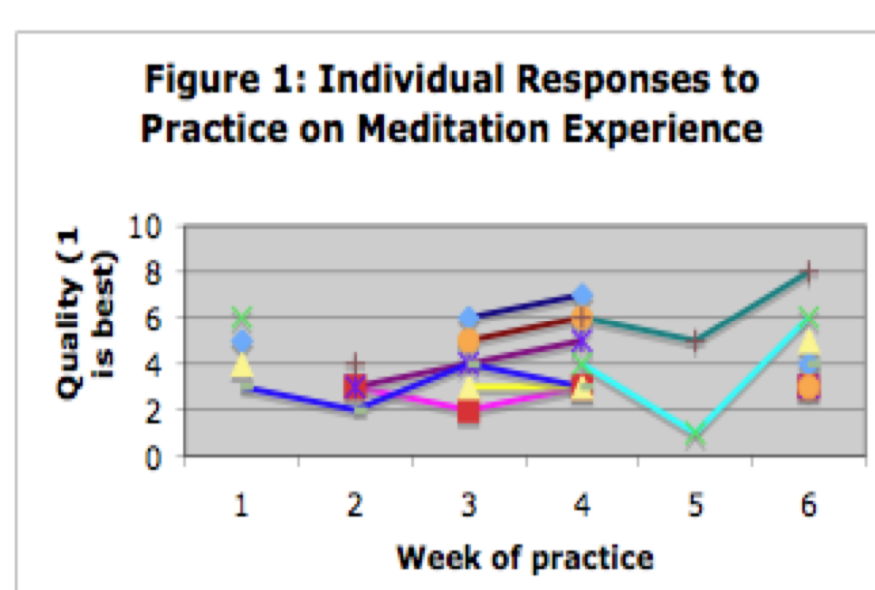
**Introduction** My initial hypothesis is that there are readily measurable results of meditation that will reduce markers of inflammation. Because of my previous interest in nutrition and vitamin C, I am also interested in evaluating how nutrition contributes to inflammation.

1. Causes of chronic disease: In 1956, Denham Harman hypothesized that reactive oxygen species (ROS) contribute to chronic disease (1). In more recent times, studies have shown that chronic inflammation is a second major source of disease (2), validating the subject of this meeting of AGE. Components of the diet may be a major cause of inflammation, including omega-6 fatty acids(3), trans fats(4), and products from four-legged animals(5-6). Another cause of inflammation is stress (7). One potential way to reduce stress is meditation (8).

2. Emotional and nutritional stress shorten telomeres: One consequence of stress appears to be shortened telomeres. Elizabeth Blackburn was awarded the Nobel Prize in 2010 for her work on telomeres (9). She has shown that telomeres are shorter in people subjected to emotionally stressful conditions (10). Nutritional stress may also affect telomeres. People using multivitamins or vitamins C and E may maintain longer telomeres (11).

3. Psychoneuroimmunology, consciousness, stress, and meditation: The field of sychoneuroimmunology explores the relationship between psychosocial processes and nervous, endocrine, and immune system functioning (12). The Dalai Lama is collaborating with the National Center for Complementary and Alternative Medicine (NCCAM) at the University of Wisconsin-Madison. That center is training people in meditation. The hypothesis is that meditation will reduce stress and improve health (8). Using the Dalai Lama’s book for our text (14), my classes have been exploring what measurable consequences of meditation can be found. We are evaluating tests to find measurable results of meditation that may also show reduction in markers of inflammation.

While evaluating how meditation may influence emotional stress and inflammation, it is possible to test how nutritional stress may also govern inflammatory processes. This led to further hypotheses: 1) A questionnaire can be found or developed reflecting psychosocial and nutritional factors influencing inflammation; 2) a blood protocol can be selected to evaluate the most important nutritional factors in inflammation; and 3) a blood protocol can be selected to quantitate the state of inflammation of an individual.



## Method

Permission to conduct these investigations was granted by the Beloit College IRB. Table 1 indicates quantitative measures that have been selected so far.

Table 1: Quantitative Measures applied to possible outcomes of meditation

| Measure            | Explanation   |
|--------------------|---|
| Pulse              | Pulse measured before and after meditation                |
| Blood Pressure     | BP measured before and after meditation                   |
| Memory             | Ability to remember 25 numbers                            |
| Calculation speed  | Speed and accuracy at simple arithmetic                   |
| Reaction time      | Hand eye coordination reacting to movement                |
| Balance            | Length of time one is able to balance on one foot         |
| Analytic Ability   | Interpreting relative weights of objects on a balance     |
| Memory             | Short term memory for matching cards or recalling numbers |
| Visual processing  | Hand eye coordination ordering moving numbers             |
| Effect of mood     | How mood affects the ability to meditate                  |
| Effect of practice | Whether quality of meditation increases with practice     |

Undergraduate students volunteered to be meditation subjects and controls in the experiments. Everyone was tested at the beginning of the semester. Subjects were then trained in meditation technique (13), and meditated 20 minutes per week for 10 weeks. From 2006 to 2008, written tests were administered using paper and pencil. In 2009 testing was done using a facebook application (14).

**Results** We have yet to find statistically significant differences between sitting quietly versus conscious meditation for measures in Table 1. Using subjective judgments of the quality of meditation, Figures 1 and 2 show that weeks of practice may increase the quality of the meditation experience.

I have selected a variety of tests that are likely to be effective. . Two ways stress might be measured are through questionnaires and analysis of blood samples. Table 2 shows three exams that attempt to measure life circumstances and dietary factors that may contribute to stress. Table 3 lists three groups of markers that may be useful in evaluating nutritional state and stress levels.

Table 2: Study Entrance Evaluations for volunteers

| Measure                                    | Goal  | Reference   |
|--|---|---|
| Stress assessment (Mayo Clinic)            | Estimate stress level of life situation   | <a href="http://www.mayoclinic.com/health/stress-assessment/SR00029">http://www.mayoclinic.com/health/stress-assessment/SR00029</a> |
| Diet and Supplement use                    | Estimate dietary influences on stress; e.g. omega-3/6; trans-fats; antioxidant vitamins; sialic acid in 4-legged diet | <a href="http://campus.beloit.edu/nutrition/ain/N409litnotes.htm">http://campus.beloit.edu/nutrition/ain/N409litnotes.htm</a>       |
| Seasons - A New Dietary inflammatory index | the inflammatory potential of individuals' diets  | J Nutr 139: 2365-2372 (2009)  |

Table 3: Blood Protocol for meditation study

| Measure                      |
|------------------------------|
| NUTRITION MARKERS            |
| Vitamin C                    |
| Vitamin E                    |
| LDL and HDL                  |
| Sialic Acid                  |
| OXIDATIVE STRESS MARKERS     |
| Protein Carbonyls            |
| TBARS                        |
| Heinz body formation in RBCs |
| 8-OH-deoxyguanosine          |
| INFLAMMATION MARKERS         |
| C-reactive protein           |
| Glucocorticoids              |
| Telomere length (24, 25)     |

**Discussion** Before parsing out how meditation may affect stress, it is necessary to be able to measure stress objectively and quantitatively. In identifying readily quantitative effects of meditation, many confounding factors are being identified and will be controlled for in future testing. However, just as the results of my study of vitamin C excretion (17) were confirmed by an NIH clinical trial (18), these pilot studies may lead to insights into how to test the value of meditation in reducing stress and inflammation to enhance health. One insight that has been gained is the important role of consciousness (19-23) in meditation, nutrition, and control of stress.

“The evolution of the capacity to simulate seems to have culminated in subjective consciousness. Why this should have happened is, to me, the most profound mystery facing modern biology” (15). The meditation studies in my class originated from our exploration of consciousness (13). My nutrition course also emphasizes that good nutrition is simply being conscious of what is put in one’s body. In 2010, I began another course on consciousness, with a series of practices to investigate consciousness operationally as described by Blackmore (16).

We began compiling the list of quantitative measures for evaluating the effects of meditation in 2006. The NCCAM study will evaluate the effect of meditation on stress of participants. It would also be possible to add questions and blood tests to examine how nutritional and exercise choices affect stress.

Stress from behavioral and nutritional choices contributes to inflammation, chronic disease, and shortened lifespan. Research discoveries are providing evidence for a variety of inexpensive and effective methods to ameliorate these conditions. Meditation may provide a simple and inexpensive remedy, regardless of poor nutrition and unhappy life experiences. Our ongoing study of meditation seeks evidence beyond personal testimonials on the value of meditation.

**Conclusion** Meditation may dramatically reduce stress and inflammation, providing a synergistic effect with dietary, exercise, and mental strategies to maintain health. Proper design of effective studies of meditation requires consideration of confounding factors like nutrition, personal circumstances, and quality of practice.

## References

- Harman, D (1956) Aging: a theory based on free radical and radiation chemistry. J Gerontol 11: 298–300
- Valtuna, S et al (2008) Food selection based on total antioxidant capacity can modify antioxidant intake, systemic inflammation, and liver function without altering markers of oxidative stress. AJCN 87: 1290-1297
- Friesen, RW, and Innis SM (2009) Dietary arachidonic acid to EPA and DHA balance is increased among Canadian pregnant women with low fish intake. J Nutr 139: 2344-50.
- Esmailzadeh, A and Azadbakht L (2008) Home use of vegetable oils, markers of systemic inflammation, and endothelial dysfunction among women AJCN 88: 913 - 21
- Cohen, J (2008) Eat, drink, and be wary: A sugar's sour side. Science 322: 659-61
- Ordman, A (2008) Please consider the No Fours Diet, <http://campus.beloit.edu/nutrition/nofours.htm>
- Yehuda, S and Mostofsky D (2006) Nutrients, Stress and Medical Disorders. Humana Press, New Jersey
- Davidson, R (2009) The Effects of Well-being Interventions on Affect, Attention, Sleep, Social Stress and Pain Regulation. <http://clinicaltrials.gov/ct2/show/NCT01057368>
- Blackburn, J. (2009) Banquet speech. [http://nobelprize.org/nobel\\_prizes/medicine/laureates/2009/blackburn-speech.html](http://nobelprize.org/nobel_prizes/medicine/laureates/2009/blackburn-speech.html)
- Epel, E.S., E.H. Blackburn, J. Lin, F. Dhabar, N. Adler, J. Morrow, and R. Cawthon (2004) Accelerated telomere shortening in response to life stress. Proc Natl Acad Sci USA. 101: 17312-15
- Aviv, A (2009) Leukocyte telomere length: the telomere tale continues. AJCN 89:1721-22
- Sternberg, E.M. (2000) The Balance Within: The Science Connecting Health and Emotions, W.H. Freeman and Company, New York
- His Holiness the Dalai Lama (2005) The Universe in a Single Atom. Morgan Road Books, New York
- Facebook (2009) Who has the biggest brain? game. <http://www.facebook.com/photo.php?pid=681702&id=26986611864>
- Aviv, A. (2009) Leukocyte telomere length: the telomere tale continues. AJCN 2009 89:1721-22
- Xu, Q. et al (2009) Multivitamin use and telomere length in women. Am J Clin Nutr 89: 1857-1863
- King, G., Beins, M., Larkin, J., Summers, B., Ordman, A.B. (1994) Rate of excretion of vitamin C in human urine. AGE 17: 87-92
- Levine, M., Conry-Cantilena, C., Wang, Y., Welch, R.W., Cantilena, L.R. (1996) Vitamin C pharmacokinetics in healthy volunteers: Evidence for a recommended dietary allowance. PNAS USA 93: 3704-9
- Gallup, G. G. Jr. (1970) Chimpanzees: Self recognition. Science 167: 86–87
- Grimm, D. (2010) Is a dolphin a person? Science 327: 1070-1071
- Fogassi, L. et al (2005) Parietal lobe: From action organization to intention understanding, Science 308: 662 - 667
- Morris J. S., Ohman A., Dolan R.J. (1998) Conscious and unconscious emotional learning in the human amygdala. Nature 393: 467-70
- Evans, B.M. (2003). Sleep, consciousness and the spontaneous and evoked electrical activity of the brain. Is there a cortical integrating mechanism? Neuropsychologie clinique 33: 1–10
- Dawkins, R (1976) The Selfish Gene. Oxford Univ. Press, Oxford
- Blackmore, S. (2004) Consciousness: An introduction, Oxford Univ. Press, Oxford.