

Breath-based meditation: A mechanism to restore the physiological and cognitive reserves for optimal human performance

Kirtigandha Salwe Carter, Robert Carter III

Kirtigandha Salwe Carter, Department of Integrative Physiology, University of North Texas Health Science Center, Fort Worth, TX 76107, United States

Robert Carter III, Tactical Combat Casualty Care Research Program, United States Army Institute of Surgical Research, Joint Base San Antonio-Fort Sam, Houston, TX 76107, United States

Author contributions: Both authors contributed equally to this work.

Conflict-of-interest statement: The authors have no conflict of interest.

Open-Access: This article is an open-access article which was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>

Correspondence to: Kirtigandha Salwe Carter, MBBS, MPH, Department of Integrative Physiology, University of North Texas Health Science Center, 2500 Camp Bowie Blvd, Fort Worth, TX 76107, United States. drkirticarter@gmail.com
Telephone: +1-210-7730307

Received: September 6, 2015

Peer-review started: September 8, 2015

First decision: October 16, 2015

Revised: January 3, 2016

Accepted: February 14, 2016

Article in press: February 16, 2016

Published online: April 16, 2016

Abstract

Stress can be associated with many physiological

changes resulting in significant decrements in human performance. Due to growing interests in alternative and complementary medicine by Westerners, many of the traditions and holistic yogic breathing practices today are being utilized as a measure for healthier lifestyles. These state-of-the-art practices can have a significant impact on common mental health conditions such as depression and generalized anxiety disorder. However, the potential of yogic breathing on optimizing human performance and overall well-being is not well known. Breathing techniques such as alternate nostril, Sudarshan Kriya and bhastrika utilizes rhythmic breathing to guide practitioners into a deep meditative state of relaxation and promote self-awareness. Furthermore, yogic breathing is physiologically stimulating and can be described as a natural "technological" solution to optimize human performance which can be categorized into: (1) cognitive function (*i.e.*, mind, vigilance); and (2) physical performance (*i.e.*, cardiorespiratory, metabolism, exercise, whole body). Based on previous studies, we postulate that daily practice of breathing meditation techniques play a significant role in preserving the compensatory mechanisms available to sustain physiological function. This preservation of physiological function may help to offset the time associated with reaching a threshold for clinical expression of chronic state (*i.e.*, hypertension, depression, dementia) or acute state (*i.e.*, massive hemorrhage, panic attack) of medical conditions. However, additional rigorous biomedical research is needed to evaluate the physiological mechanisms of various forms of meditation (*i.e.*, breath-based, mantra, mindfulness) on human performance. These efforts will help to define how compensatory reserve mechanisms of cardiovascular and immune systems are modulated by breath-based meditation. While it has been suggested that breath-based meditation is easier for beginning practitioners when compared to other forms of meditation more research is needed to elucidate these observations. A breath-based meditation sequence such

as Sudarshan Kriya has the potential to help develop an individual's self-awareness and support better integration of the brain (*i.e.*, mind) with other organ systems (*i.e.*, body) for enhanced human performance.

Key words: Meditation; Breathing technique; Cognitive reserve; Neurophysiology; Stress; Human performance; Emotional regulation

© **The Author(s) 2016.** Published by Baishideng Publishing Group Inc. All rights reserved.

Core tip: Breath-based meditation has potential benefits for patients with chronic diseases and mental health disorders to otherwise healthy individuals interested in optimizing their physical and cognitive performance.

Carter KS, Carter III R. Breath-based meditation: A mechanism to restore the physiological and cognitive reserves for optimal human performance. *World J Clin Cases* 2016; 4(4): 99-102 Available from: URL: <http://www.wjgnet.com/2307-8960/full/v4/i4/99.htm> DOI: <http://dx.doi.org/10.12998/wjcc.v4.i4.99>

INTRODUCTION

Stress can be associated with many physiological changes resulting in significant decrements in human performance. Recent innovations in medicine and wellness are currently rediscovering and validating numerous health practices such as yoga, meditation and breathing techniques from traditional cultures. While most often associated with Eastern cultures and traditions, the term "meditation" denotes emotional and reflective practices from cultural frameworks including Christianity, Judaism and Islam. More recently, breath-based meditation techniques that are a major component of routine Eastern practices, have been so called "Westernized" and are routinely suggested for better health and well-being^[1]. Furthermore, a growing number of Westerners are adopting Eastern spiritual practices and mind-body therapeutic interventions such as yogic breathing^[2].

Breath-based meditation techniques generally utilize rhythmic breathing to guide practitioners to enter into a deeply meditative, relaxed mental state. We postulate that yogic breathing should not only be considered as a solution for health, but as a natural, technological solution for optimizing human performance. Human performance is generally categorized into cognitive function (*i.e.*, mind, brain) and physical performance (*i.e.*, cardiorespiratory, muscle metabolism) (Figure 1). Specifically, performance can be defined as activities and outcomes related to measurable goals and objectives that are expressed in absolute or relative terms.

As previously described, the concept of so-called "physiological reserve" is described as the compensatory

mechanisms available to sustain physiological function before the clinical expression of a disease or disorder^[3]. For example, we recently demonstrated that optimizing the respiratory pump (rhythmic breathing) contributed to increasing tolerance to decreases in central blood volume by extending the body's compensatory reserve mechanisms^[3]. Recently in a randomized control trial, breath-based meditation (*i.e.*, Sudarshan Kriya) significantly reduced post-traumatic stress disorder (PTSD) symptoms, hyperarousal, re-experiencing symptoms, anxiety, and respiration rate in United States military combat veterans^[4], suggesting that rhythmic breathing has the potential to restore cognitive functional reserve mechanisms. Reductions in PTSD symptoms and hyperarousal have been shown to have a positive impact on quality of life, which also may be an important component of optimized human performance. We hypothesize that yogic breathing plays a significant role in restoring the compensatory mechanisms, as it relates to mitigating PTSD and associated life stressors.

The purpose of this editorial is to introduce the notion that breath-based meditation (*i.e.*, pranayama, Sudarshan Kriya, alternate nostril, Ujjayi) may play a significant role in preserving and "restoring" both physiological and cognitive functional reserve. We discuss the proposed underlying mechanisms of yogic breathing in optimizing human performance and well-being.

THE PHYSIOLOGICAL MECHANISMS OF YOGIC BREATHING

Yogic breathing, when practiced together with traditional meditation has been shown to reduce physiological stress. This has been previously described in detail by Brown *et al.*^[1] and reviewed by Sharma *et al.*^[5]. A detailed description of the fundamental breathing techniques that comprise of the Sudarshan Kriya sequence has been previously outlined by Brown *et al.*^[1] and others^[6]. Briefly, Sudarshan Kriya is a form of breath-based meditation which follows four breathing exercises: (1) victory breath or Ujjayi; (2) bellows breath or Bhastrika; (3) "Om" chanted three times; and (4) concluded with a series of three distinct rhythmic, circular breathing patterns^[5].

A growing body of evidence suggests that yogic breathing contributes to improved cognitive performance, better tissue perfusion, lower blood pressure^[7], glucose metabolism^[8] and increased immune system^[9]. It is well documented that these physiological changes are associated with optimal human performance.

Similar to routine physical activity, the daily practice of pranayama and breath-based meditation can provide moderate stimulation to the autonomic nervous system^[1]. Therefore, the compensatory reserve mechanisms to defend against routine insults may be preserved by appropriate activation of the sympathetic nervous system and balancing the components of the autonomic nervous system^[3].

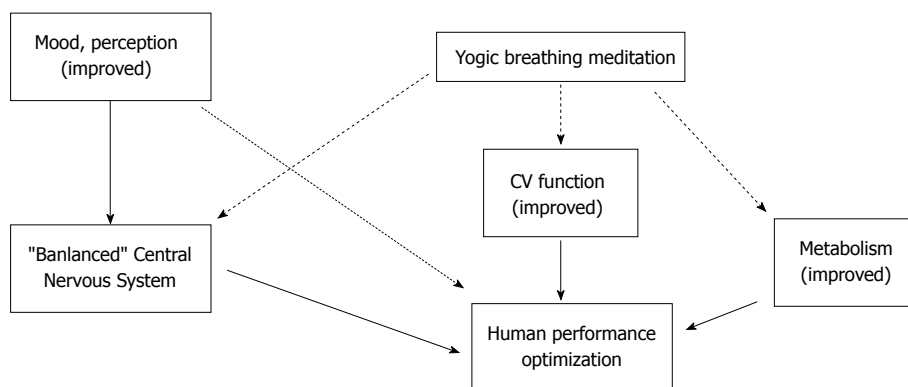


Figure 1 Proposed model of the relationship between yogic breathing meditation and human performance.

The physiological responses to physical stress (*i.e.*, exercise, hemorrhage) or cognitive stress consist of adjustments in metabolism, cardiovascular function, and the autonomic nervous system. Each of these mechanisms contribute to the physiological reserve of an individual and is specific to the genetic make-up, non-genetic factors, and event dependent (*i.e.*, the level of stress). In nature, the breathing patterns of animals reflect the presence of environmental stressors (*i.e.*, predators, drought) and the level of physical activity. While, humans are presented with numerous internal and external stressors on a daily basis, the consequences of these insults on short and long term human performance, health, and well-being are not always considered.

Brown *et al.*^[1] introduced the neurophysiological mechanisms underlying yogic breathing. They suggested that a concomitant temporary state of alertness and calmness are spontaneously produced by activation of the autonomic nervous system. Breath-based meditation seems to modulate the appears to modulate metabolism and cardiovascular function through neural pathways and structures within the brain^[6]. However, specifically how these physiological responses contribute to potential acute and long-term improvements in human performance and well-being are unknown. However, we postulate based on existing evidence that Sudarshan Kriya the unique sequence of breathing patterns and durations likely simulate various peripheral and central sensory pathways related compensatory mechanisms that govern balancing metabolism, cardiovascular and nerve function.

MODULATING FACTORS ON COGNITIVE FUNCTIONAL RESERVES

The concept of functional cognitive reserves is the postulated capacity of a mature adult brain to sustain the effects of chronic stress, disease or injury (traumatic or non-traumatic) without manifesting clinically. Generally, it is hypothesized that the variability in functional reserve is related to individual differences in cognitive processes and brain neural networks which

allow some individuals to cope better than others^[10]. A growing body of literature suggests that the reserve capacity is not only active and functional but modifiable with time, experience, and training^[11]. This is a significant derivation from the previous concept of "brain reserve" which suggested that brain size govern the capacity of cognitive processes and reserves. Thus suggesting that individuals with similar brain neural network and baseline cognitive processes may have different functional reserves their cognitive functional reserves may be modifiable with techniques such as breath-based meditation.

Recently, enriched environment (EE), cognitively stimulating activities, cognitive training, and physical training were identified as factors for enhanced psychological resilience^[12] and sustained functional cognitive reserves. It is likely that these factors may contribute to more resistance to cognitive decline, optimized human performance and improved quality of life.

EE

There is emerging evidence that stressful environmental conditions may have a negative impact on human performance and lead to significant decrements in cognition^[13].

Cognitive stimulating activities

Stimulating cognitive activities and training have been shown to improve neural function and lessen age-related decline in memory loss. Breath-based meditation could be considered as a cognitively stimulating activity to help promotion better brain health.

Physical training

A study showed that physical training combined with yoga may have more benefits than exercise alone^[9]. Stress may negatively affect cognition, mood, and mental status during physical training. Given that yogic breathing has been shown to reduce stress, this may be a plausible mechanism to improve physical training and human performance. Furthermore, there is emerging evidence that the ability to sustain exercise performance comes from a conscious effort and meditation may have a positive impact on this relationship.

Recently, it was demonstrated that training in meditation has significant advantages over exercise for reducing cold and flu illness, and was associated with improved immune system and quality of life^[11]. While the scientific community may not fully understand the impact of mental status and perception on health and human performance, it is apparent that the compensatory reserve of each organ system responds to preserve functionality.

CONCLUSION

Daily stress is associated with many physiological changes resulting in significant decrements in human performance. The mechanisms by which yogic breathing may positively impact our compensatory mechanisms to restore functional cognitive reserves and other physiological systems are not completely understood. It is very likely that meditation and intentional rhythmic breathing may, in part, reduce the overall physiological strain and mental workload on these human systems. By reducing the physical and cognitive workloads on the organ systems, optimal human performance is accomplishable. Physical activity training, EEs and cognitive reserve preserving activities such as meditation may have a positive impact on sustaining human performance during periods of acute or prolonged stress.

REFERENCES

- 1 **Brown RP**, Gerbarg PL. Sudarshan Kriya yogic breathing in the treatment of stress, anxiety, and depression: part I-neurophysiologic model. *J Altern Complement Med* 2005; **11**: 189-201 [PMID: 15750381 DOI: 10.1089/acm.2005.11.189]
- 2 **Zope SA**, Zope RA. Sudarshan kriya yoga: Breathing for health. *Int J Yoga* 2013; **6**: 4-10 [PMID: 23440614 DOI: 10.4103/0973-6131.105935]
- 3 **Poh PY**, Carter R, Hinojosa-Laborde C, Mulligan J, Grudic GZ, Convertino VA. Respiratory pump contributes to increased physiological reserve for compensation during simulated haemorrhage. *Exp Physiol* 2014; **99**: 1421-1426 [PMID: 25016024 DOI: 10.1113/expphysiol.2014.081208]
- 4 **Seppälä EM**, Nitschke JB, Tudorascu DL, Hayes A, Goldstein MR, Nguyen DT, Perlman D, Davidson RJ. Breathing-based meditation decreases posttraumatic stress disorder symptoms in U.S. military veterans: a randomized controlled longitudinal study. *J Trauma Stress* 2014; **27**: 397-405 [PMID: 25158633 DOI: 10.1002/jts.21936]
- 5 **Sharma P**, Thapliyal A, Chandra T, Singh S, Baduni H, Waheed SM. Rhythmic breathing: immunological, biochemical, and physiological effects on health. *Adv Mind Body Med* 2015; **29**: 18-25 [PMID: 25607119]
- 6 **Brown RP**, Gerbarg PL. Sudarshan Kriya Yogic breathing in the treatment of stress, anxiety, and depression. Part II--clinical applications and guidelines. *J Altern Complement Med* 2005; **11**: 711-717 [PMID: 16131297 DOI: 10.1089/acm.2005.11.711]
- 7 **Agte VV**. Sudarshan Kriya Yoga for Improving Antioxidant Status and Reducing Anxiety in Adults. *Alternative and Complementary Therapies* 2008; **14**: 96-10 [DOI: 10.1089/act.2008.14204]
- 8 **Agte VV**, Jahagirdar MU, Tarwadi KV. The effects of Sudarshan Kriya Yoga on some physiological and biochemical parameters in mild hypertensive patients. *Indian J Physiol Pharmacol* 2011; **55**: 183-187 [PMID: 22319901]
- 9 **Kochupillai V**, Kumar P, Singh D, Aggarwal D, Bhardwaj N, Bhutani M, Das SN. Effect of rhythmic breathing (Sudarshan Kriya and Pranayam) on immune functions and tobacco addiction. *Ann N Y Acad Sci* 2005; **1056**: 242-252 [PMID: 16387692 DOI: 10.1196/annals.1352.039]
- 10 **Katzman MA**, Vermani M, Gerbarg PL, Brown RP, Iorio C, Davis M, Cameron C, Tsirgielis D. A multicomponent yoga-based, breath intervention program as an adjunctive treatment in patients suffering from generalized anxiety disorder with or without comorbidities. *Int J Yoga* 2012; **5**: 57-65 [PMID: 22346068 DOI: 10.4103/0973-6131.91716]
- 11 **Khemka SS**, Ramarao NH, Hankey A. Effect of integral yoga on psychological and health variables and their correlations. *Int J Yoga* 2011; **4**: 93-99 [PMID: 22022128 DOI: 10.4103/0973-6131.85492]
- 12 **Johnson EM**, Traver KL, Hoffman SW, Harrison CR, Herman JP. Environmental enrichment protects against functional deficits caused by traumatic brain injury. *Front Behav Neurosci* 2013; **7**: 44 [PMID: 23734108 DOI: 10.3389/fnbeh.2013.00044]
- 13 **Adam GE**, Carter R, Chevront SN, Merullo DJ, Castellani JW, Lieberman HR, Sawka MN. Hydration effects on cognitive performance during military tasks in temperate and cold environments. *Physiol Behav* 2008; **93**: 748-756 [PMID: 18166204 DOI: 10.1016/j.physbeh.2007.11.028]

P- Reviewer: Hauswald A

S- Editor: Qiu S L- Editor: A E- Editor: Jiao XK





Published by **Baishideng Publishing Group Inc**

8226 Regency Drive, Pleasanton, CA 94588, USA

Telephone: +1-925-223-8242

Fax: +1-925-223-8243

E-mail: bpgoffice@wjgnet.com

Help Desk: <http://www.wjgnet.com/esps/helpdesk.aspx>

<http://www.wjgnet.com>

