

REVIEW ARTICLE

Utility of a Rhythmic Breathing Technique in Enhancing Immune Parameters among Healthcare Workers; A Possible Solution to Prevent Burnout

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ABSTRACT

Background: Healthcare workers (HCWs) form the crux of any healthcare system. They are constantly exposed to high-risk infections and have demanding work conditions, hence being subjected to constant physical and psychological stress. With the recent global situation where millions continued to be affected by the coronavirus, for which no potential cure has been identified, there is an urgent need to strengthen the immune system of HCWs naturally to handle future outbreaks and manage acute crises, avoiding possible “burnout”.

Methods: This review gathered literature from PubMed, Scopus, Google scholar, Cochrane Library and EMBASE by using keywords based on MeSH terms related to Sudarshan Kriya Yoga (SKY) and its comprehensive health & well-being benefits on various populations.

Results: Mind-body therapy (MBT) methods like yoga and meditation techniques, are known to have beneficial effects in enhancing immunity and thus preventing various diseases. One of the most cost-effective and self-empowering methods is the Sudarshan Kriya Yoga (SKY). SKY is a rhythmic breathing technique that is scientifically effective in managing depression, anxiety, and stress, improving sleep and overall well-being, reducing free radicals, boosting the immune system,

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improving lung capacity, enhancing brain wave activity and much more. A recent pilot study evaluated the impact of SKY on the well-being of HCWs during the COVID-19 pandemic and suggested a positive effect on reducing stress and improving resilience.

Conclusion: This review highlights the immense potential of SKY in generating a long-lasting impact to promote health, well-being and prevent diseases in populations. However, to strengthen the evidence, further large scale randomized controlled trials are warranted to establish its effectiveness in the prevention of a burnout among HCW's in future challenging situations such as the pandemic.

KEYWORDS

• Yoga • Stress • Wellbeing • Health • Immunity

INTRODUCTION

Healthcare workers (HCWs) are frontline warriors crucial for any healthcare system. They are at a higher risk of getting chronically stressed and are exposed frequently to infections. The coronavirus disease 2019 (COVID-19) has witnessed this phenomenon of excessive stress among HCWs, resulting in physical, mental, and emotional exhaustion, thus causing "Burnout". In a recent publication, the World Health Organization (WHO) predicted a shortage of > 18 million HCWs by 2030.¹ The number of healthcare providers is less than 25% of the WHO's benchmark. A high prevalence of stress, anxiety, depression and sleep disorders resulting in frequent illness, depressed immunity and a proinflammatory response was observed during the COVID-19 pandemic.² The pandemic has exacerbated the excess shortage. Though the phase of severe stress to burnout is gradual, it is crucial to implement preventive and promotive strategies to cope with the increasing demands.

HCWs also have a higher risk of exposure to infections with lesser recovery times due to more prolonged and erratic working hours, resulting in a pro-inflammatory state. Smouldering inflammation is implicated in a variety of conditions, such as obesity, cancer, diabetes, autoimmune diseases, allergic disorders, heart diseases and ageing.³ Mental stress, anxiety, addictions, poor quality of nutrition and inadequate sleep among HCWs may result in depressed immunity. Hence, equilibrium must be maintained to keep the immune system under check, thus avoiding a hyper-vigilant vs a feeble response.⁴ More so, with increasing work pressure on healthcare

workers during demanding times, their physical and mental health must be cared for.⁵ The consequence of stress & mental health on the immune system is also well-established in Psychoneuroimmunology.⁶ Therefore, reducing tension and building immunity would help individuals, particularly HCWs, fight future waves of infections, alleviate stress-related psychosomatic illnesses and control chronic inflammation-related metabolic and endocrine diseases. There are multiple ways to improve immunity, like changing diet, exercise, sleep patterns, avoiding addictions, and consuming health supplements.⁴ Along with these, Mind-body therapies (MBTs), including yoga and meditation techniques, have beneficial effects in enhancing immunity and preventing various diseases.⁷ They hold significant promise and potential to boost immunity and reduce stress across multiple populations. Although the exact mechanisms are unclear, they are mostly known to modulate via the autonomic nervous system through the hypothalamic pituitary adrenal (HPA) axis.⁷

Among the various therapies, one of the most cost-effective and self-empowering methods is the Sudarshan Kriya Yoga (SKY). SKY is a rhythmic breathing technique that is scientifically proven to be effective in managing various stress and its related health conditions.⁸ Although yoga practices have become popular recently, there still exist hurdles to their application among the healthcare population. With advances in technology & virtual delivery methods, incorporating these interventions into daily life holds promise to serve as an accessible, doable, simple, yet profound adjunct to improve the overall

quality of life. Here, we reviewed the impact of Sudarshan Kriya Yoga (SKY), a globally accepted, virtually deliverable intervention, on various parameters concerned with the immune system & well-being of multiple populations and its potential to impact the healthcare community positively.

METHODS

The study was registered and clearance given by the Institutional Ethics Committee with the number IEC-NI/21/APR/78/70. This mini review gathered literature from PubMed, Scopus, Google scholar, Cochrane Library and EMBASE by using keywords based on MeSH terms related to Sudarshan Kriya Yoga (SKY) and its comprehensive health & well-being benefits on various populations. Duplicates were removed, data was assessed and recorded. Inclusion criteria were articles published on effects of SKY on the inflammatory, immune, mental and cardiorespiratory health parameters. Exclusion criteria were case reports or studies with small sample sizes, other mind body interventions and articles of low quality. Based on the above, a comprehensive analysis was performed with strategies aimed at potential applications to enhance public health care policies towards HCW's.

RESULTS & DISCUSSION

Health care workers

Healthcare professionals worldwide report higher levels of absence due to sickness, discontentment, distress, and "burnout" at work than other communities.⁹ Recent research after the outbreak of the pandemic confirmed that many had undergone symptoms of depressed mental health, such as anxiety, distress and depression, with those treating COVID-19 patients.⁹ Though the predictors of stress and poor mental health among healthcare communities are not precisely known, research from evidence of previous epidemics of infectious diseases identified key predictors attributed to challenging work conditions, working long hours, erratic timings, emotional instability, feelings of isolation, fear and concern about the health of oneself and family. Interventions to promote and improve physical and mental health are warranted.¹⁰ This is a research area of potentially fruitful

inquiry.

The British Psychological Society (BPS) has recently developed a guide offering practical healthcare services and recommendations on responding to the pandemic at personal, management, and organisational levels.¹¹ Other available resources include suggestions to manage mental distress among healthcare populations. Yoga and mindfulness effectively reduce stress, panic attacks and anxiety in HCWs, giving them more awareness to handle stressful work demands.¹² Substantial evidence from systematic reviews regarding the positive effects of yoga practices on stress management and prevention of burnout among healthcare workers indicates that it can be incorporated into the workplace in healthcare settings for health promotion.¹³ Healthcare professionals have to juggle between personal and professional lives. Various factors serve as a barrier to maintaining this balance and preventing burnout. In a study done during COVID-19, it was found that practitioners of SKY experienced positive effects such as professional fulfilment and resilience compared to the controls.¹⁴ Another randomised controlled trial involving 98 healthcare providers who underwent 12 weeks of yoga & breathing-based interventions demonstrated improved professional quality of life and decreased burnout.¹⁵ Hence, it is imperative to explore and adopt these therapies into daily life to improve the health and well-being of HCWs.

Immune system & inflammation

The human immune system is vital for survival, and it has evolved to control pathogens, thereby resisting infections and inflammatory diseases. It plays a dual role by resisting the body from the harmful effects of pathogens and also by tolerating and preventing an exaggerated response. Thus, disorders of the immune system may occur as a result of too much or too little immunologic reactivity. The production of proinflammatory cytokines that influence these conditions can be stimulated directly by stress and indirectly by prolonged infection. The effects of stress on the immune responses cause variations in the immune cell count and cytokine deregulation.

Chronic inflammation represents a sustained immune system reaction to noxious stimuli, resulting in damage to healthy tissues and

organs, leading to the evolution and progression of various diseases. Thus, the standard protective mechanism of inflammation can cause tissue damage, resulting in clinical consequences. Smouldering inflammation is implicated in many diseases like type 2 diabetes, lung fibrosis, rheumatoid arthritis, atherosclerosis, Alzheimer's, and other degenerative disorders and cancers. The harmful effects of inflammation are also called the "silent killer". Sepsis is a form of systemic inflammatory response syndrome due to disseminated bacterial infection causing widespread multiorgan abnormalities.³

Depressed immunity can result from stress, anxiety, addictions, metabolic disorders, intake of immunosuppressive drugs in persons who receive chemo/radiotherapy and acquired (secondary) immune deficiencies. Hence, a balance has to be maintained.

Coronavirus (COVID-19) is one of the most dreaded pandemics of recent times, which has led to a feeling of fear, insecurity and anxiety, impacting the health and socioeconomic status of large populations. A rise in proinflammatory cytokines with a decrease in lymphocyte count was seen in COVID-19-related studies.¹⁶

Medical experts worldwide have focussed on optimising one's immune system to avoid hyperstimulation (such as cytokine storm) or an immunosuppressed state to combat the

infection effectively. The functioning of the immune system, and thus the inflammatory response, has gained importance in the pathogenesis and response of the human body to microbial agents such as bacteria or viruses and diseases in general. This creates a solid need to enhance our defence mechanisms by strengthening immunity and adopting effective preventive strategies.

Influence of Psychoneuroimmunology

The benefits of MBTs are known to occur via effector pathways like the autonomic nervous system and the hypothalamic pituitary adrenal axis (HPA). Hence, Psychoneuroimmunology has gained popularity over the last few decades.¹⁷ Negative emotions can result in immune dysregulation, causing diverse health diseases.¹⁸ Emotions such as anger, greed, jealousy, and hatred directly and indirectly influence the functioning of the central nervous, immune, and endocrine systems. Dysregulation in IL6, particularly by the effect of negative emotions, is implicated across various diseases.¹⁸ Negative emotions can upregulate or downregulate the secretion of pro-inflammatory cytokines, increasing susceptibility to infectious diseases via alterations in immune responses.¹⁸ The endocrine system is another critical gateway because emotions provoke the release of hormones from the hypothalamic-pituitary-adrenal axis, causing alterations in cardiovascular and immune function.¹⁹ (Fig. 1)

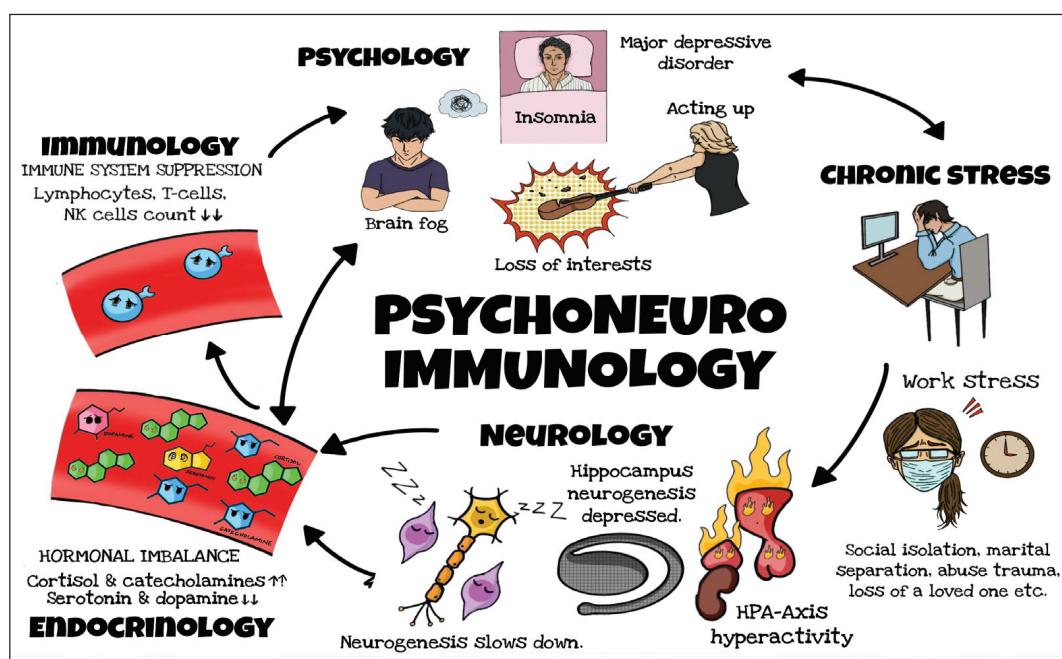


Figure 1: Effects of psychoneuroimmunology in various systems of the body

Effects of Mind-body therapies (MBTs) on achieving optimum health

WHO defines health as complete physical, mental, and social well-being, not merely the absence of disease or infirmity. The fast

pace of life, urbanisation, changing lifestyles, environmental pollution, natural disasters, and accidental deaths have increased stress levels in populations, exerting harmful effects on physical and mental health. (Figure 2).

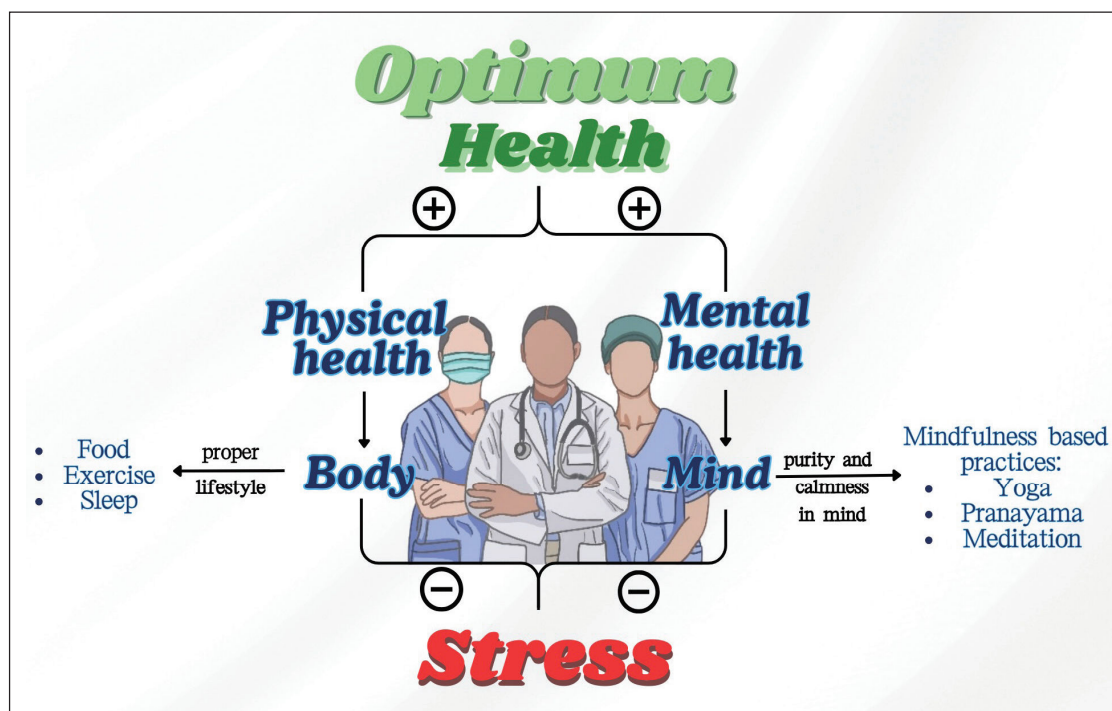


Figure 2: Achieving optimum health by taking care of the body & mind

Various stress management strategies, such as meditation, yoga, breathing techniques, hypnosis, and muscle relaxation, have been shown to reduce the harmful effects of stress in many diseases.²⁰ Yoga therapies incorporating body postures, breathing modulations and mindful awareness techniques have promising results in achieving harmony between the body and mind. Yoga has always been a part of our ancient culture, and now it has become more critical to scientifically validate its usefulness in improving overall health and well-being. Over the last few decades, the effects of MBTs on immune and inflammatory responses have been investigated. However, these immunomodulatory effects are incomplete and warrant further methodological studies to determine the clinical relevance in inflammatory and immune outcomes.²¹

The immune system can be boosted in many ways, as per the article published by Harvard Medical School.²² These include adopting a healthy lifestyle with adequate sleep, a diet rich in macro and micronutrients, minimising meat and

fatty food consumption, regular exercise, not smoking, maintaining a healthy body weight, and regular medical screening. Other than these methods, herbal supplements used in Ayurveda, have anti-inflammatory and immune-boosting properties.⁴ In addition to all the above, over the last few decades, mind-body therapies (MBTs), including yoga, meditation and breathing techniques, have received increasing attention from the scientific community to understand the efficacy of these widely practised techniques.²³ MBTs are known to reduce inflammation, strengthen anti-viral immune responses and improve immune parameters.²⁴ Literature search has shown that MBTs offer numerous health benefits in multiple physiological systems of the body like the nervous system, endocrine system, gastrointestinal system, respiratory system, circulatory system, musculoskeletal system and immune system.²⁴ It is postulated that these changes may be brought about mainly via the HPA axis by vagal stimulation through the parasympathetic nervous system which

regulate various physiological responses in the body. In addition, yoga has the ability to modify gene expression thereby bringing about desirable effects. One such modification was reported in telomerase related genes thus limiting aging process.²⁴ Despite these advances, there still exists lacunae in precisely understanding the mechanistic basis of bringing these effects.

Some MBTs include cognitive therapies, hypnosis, imagery, meditation, yoga, biofeedback, Tai Chi, Qigong, group support and autogenic training. Mind-body medicine incorporates these techniques and focuses on the interactions among the body, mind and behaviour. It recognises that mental, social, spiritual and behavioural factors can directly impact health.²³

Over the last few decades, scientific work on MBTs has received increasing attention from the scientific community as it has been shown to have a role in regulating the immune system. In a meta-analysis by Nani Morgan et al.,¹⁸ studies reported data on MBTs on inflammatory outcomes, seven studied antiviral outcomes and 14 other immune cell enumerative outcomes.²¹ For inflammatory outcomes, reports on MBTs reduced C-reactive protein significantly; concerning antiviral outcomes, there was evidence that MBTs increase immune responses to vaccination²⁵. Other studies have also shown to reduce chronic inflammation, enhance immunological memory and reduce sick days associated with upper respiratory tract infections. However, most studies were heterogeneous regarding population characteristics, type, duration and frequency of interventions, and outcome changes were not sensitive to change with MBTs. Thus, further methodological rigorous evaluation of the effects of MBTs on the immune system is warranted.

The interventional tool: Sudarshan Kriya Yoga (SKY)

Balancing fast-paced life and bringing about inner peace and transformation is just a click away in these modern times. Utilising science & technology to deliver yoga remotely has increased in the real world, especially for professionals like healthcare workers who struggle to find time. These methods will bridge the gap, facilitate easy delivery methods from the comfort of their location, improve participant compliance and justify delivery

methods while designing studies. Among the breathing techniques, Sudarshan Kriya Yoga (SKY) is a very effective rhythmic breathing technique taught by the Internationally acclaimed Art of Living Foundation. This could be learnt quickly via remote learning methods and in-person teaching. It comprises a minimum 8-hour module of synchronous delivery method followed by daily practice of 30-40 minute duration, with assistance via asynchronous delivery methods (video recordings/access to apps/cartoons) and booster sessions.

The steps of SKY breathing include:

1. Ujjayi breath pranayama-3 stages with specific hand positions, eight cycles each in each position.
2. Each cycle consists of breathing in for four counts, holding the breath for four counts, breathing out for six counts, and holding for two counts.
3. Bhastrika pranayama-20 times, 3 rounds each.
4. Sudarshan Kriya (rhythmic breathing), Counts of 20-40-40 with varying rhythms for three cycles.
5. Rest for 10 minutes.

It has a demonstrable measurable impact on overall health and well-being. Numerous independent studies have been conducted from different parts of the world and have demonstrated a comprehensive range of benefits from SKY. A recent study indicated that SKY breathing technique had positive effects on the well-being of healthcare professionals during the pandemic.²⁶ It was a pilot study providing data for future multisite RCTs. Universities, such as Yale University and Beth Israel, have studied the effect of mental health and improved resilience among university students who practised SKY breathing.²⁷

A study was done revealed that SKY reduced non-clinical depression and non-clinical anxiety.²⁸ Another report studied that 73% of individuals with generalised anxiety disorder experienced significant remission four weeks after learning SKY.²⁹ Substantial reductions in post-traumatic stress disorder symptoms in U.S. military veterans who learnt SKY persisted for a year, irrespective of continued practice, demonstrating a long-

term benefit.^{30,31} In another study a significant increase in life satisfaction with practice of SKY was observed.³² Studies on immune cell counts have demonstrated that increased levels of CD3, CD8, and CD56 in meditators were found by flow cytometry.³³ A study was also performed in chronically stressed women to assess the effect of IL-6 and TNF at the molecular level after a brief period of yoga intervention, which was however not statistically significant.³⁴ In a study, the effects of yogic breathing practices and immune function among breast cancer patients showed increased NK cell activity and cytokine levels.³⁵ Multiple studies have also demonstrated the effects of yoga and meditation on the immune system.³⁶ The effects of yoga were examined among healthy students, and a significant increase in IL-2 and IFN gamma levels was found.³⁷

The effect of SKY was studied in the NK cell counts in cancer patients at AIIMS, Delhi, demonstrating that NK cells significantly increased in the SKY group compared to cancer patients who did not practice SKY.³⁸ This is particularly encouraging since cancer patients have low immunity that can predispose them to infections and new/recurring cancers. In a study on depression done at NIMHANS, SKY significantly reduced major depressive disorder as effective as anti-depressant drug therapy.³⁹ Another published study demonstrated that adding SKY to conventional treatment in individuals recovering from substance abuse reduced serum cortisol levels significantly as compared to standard therapy alone.⁴⁰ SKY significantly increased the lymphocyte count by more than fivefold compared to controls, suggesting an enhanced immune function. In another study, people practising SKY showed healthier heart rates and blood pressure values.⁴¹ An exciting study demonstrated significantly greater Beta wave activity on the electroencephalogram in SKY practitioners than in controls, indicating heightened alertness and mental focus.⁴² The effectiveness of SKY in improving antioxidant status and anxiety in adults was demonstrated in a study.⁴³ Another promising study observed the effect of SKY in significantly reducing cholesterol levels with no change in diet, even under stressful conditions.⁴⁴ Another study demonstrated better antioxidant status and lower blood

lactate levels in SKY practitioners.⁴⁵ White blood cells from SKY practitioners were assayed for gene expression profiling. It was observed that they had a upregulation of antioxidant genes reflecting a better antioxidant status at the RNA level.⁴⁶ A significant reduction in NK, an important mediator of the inflammatory response, was observed in chronic periodontitis patients practising SKY.⁴⁷ In a study done on post-traumatic stress disorder patients, it was observed that the inflammatory marker C-reactive protein was reduced at 12 weeks and 24 weeks of regular SKY practice. However, no reduction in IL-6 was observed. Research on other types of yoga and meditation has also measured variables related to inflammatory response, immune cell number and immune function. Demonstrated a significant increase in CD4 counts in HIV individuals with Yoga practice.⁴⁸ Effects of yogic practices on immune responses in medical students. It was found that the rise in serum cortisol and decrease in IFN γ in the yoga group was less significant than in the control group.⁴⁹ Thus, growing interest in mind-body therapies is being explored for their application in clinical and non-clinical conditions. This necessitates further investigations in this area that align with the recommendations for future research.

Cardiorespiratory autonomic and neurophysiologic balance modulation by breathing techniques such as Pranayama & practising physical postures in Yoga

The effects of breathing techniques & yoga have been well documented through studies on electrical activities of the [heart electrocardiogram (ECG)], [brain electroencephalography (EEG)], and [muscles electromyography (EMG)], and assessment of the regulation of the autonomic nervous system (ANS), neuroendocrine axis, and radio imaging. Yoga is a perfect antidote for stress, effectively tackling the harmful effects of stress by modulating sympathovagal, neuroendocrine, and psycho-neuro-immunological balance and restoring good health.^{50,51,52} Enhanced cortical GABA tone is noted following yoga practice.⁵³ Heart rate variability (HRV), an effective technique to assess the regulation of the ANS, has been widely used to understand the intrinsic mechanisms underlying the potential effects

of yoga. Studies have shown that pranayama influences the ANS by exhibiting increased high-frequency (HF) power in HRV, reflecting increased vagal tone.⁵¹ This rise in the activity of the sympathetic nervous system (SNS) mediates modification in the neuroendocrine system through the HPA axis.⁵⁴ Changing the level of stress hormones such as adrenaline, aldosterone, cortisol, and norepinephrine increases heart rate, blood pressure, blood glucose levels and lipids. This mechanism also contributes to the progression of atherosclerosis and cardiovascular diseases (CVDs), particularly in people with chronic stress and sedentary lifestyles. A yoga study done on hypertensives have evaluated several cardiovascular indicators before and after a yoga therapy intervention and found improvement in systolic blood pressure, diastolic blood pressure, mean arterial pressure, total peripheral resistance and baroreflex sensitivity compared to control group.⁵⁵ Studies examining blood pressure and HRV have found that yoga significantly improved HRV and modulates the sympathovagal balance, suggesting that yoga enhances the vagal tone and reduces sympathetic activity.⁵¹ Yoga is also known to effectively tackle the negative impacts of oxidative stress on diabetes mellitus, mainly by achieving sympathovagal balance, and helps to maintain homeostasis and restore health by modulating the long-term mediators (HPA axis, biochemical and inflammatory markers of stress).⁵⁶ Thus, yoga achieves homeostasis in various disorders by modulating the ANS, neuroendocrine, and psycho-neuro-immunological axis and effectively integrating the functions of multiple body systems. By improving cardio-vagal activity and reducing sympathetic function, yoga modulates neuro-cardiac regulation and reduces the risk of CVDs.⁵² The practice of yoga has thus shown beneficial effects in the modulation or normalisation of the sympathovagal balance of the ANS, evidenced in the form of reduced heart rate, blood pressure, respiratory rate, intraocular pressure, fasting blood sugar in diabetes, increased breath holding time, galvanic skin response, and better sympathovagal balance with normalisation of baroreceptor sensitivity, and blood pressure variability.⁵¹⁻⁵⁶ Though the exact mechanism is unknown, a systematic review done, considers two hypotheses for explaining

psychophysiological changes induced by performing breathing techniques: one is related to a voluntary regulation of internal bodily states (interoception), the other is associated with the role of mechanoreceptors within the nasal cavity in translating slow breathing in modulation of olfactory bulb activity, which in turn tunes the activity of the entire cortical mantle.⁵⁷ However, further studies are needed to disentangle the ambiguous mechanisms involved.

STUDY LIMITATIONS

This review provides a comprehensive overview of the effects of SKY on the overall health & wellbeing of populations. Most relevant studies published in SKY have been included, however certain databases may have not been covered, potentially leading to omission of relevant content. As this is a narrative review, a systematic or meta-analysis has not been performed to assess the overall effectiveness of the intervention. Absence of large scale interventional studies on specific populations is necessary to form constructive opinions. This study paves way to conduct long term validation of SKY as a tool for the promotion of health & prevention of diseases among HCW's which are a vulnerable group.

CONCLUSION

Healthcare workers form the core of any healthcare system. They are at an unprecedented risk of contracting infections and are under constant mental pressure to balance demanding situations at the workplace. Building resilience is paramount in facing further challenging situations like the corona pandemic. Building resilience is paramount in facing further challenging situations like the current pandemic. Mind-body interventions such as SKY have several benefits and if scientifically validated, have a higher potential to be integrated into their professional training for building resilience. The outcome of this review could reiterate the existing findings and provide possible solutions to prevent burnout. This could be used to develop healthcare policies that provide solutions to ease the burden on healthcare providers in stressful situations which is an essential public health care system worldwide.

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