

A Systematic Review of Yoga Studies to Design Children's Yoga-Intervention Programs

Julie A. Wancik and Valerie E. Cadet, PhD

Dept of Biomedical Sciences, GA Campus, Philadelphia College of Osteopathic Medicine

Abstract

The movement of incorporating yoga and meditation programs into schools has become a current sensation in the United States. Historically, qualitative research measuring yoga and meditation's effectiveness has laid the groundwork for recent quantitative studies. One study claims that yoga may induce immunoglobulin genetic variant shifts toward better health. Most of the variables isolated in yoga studies offer mental and behavioral health benefits for school-aged children. Research on cerebral cortical changes in the hypothalamic-pituitary-adrenal axis (HPA-axis) induced by high cortisol levels illustrated externalization of behaviors in children. To this end, a review of the reduction of cortisol levels in younger populations with yoga-meditation intervention programs has shown to be beneficial. Positive outcomes in self-esteem and a reduction in aggressiveness have been widely reported with yoga trials in children. Further, an intervention of yoga and mindfulness with obese children showed a positive impact on reducing BMI levels and decreasing overall negative feelings. The empirical relevance of the social and emotional impact of yoga and meditation is clear yet needs further replication and increased methodology rigor of study designs. The direction for future research is toward more quantitatively, replicable studies that will assist in developing and validating the need for additional school-based yoga programs.

Hypothesis

Evidence-based yoga-studies will need to show efficacy in the following areas in order to promote funding and support of more school-based programs:

- more robust and replicable study designs
- more standardization of measurements
- and clear congruencies made between previous study variables

Methods

1. Systematically searched PubMed, clinicaltrials.gov, and PCOM library databases for studies based on test variables:

- "yoga and mindfulness"; "yoga and behavior"; "yoga and stress reduction";
- "yoga and cortisol"; "mindfulness and stress reduction"
- "yoga and adults"; "yoga and children"
- "cortisol and yoga"; "cortisol levels in children"; cortisol levels"

2. Isolated variables of interest used in systematic analyses of previous yoga studies both in children and in adults:

- Cortisol level changes
- Cerebral cortical changes
- Behavioral changes

4. Isolated congruencies and incongruencies of test variables, methods, and outcomes.

5. Identified future study designs and needs.

Acknowledgments

Appreciation and thanks to Dr. Brian Matayoshi for his influence and guidance in the development of this research topic.

Appreciation and thanks to my advisor, Dr. Valerie Cadet for her continued commitment and patience.

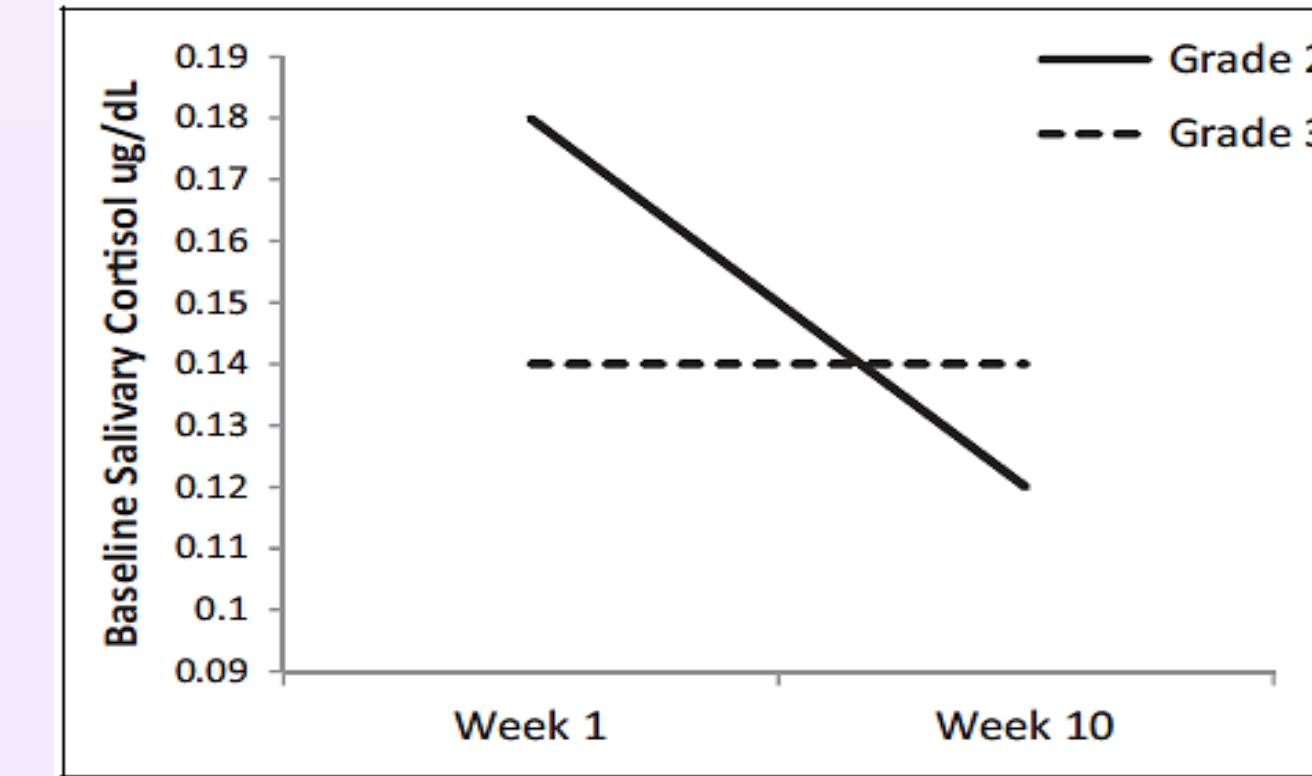
Special thanks to my fellow classmate, Nicole McManus, for her graphic design critiques.

Selected Variables of Yoga Studies

Yoga decreases cortisol levels

Cortisol level increase has been attributed to stress-induced situations and behaviors. Salivary cortisol levels have become the latest experimental variable used to quantitatively analyze the effects of yoga.

- Measurements of salivary cortisol levels in second and third grade students enrolled in classroom-based yoga were taken for 10 weeks. Enrolled students maintained significantly decreased salivary cortisol levels even after a stress stimulus was delivered (Butzer, *et al* 2015).



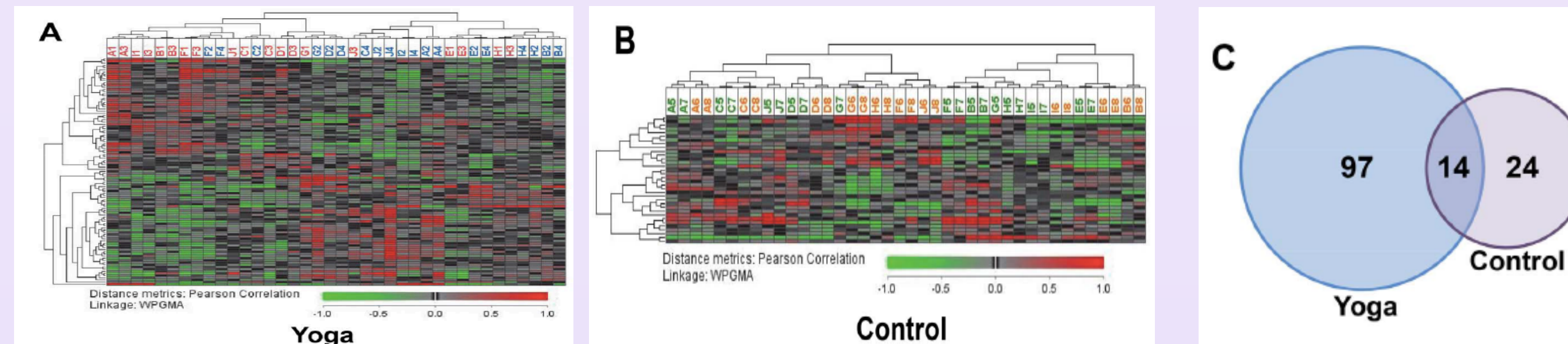
- The effect of social stress on weight gain and attention were assessed by measuring salivary cortisol levels in 84 middle school students. High salivary cortisol levels were positively correlated to the retention of excess weight and a decrease in task-oriented response-time. These students also had difficulty in discriminating directions in initiating task oriented activities (Verdejo-Garcia, *et al* 2015).

- A longitudinal analysis of HPA-axis changes observed that hyper- and hypo-cortisolism could be associated with internalizing and externalizing behaviors caused by the dysregulation of diurnal cortisol patterns in the brain (Ruttle, *et al* 2011).

- Hankin *et al* (2015) uncovered that determining cortisol levels predates symptom elevations, thus correlating that an HPA-axis shift in adolescent girls could suggest a predisposition to psychopathologies.

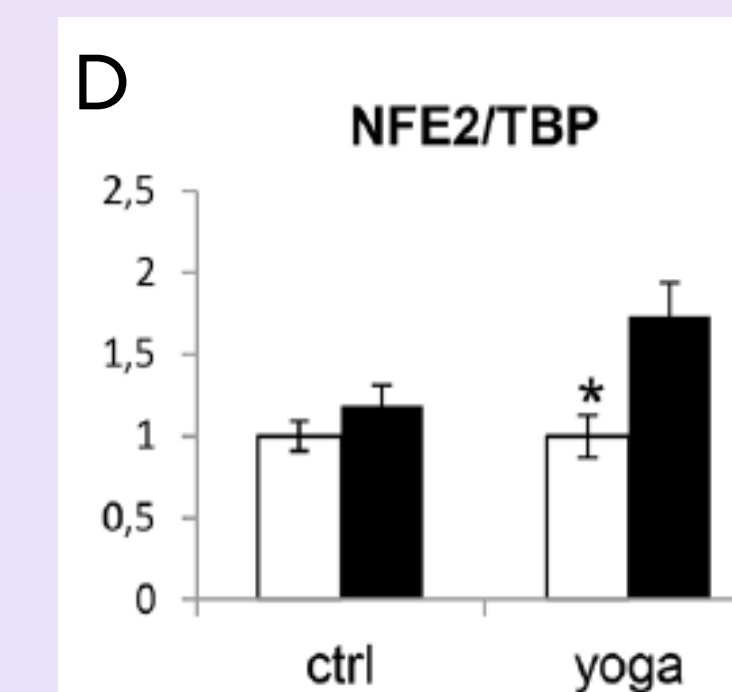
Yoga causes mononuclear genetic changes

- In a small sample population of 10 subjects age 18-50 years old, yoga induced rapid changes in circulating immune cells significantly over a control group. Microarray analysis showed upregulation of peripheral blood mononuclear cell genes. Congruencies between experimental (Fig. A) and control groups (Fig. B) were assessed. Figure C shows the congruently affected genes between the yoga and control groups (Qu, *et al* 2013).



- **Nuclear Factor Erythroid 2 (NFE2)** plays a role in megakaryocyte maturation. *NFE2 deficiency* is noted to cause a lack of platelets and hemorrhagic morbidity in lab animals.

- Upregulation of NFE2 was significantly different between the yoga intervention group and the control group (Fig. D).



Yoga affects behavior and promotes psychological changes in adolescents

- With a basic yoga technique called Iyengar, a 14-year old girl who suffered from persistent abdominal pain, sudden weight loss, and symptoms of anxiety made a dramatic full recovery from both pain and unwanted weight loss with diminished symptoms of anxiety (Evans, *et al* 2013).

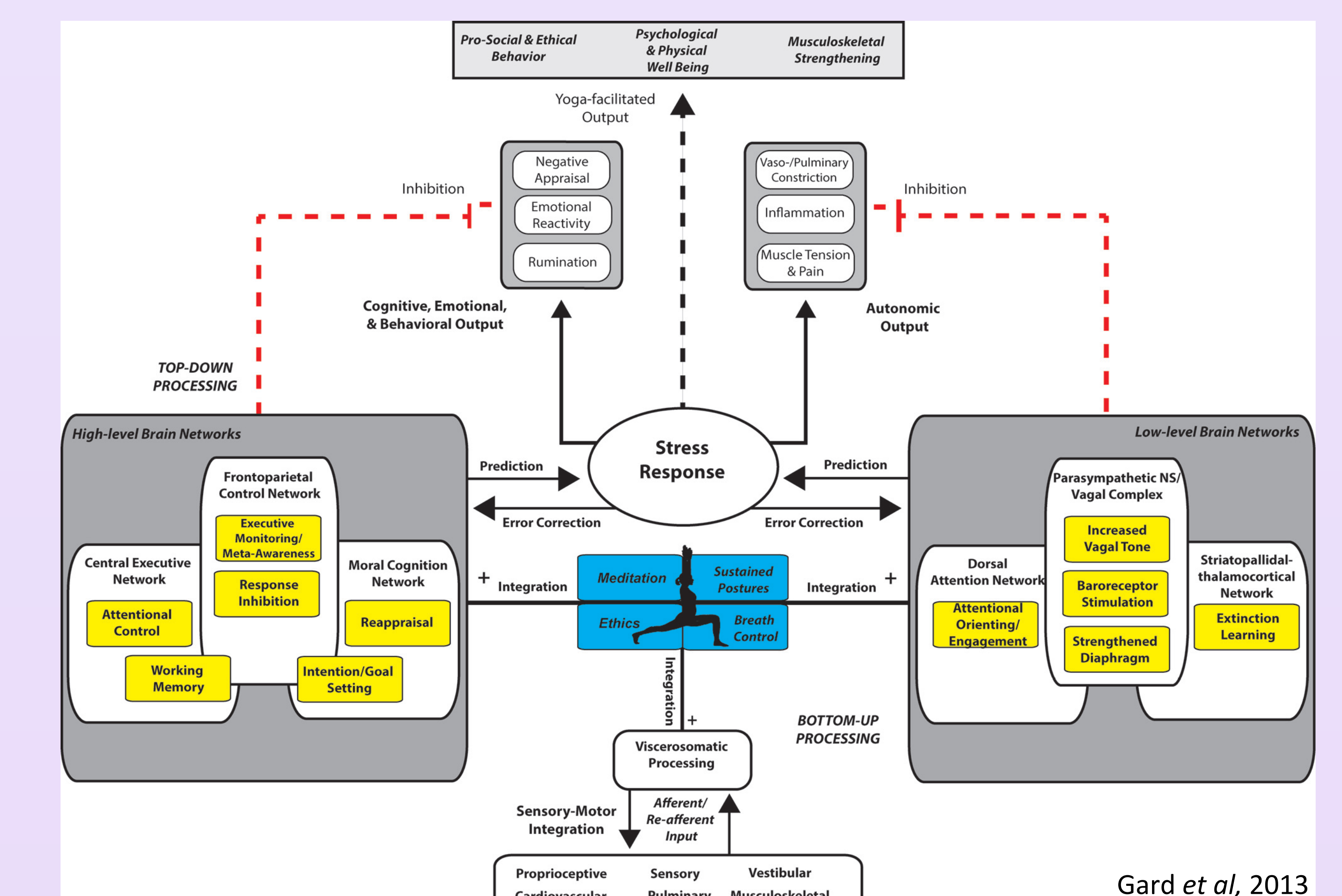
- A review of short- and long-term psychological benefits of yoga studies in school-aged children shows that yoga improves the health outcomes in both healthy subjects and in subjects with physical illnesses (Menezes, *et al* 2015).

- A 12-week study of middle-school aged children showed that yoga increased mindfulness and body awareness (Haden, *et al* 2014).
- An 8-week study of 66 college freshmen participating in a yoga-nirada intervention program (yoga with a guided meditation practice) showed that participants perceived a reduction in stress and an increase in mindfulness with skill-based tasks (Eastman-Mueller, *et al* 2013).
- Cognitive, social, and emotional skill improvements in second and third graders enrolled in classroom-based yoga for 10 weeks were assessed. Classroom teachers perceived mixed results with some teachers seeing improvements while others did not (Butzer, *et al* 2015).

Future Study Recommendations

- Adequate control groups are essential to show evidence-based outcomes even in psychological test parameters.
- Salivary cortisol level fluctuation standardization and age-range should be taken into study design and methodology planning. Both time of day and age can determine variable readings and outcomes in yoga studies (Butzer, *et al* 2015).
- Understanding of the tendency for cortisol levels to down-regulation in high-risk, stressed adolescents is crucial to consider in a cortisol measured-stress reduction yoga study design (Ruttle, *et al* 2011).
- Genetic variant upregulation should be further measured and functional consequences assessed (Qu, *et al* 2013).
- Population demographics should be weighted with yoga intervention programs in order to account for socioeconomic stratification (Haden, *et al* 2014).
- Serwacki and Cook-Cottone suggested that though school-based programs are beneficial, there are methodology issues in randomization, convoluted details, and limited conclusions which can be made from the trials (Serwacki and Cook-Cottone, 2012).

Gard and colleagues' model of the various testable mechanisms and benefits of yoga



References

Bauer B, Day D, Potts A, Ryan C, Coleman S, Davies D, Westwood K, Elert M, Flynn L, Khalil SR. *Effects of a classroom-based yoga intervention on cortisol and behavior in second- and third-grade students: a pilot study.* J Endocrinol Invest. 2014;37(11):1419-25. doi: 10.1007/s12005-014-0457-9. Epub 2014 Nov 19. PMID: 25118136. PubMed Central PMCID: PMC4179742.

Eastman-Mueller H, Wilson T, Jung AK, Kimura A, Farrant J. *Best practices on the college campus: changes in stress, depression, anxiety, and mindfulness.* Int J Yoga Therap. 2013;23(1):5-24. PMID: 24165520.

Evans S, Serwacki B, Zetterl R, Tann J. *Yoga, yoga and the use of yoga in pediatric chronic pain: a case study.* Altern Ther Healthc. 2013 Sep-Oct;19(5):66-70. PMID: 23981408. PubMed Central PMCID: PMC3836371.

Gard T, Neigale JJ, Park CL, Vago DR, Wilson A. *Yoga and respiratory reactivity in yoga for psychological health.* Front Hum Neurosci. 2014 Sep 30;8:770. doi: 10.3389/fnhum.2014.00770. eCollection 2014. PMID: 25288562. PubMed Central PMCID: PMC4179742.

Haden SC, Day S, Payne M. *Assessing the Impact of Yoga and Meditation on the Emotional and Behavioral Development of Middle School Children.* Focus Altern Complement Ther. 2014 Sep;19(3):149-155. PMID: 25118136. PubMed Central PMCID: PMC4179742.

Hankin RL, Badtke LS, Swanson N, Young JF. *Gender differences in stress reactivity and autonomic nervous system responses to stress reactivity.* J Abnorm Psychol. 2015 Feb;124(1):41-51. doi: 10.1037/abn0000009. PMID: 25681622. PubMed Central PMCID: PMC4222250.

Menezes CA, Delpaz, Natalia R, Casses, Luz Dabian, Spahr, William, Hernandez, Julian, Ochoa, Ayo A. *Yoga and emotion regulation: A review of primary psychological outcomes and their physiological correlates.* Psychology & Neuroscience. Vol 8(1), Mar 2015, 85-101.

Cu S, Oshoff SM, Mesa Zapata LA, Santoghi F. *Basal gene expression changes in peripheral blood leukocytes upon practice of a contemplative yoga program.* PLoS One. 2013 Apr 17;8(4):e61910. doi: 10.1371/journal.pone.0061910. PMID: 23643970. PubMed Central PMCID: PMC3629742.

Ruttle PL, Shoroff EA, Sartin LA, Fisher DB, Spaid DM, Schermer AE. *Disrupting psychobiological mechanisms underlying intolerance and emotional behaviors in youth: longitudinal and concurrent associations with cortisol.* Horm Behav. 2011 Jan;59(1):123-32. doi: 10.1016/j.yhbeh.2010.10.015. Epub 2010 Nov 5. PMID: 21000000. PubMed Central PMCID: PMC3045641.

Serwacki ME, Cook-Cottone C. *Yoga in the schools: a systematic review of the literature.* N J Yoga Therap. 2013;23(1):101-9. Review. PMID: 23975985.

Verdejo-Garcia A, Moreno-Puellos M, Garcia-Roz SAC, Lopez-Tamajak F, Delgado-Pena E, Schrab-Rov V, Fernandez-Serrano MA. *Social stress increases cortisol and dopamine secretion in adolescents with anxiety.* PLoS One. 2015 Apr 21;10(4):e0122565. doi: 10.1371/journal.pone.0122565. eCollection 2015. PMID: 25892824.