Chapter 2
Psychophysiology:
Healing Effects of Voluntarily Regulated Breathing Practices

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ABSTRACT

This chapter describes the physiological mechanisms that underpin the varying effects of different types of breath practices inherent in the yoga tradition and ultimately the role that breathing techniques play in person and public health. Concurrently, the script elucidates how different practices alter psychophysiological states clarifying why and how they may be employed with specific health populations, how they may enhance and or maintain well-being, and clear guidance regarding precautions and contraindications.

INTRODUCTION

For thousands of years, breathing techniques, called *pranayama* in Sanskrit and translated as "restraining of life force or breath", have been practiced for their energetic, physiological, psychological, and spiritual benefits. Here we use the current secular terminology, Voluntarily Regulated Breathing Practices (VRBPs), to indicate techniques in which a person volitionally changes their respiratory pattern (Telles & Singh, 2013). The term VRBP recognizes the multi-cultural origins of breath practices and it is more readily accepted by scientists, governmental agencies, and people of diverse religious backgrounds. The physiological effects of VRBPs overlap but differ from, those of the automatic breathing they override.

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VRBPs entail volitional alterations in breath patterns that include changes in the respiratory rate, the relative length of four components of each breath cycle (inhalation, pause, exhalation, pause), forcefulness of the inhale or exhale, depth of respiration, use of the diaphragm versus accessory muscles, nostril dominance, resistance to airflow, and breath holding (Brown & Gerbarg, 2012; Gerbarg & Brown, 2016). Effects may be synergistic when techniques are done in concert with visualization, movement, vocalization, and meditation, or through the sequencing of practices.

A growing body of research is documenting the physiological and psychological effects of breath techniques, inspiring yoga teachers and healthcare professionals to apply VRBPs therapeutically. Health educators and policy makers are recognizing the value of VRBPs as public health interventions for an array of mental health disorders and physical health problems, for example, cardiovascular, gastrointestinal, inflammation, pain, and stress-related medical conditions.

Notably, breath practices are valued for their therapeutic role in emotion regulation, autonomic balance, stress reduction, attentional control, mood, cognitive function, social engagement, and substance abuse. Accordingly, VRBPs offer significant benefits in prevention and treatment of mental disorders, including the global epidemic of anxiety, depression, trauma, and post-traumatic stress disorders.

VRBPs are advantageous for both individual and public health interventions. They are easy to learn in a short period of time, teachable to large groups by small numbers of providers, inexpensive, rapidly effective, low risk, non-stigmatizing, and easily adapted for acceptance by diverse cultures when taught in a secular manner. Furthermore, VRBPs can be transmitted and sustained by local trainees without professional degrees. Many techniques can be practiced anywhere and would be undetectable, even in the company of others.

This chapter explores the mechanisms that underlie physiological changes associated with specific breathing practices and, where possible, links these with clinical applications. To understand the rapid, global effects of Voluntarily Regulated Breathing Practices (VRBPs) on the mind and body, we must recognize that every breath activates a constellation of psychophysiological processes. We review the anatomy and physiology of natural, automatic breathing, including cardiorespiratory reflexes. From this foundation, we explore the evidence supporting neurophysiological theories about the mechanisms of action brought into play by changing the patterns of breathing and the effects these may have on psychophysiological states and pathophysiology. Taking into account the afferent, bottom-up messages rising from the respiratory system to the brain, the efferent, top-down messaging descending from the brain to the body, the feedback loops at all levels—peripheral, brainstem, subcortical, and cortical—we may well stand in awe of the complex systems we are trying to delineate.

Physiology of Natural Respiration – Automatic Breathing

Automatic breathing is controlled by inspiratory neurons, the dorsal respiratory group (DRG), and expiratory neurons, the ventral respiratory group (VRG) located in the brainstem (medulla oblongata). Additionally, the pontine respiratory group (PRG) houses the pneumotaxic and apneustic centers, which jointly inhibit inspiration and prevent over distension of the lungs. The DRG lies in the nucleus tractus solitarius (NTS), a relay station for chemosensory and somatosensory information. Inhalation begins when the DRG signals the phrenic nerve to contract the diaphragm downwards reducing pressure within the pulmonary system and expanding the lungs. Air is pulled into the respiratory tract when the pressure within the lungs is lower than the external air pressure. When the lungs expand numerous stretch receptors within the alveoli (millions of small air sacs throughout the lungs), lung tissue, and airways discharge;