

Chapter 7

Molecular Mechanisms Underlying the Effects of Yoga

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ABSTRACT

Complex chronic lifestyle disorders are the leading causes of death and disability worldwide. Stress and anxiety associated with today's hectic life schedule and polluted environment have contributed a lot in triggering and causing many chronic diseases and decreased quality of life, even with pharmacologic treatment. Most of the chronic complex diseases, such as chronic obstructive pulmonary disease, depression, autoimmune diseases, cancer, cardiovascular diseases, obesity, and diabetes mellitus share underlying mechanisms like high levels of stress, anxiety, depression, oxidative stress, shorter telomeres, persistent activation of hypothalamo-pituitary adrenal axis, inflammation and dysregulated immune system, and thus need to be managed by an integrated approach that targets both mind and body. The individuals with these conditions have been reported to benefit from yoga, but the underlying mechanism of action of yoga remains unclear. The aim of this chapter is to summarize the mechanism of action underlying the cumulative effect of yoga on multiple pathways at a cellular level.

INTRODUCTION

Yoga is a mind body intervention of Indian origin which brings balance to all dimensions of health viz physical, mental, emotional, and spiritual. It aims to bring about the synchrony of physical and mental health by prevention of disease, maintenance of health and attaining peace of mind. The literal meaning of the Sanskrit word “yoga” is “union” (Woodyard, 2011). According to the proponent of Ashtanga yoga “Maharishi Patanjali”, yoga is defined as the discipline to develop one's inherent power in a balanced manner and subduing modifications of one's mind. Yoga is an integrative science which regulates various organ systems of the body and offers the means to attain complete self-realization (Gard et al.,

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2014). The most commonly used components of yoga therapy for health benefits are *asanas* (physical postures), *pranayama* (regulated breathing) and *dhyana* (meditation). The features like breath regulation, mindfulness and maintenance of postures are some of the elements which are responsible for the activation of parasympathetic nervous system and hence differentiate yoga practices from physical exercises (Ross & Thomas, 2010). Several studies cited the positive effects of mind body interventions (MBIs) improving patients' overall well-being and quality of life, reducing their psychological distress, improving sleep patterns and creating a positive mental state and decreasing their pain intensity (Fernros et al., 2008; Gautam et al., 2019; Telles & Singh, 2012; Tolahunase et al., 2018; Tolahunase et al., 2017; Zautra et al., 2008). Yoga is a complete package of mindfulness-based stress reduction and relaxation techniques which acts via a well-defined psycho-neuroendocrine pathway. Various stressors reduce the immune efficiency and fail to protect the health of all vital systems. The cortical region of CNS is the seat of awareness, consciousness and all voluntary psycho-physiological functions including control of breath, which results in modulation of neuro-humoral response as well as monitors the homeostasis of all the physiological systems for optimum health. However, ill-effects of stress causing the cortical dysfunction may jeopardize the overall homeostasis leading to various disorders. The psychophysiological aspects of stress response arising from the brain functions are supposed to reflect on the functions of hypothalamic-pituitary-adrenal (HPA) axis. The HPA axis is hypothalamic, pituitary, adrenal axis, which consist of a central stress response system. Since most of the motor commands are routed through HPA axis and other endocrine functions, the motor commands are propagated via brain stem and reticular activating system to HPA axis. Thus, the stress related effects of HPA working in unconscious mode might modulate neuro-endocrine axis that in turn affects immune system. HPA hyperactivity predisposes to increased cellular oxidative stress (OS). Yoga leads to an inhibition of the posterior or sympathetic area of the hypothalamus, thus, optimizing the body's sympathetic responses to stressful stimuli, and restores autonomic regulatory reflex mechanisms associated with stress. It is also well known that the hypothalamus and the limbic system are intimately concerned with emotional expressions. Yoga practices inhibit the areas responsible for fear, aggressiveness, and rage, and stimulate the rewarding centers in the median forebrain and other areas, leading to a state of bliss and pleasure (Woodyard, 2011). This results in lower anxiety, heart rate, respiratory rate, blood pressure, and cardiac output in individuals practicing yoga and meditation. Yoga practices probably inhibit the activity of the paraventricular nuclei of the hypothalamus, which in turn affects the anterior pituitary gland to produce less ACTH (Arora & Bhattacharjee, 2008). The decrease in ACTH decreases the synthesis of cortisol from the adrenal glands. Yoga possesses a buffering action on stress mediated immune responses, maintains cardio-vagal tone, and maintains a homeostasis between parasympathetic and sympatho-adrenal nervous system and downregulates HPA axis response (Arora & Bhattacharjee, 2008; Kanojia et al., 2013).

The growing popularity of mind body therapies (MBTs) including yoga based lifestyle intervention (YBLI), mindfulness based stress reduction (MBSR), Tai-chi, Qigong etc. have emphasized the need to discover the molecular mechanisms behind their therapeutic actions. A meta-analysis on the effect of mind body therapies on the immune system concluded that yoga has anti-inflammatory and immunomodulatory potential (Morgan et al., 2014). Short term yoga and related practices result in rapid global gene expression profile changes in the peripheral blood mononuclear cells (PBMCs) which may be the basis for their long term cell biological and higher level health effects (Qu et al., 2013). A review of clinical effectiveness of mindfulness training and yoga for the management of chronic non-malignant pain provided the evidence of improved pain acceptance and depression scores (Lachance & McCormack, 2019). Recent studies from our laboratory that focussed on various complex chronic lifestyle disorders

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