



SRI SRI INSTITUTE FOR ADVANCED RESEARCH

Art of Living Research Wing

A White Paper Series on Sudarshan Kriya

A White Paper on Sudarshan Kriya and Stress

Introduction

Stress

Stress is a universal and a ubiquitous hallmark of modern lifestyle. Advent of technology and gadgets have certainly eased physical discomforts but has not necessarily reduced the mental burden. There are many reasons for increased stress in the modern era including but not limited to excess technology usage, fast paced life style, lack of healthy social relationship and reduced physical activity. The pressure to cope up with modern day expectations, work demands can create small and big aggravations through out the day, thereby creating a series of stressful reactions in the body. Physical stress is common and activates the sympathetic activity of the body but emotional and mental stress are demanding and debilitating leaving a long term physiological impact on body and mind. Not only the real life circumstances and events create stress among individuals but mental imagination like reliving past trauma mentally or being anxious about the future can also create similar physiological stress response in the body. It is interesting to note that stress is one phenomenon that affects all the systems of the body ranging from cardiovascular to reproductive systems. The stress response is induced in the body to save oneself from life-threatening events, therefore also known as flight or fight mechanism. However, the induction of constant stress due to worry and tension can create catastrophic physiological events that destroy the balance and well-being of the body.

Types of Stress

Acute Stress:

This type of stress is present for a very short period of time and is an immediate response to an unpleasant situation or threat. A person may undergo this type of stress several times a day. This type of stress response is essential to make quick actions, elevate mental and cognitive performance and increase short term immunity in the body. Few example of acute stress includes getting stuck in

traffic jam, losing a key or preparing for an important meeting /exam the next day.

Traumatic Stress:

This type of stress is encountered post a traumatic event that could be dangerous and shocking in nature. This type of stress produces all the physiological changes encountered during a stress and additionally develop psycho-emotional experience such as extreme fear, anxiety and worry. Few example of traumatic stress is sudden loss of closed one, having near death experience and life-threatening events.

Chronic Stress:

This type of stress is a low level of stress that lingers for very long time and keeps the physiological stress response active. It may also be an effect of concurrent stressful events at the same time causing multiple sparks of stress. This type of stress usually relates to a constant sense of worry, feeling pressurized or overwhelmed for a long time. Few examples of chronic stress are feeling stressed about work daily, sense of financial pressure, bad relationships, exam stress before 3 months of exam etc. This type of stress is the most common in today's world and can have a long term detrimental effect on mind and body.

The physiology of stress

Under any unfavourable situation, perceived as threat or danger to the life by sense organs, amygdala, sends distress signals to hypothalamus (another brain region). Hypothalamus acts as command center communicating to other parts of the body through hormones and other parts of nervous system preparing it for fight or flight response. The cascade of events includes activation of – sympathetic nervous system; a branch of autonomic nervous system that controls the involuntary functions of the body. The signals from hypothalamus are received by the sympathetic nervous system which activates the adrenal glands to release hormones such as adrenaline (epinephrine) bringing about a number of physiological changes such as increased heart rate and blood pressure; increased flow of oxygen into the muscles and brain, increased blood sugar, contraction of pupils and shutting down all non-essential functions like digestion. If the stress still persists (as in case of chronic stress), after the epinephrine decline, the hypothalamus along with pituitary gland release another set of hormone known as corticotropin-releasing hormone (CRH) and adrenocorticotrophic hormone (ACTH). Together, these hormones travel to adrenal gland to release cortisol hormone that keeps the sympathetic system active. Only after decline in stress till the basal values, cortisol levels drop and parasympathetic system or rest and digest arm of autonomic nervous system gets activated.

Role of Cortisol in stress response and overall biological systems

Cortisol is a type of steroid hormone produced by the adrenal glands. It has varied functions in the body apart from regulating stress response. Cortisol production affects various organ system of the body including nervous system, cardiovascular system, respiratory system, musculoskeletal system, immune system and reproductive system. While an optimum level of cortisol for a short time can be beneficial to the body supporting it to handle the stressful situation, chronic cortisol production in body backfires and disrupts many body functioning.

Few of the commonly known functions of cortisol hormone include

1. Regulation of stress response: One of the most common function of the cortisol is regulation of stress response. It increases heart rate , blood pressure and breathing rate. It also cuts down all the non-essential activities of the body that may not be required by the body during a threat like digestion.
2. Blood glucose increase and regulation of metabolism: Cortisol triggers glucose release from the liver into the bloodstream to support the brain and other organs during flight or fight response. It suppresses insulin function that lowers the blood glucose. During chronic stress, the continuous release of the glucose leads to hyperglycemia or diabetes.
3. Increased immunity and suppressing inflammation: Short spurts of cortisol is anti-inflammatory in nature and can reduce the inflammation thereby enhancing immunity. However, continuous production of cortisol can cause reverse effects by making the immune response resistant and accumulation of high levels of cortisol can in turn produce inflammatory cytokines that affects the immune system
4. Biological rhythm: During low levels of cortisol, the body moves into rest, digest and repair state which is rejuvenating in nature. However, under stressful conditions, cortisol disrupts the sleep and digestion cycle. Chronic levels of cortisol can therefore hamper the biological rhythm.

Effect of long term cortisol production on Physical health

1. Cardiovascular : Increased heart rate due to flight or fight response can cause the heart muscles to weaken. Also, persistent increased epinephrine levels damage blood vessels and cause heart attacks and strokes. Constant stress can cause spasm in the coronary blood vessels , instability in the conduction system and abnormality in the heart rhythm all leading to myocardial infarctions (heart attack).
2. Digestive (Gastrointestinal, Irritable bowel syndrome, Indigestion) : During the stress response, cortisol curbs the digestion and reroutes the available resources for fight or flight response. Also, chronic stress leads to reduction and imbalance of 'good microbes' present in the gut that helps in digestion. Other side effects of stress on digestion are cramps and indigestion.
3. Respiratory (Increased breath rate) : Stress induces rapid breathing and shortness of breath. Under stress induced breathing, lungs undergo wear and tear that cause chronic pulmonary disorders like asthma and Chronic Obstructive Pulmonary Disorder (COPD).
4. Physiological : Stress cause insomnia, high blood pressure and other metabolic disorders due to constant activation of sympathetic nervous system or fight or flight response.
5. Reproductive : Several reproductive issues have emerged in the past decade which are mainly due to sedentary lifestyle behaviors. Scientists believe issues like menstrual irregularities, PCOS, PCOD, lack of libido are mainly due to stress.
6. Cognitive and brain : While short spurts of stress can create alertness and awareness enhancing the cognition, chronic cortisol production causes the damage of hippocampus, a part of the brain that is responsible for learning and memory. Therefore, chronic stress is usually associated with dementia and cognitive decline.

Sudarshan Kriya Yoga(SKY)

Sudarshan Kriya Yoga is a technique taught by the Art of Living Foundation in more than 180 countries with more than 6 million practitioners across the globe. It is taught in various modules across various age groups in different parts of the world.

SKY is a cyclic rhythmic breathing technique with its roots in traditional yoga. The 25 minutes process includes three yogic components – pranayama, Om chanting and Sudarshan Kriya. The pranayama is done using the Ujjayi breath. Ujjayi involves experiencing the conscious sensation of the breath touching the throat. This slow breathing technique is performed at a rate of 2–4 breaths per minute (bpm). This technique improves lung capacity, allowing more air to pass through the lungs. ‘Om’ is chanted three times with prolonged exhalation. Lastly, Sudarshan Kriya rhythmic breathing is done in two variations: long SKY, which is done under Gurudev Sri Sri Ravishankar’s recorded instruction, and short SKY, which can be done at home taking slow (20 bpm), medium (40–50 bpm), and fast (60–80 bpm) breaths. The entire technique is done in a seated posture with eyes closed.

Research studies on Sudarshan Kriya Yoga and Stress

Chronic stress has become a part of daily life. The below research summaries highlight the effects of Sudarshan Kriya in mitigating stress and related physiological imbalance.

1. Effect of Sudarshan Kriya Yoga on Stress Level of Medical Undergraduate Students Before Term Examination

Medical students experience considerable stress due to extensive academic syllabus, responsibility of patient care, and a steep learning curve. Tests and examinations can be a source of additional stress for them. In a cross sectional study enrolling 102 medical students, Kumar et al^[1] observed the impact of SKY practice on exam stress, using serum cortisol as a measure. A total of 62 students (40 males and 22 females) who had been practicing SKY for 6 months were included in the study group, while 40 students comprised the control group. The students in the control group did not practice yoga or any other mind-body intervention. Serum cortisol was measured before the exams, at the time when exam stress among the students was at its peak. The authors compared serum cortisol levels between both the groups, and reported that the serum

cortisol level in the SKY group ($14.47\mu\text{g/dL} \pm 2.95$) was much lower, a 39.6% difference, in comparison to the control group ($23.95\mu\text{g/dL} \pm 2.95$). They concluded that this difference may be attributed to the stress mitigating effect of SKY.

Summary: Examination stress can increase serum cortisol in students. The results of a cross-sectional (one-time assessment) study on medical students, revealed a prominent reduction in the cortisol levels among the study group ($14.5\mu\text{g/dL}$), who had been practicing SKY for 6 months, in comparison to the control group ($23.95\mu\text{g/dL}$), (a 39.6% difference) while experiencing the same stressor, leading to the conclusion that the practice of SKY can prevent the spike in serum cortisol secondary to stressors.

2. Impact of Sudarshan Kriya Yoga Based Occupational Stress Management Intervention on Physiological and Psychological Outcomes

According to a survey in 2022, almost 80% of Indian professionals, including 95% of millennials, suffer from work related stress. Another report has cited that Indians have the longest working hours of any nation globally. Given that a significantly high percentage of the workforce experiences stress, it is critical that companies adopt effective measures to alleviate stress at work. A study conducted by Mulla et al.^[2] investigated the physiological and psychological effects of Sudarshan Kriya Yoga (SKY), in managers working at Larsen & Toubro Limited (L&T), India. SKY was taught as a part of the Art of Living's "APEX (Achieving Personal Excellence)" program. Two groups of 37 and 35 participants attended the APEX program, and were assessed before the program and at 3 months and 6 months of daily practice. The two groups underwent the program and different time points thereby, one group acting as a waitlist control group.

Group 1 was taught in April of that year, Group 2 in July. For the April group, a significant decrease in stress of 44% as measured by a self-reported questionnaire, accompanied by an increase in life satisfaction, higher emotional stability, and improved emotional regulation, both immediately after the intervention, and at 3 months of practice was seen and the changes were retained after 6 months. Noticeable reduction in scores was not observed for the waitlist control group. Physiological parameters e.g. stress were measured via serum cortisol measurements, and through self-report by completing one questionnaire before, and after practice of SKY. Results showed a sustainable decrease in the blood cortisol levels, after practicing SKY for a period of 3 months. It was found that the cortisol levels of employees who underwent SKY reduced by 23.02% in 3 months and by 37% over 6 months. However, in the waitlist control group the cortisol levels increased in the 3 months period.

Summary: A study on the physiological and psychological benefits of the Art of Living's "APEX (Achieving Personal Excellence)" program, which includes SKY, showed a sustainable positive effect of the program on the participant's psychological health, measures of stress, life satisfaction, emotional stability and emotional regulation. It was found that the cortisol levels of employees who underwent SKY reduced by 23.02% in 3 months, and by 37% in 6 months with practice of SKY. Waitlist control group demonstrated a reverse trend. Employees also reported a higher level of life satisfaction and emotional regulation with SKY practice.

3. Palliative Care for Advance stage breast Cancer patients: Management of Pain and Stress through Sudarshan Kriya Yoga

Evidence suggests that cancer-related stress has a negative impact on health, possibly via neuroendocrine pathways. Cortisol, a stress marker, affects multiple physiological processes, including metabolic and immune responses (e.g. suppressing T lymphocyte functions and natural killer cell cytotoxicity). Women living with breast cancer have higher cortisol levels compared to healthy women, and higher cortisol levels are associated with greater severity of disease in women with breast cancer. Kumar et al.^[3] studied the effect of SKY on serum cortisol level and pain among women suffering from advanced stage breast cancer. Participants (n=147) were screened and randomized to receive standard care (n=69), versus standard care along with SKY (n=78). Participants were taught SKY and encouraged to practice it at home for 30 min a day as an adjuvant to standard pharmacological treatment for pain. After 3 months of SKY practice, a 19% reduction in blood cortisol levels was noted for the SKY group. During the same time period, blood cortisol level increased by 11.3% in the control group. After 3 months of SKY practice, pain perception was reduced by 3 points for the SKY group, in comparison to the control group, on a 0-10 verbal scale of pain.

Summary: The results of a study analyzing the impact of SKY on women with breast cancer, depict that a 3 month practice of SKY can reduce pain perception in women living with breast cancer by 3 points, while also reducing cortisol level by 19%. It is significant to note that while the SKY group experienced a decrease of 19% in the cortisol level, the control group experienced a growth of 11.3% in cortisol level during the same timeframe. Diseases like cancer significantly affect the quality of life and are characterized by high levels of pain and stress. Reduction of pain and stress can lead to a better management of disease and an improved quality of life for the patients.

4. Antidepressant efficacy and hormonal effects of Sudarshan Kriya Yoga in alcohol dependent individuals

A study by Vedamurthachar et al.^[4] evaluated the antidepressant efficacy of SKY and its effect on alcohol abstinence in dependent individuals. Following a week of inpatient detoxification management at the de-addiction center at NIMHANS Bangalore, consenting subjects (n= 60) were equally randomized to receive SKY (n=30) or not (control group, n=30) for a two-week study. SKY intervention included alternate day practice of SKY under supervision. Subjects completed the Beck Depression Inventory (BDI) before and after the two weeks of SKY intervention. Morning plasma cortisol, ACTH and prolactin were measured before, and at the end of 2 weeks. After 2 weeks of SKY practice, a drop of 56.6% was observed in the cortisol levels for the SKY group. The control group also recorded a drop in the cortisol levels (24.7%) however, the SKY group showed a much greater reduction. The ACTH (Adrenocorticotrophic Hormone) levels were reduced by 32.6% in the SKY group, and by 12.8% in the control group after 2 weeks. ACTH plays a role in stress pathways in the human body. It's usually produced in response to biological stress. Its principal function is to regulate cortisol level.

The extent of depression in the study subjects was measured using Beck's Depression Inventory. After two weeks, the SKY group experienced a drop of 75.8% in BDI scores and the control group experienced a drop of 58.8%. However, interestingly, a correlation could only be established in the SKY group between the decrease in BDI-scores and the cortisol level, which indicates that SKY exerts its impact on both mental as well as physical mechanisms of wellness. SKY can be an effective addition to detoxification and de-addiction treatments aimed at achieving abstinence from alcohol dependence.

Summary: SKY can be a potential yet safe antidepressant therapy in alcohol dependent subjects during the detoxification period. Achieving abstinence can be challenging. Poor mental health and depression are common comorbidities that create susceptibility to relapse and prevent achievement of long term freedom from alcohol dependence. In this study, the antidepressant effects of SKY correlated with lowering of serum cortisol. Reduction in stress-hormone levels (cortisol and ACTH), along with reduction in the depression scores support a biological mechanism of SKY in producing beneficial effects. The results show that after 2 weeks of SKY practice, participants experienced greater reduction (75.8%) in depression scores than the control group. A 56.6% drop in plasma cortisol levels and a 32.6% drop in ACTH levels was observed in the SKY group.

5. Modulation in saliva pH post a single session of Long Sudarshan Kriya Yoga

Secretion of biochemical products by endocrine and exocrine glands is modulated by stress. These hormones act as physiological markers for stress. Saliva is an exocrine bioproduct secreted by the salivary glands. It maintains the pH of the oral cavity close to neutral. However, salivary pH changes under stress, either becoming alkaline or acidic. A study by Kanchibhotla et al.^[5] used salivary pH as a marker for stress response and measured it before and after a SKY session. A total of 321 healthy individuals (who were novice to SKY) participated in this first of its kind study. The participants were asked to discharge a small amount of saliva into an airtight plastic bottle before the SKY intervention. The pH of saliva was immediately measured using a pH meter. The procedure was repeated immediately after a single 90-minutes SKY session.

The results demonstrated a unique effect of SKY on salivary pH. Based on their pre-intervention salivary pH values, the participants were divided into three groups ; i.e those with acidic pH, neutral pH and alkaline pH. It was noticed that the change in salivary pH after SKY was conditioned on the pre-intervention salivary pH. Participants who recorded a neutral pre-intervention salivary pH, continued to maintain neutral values post SKY. However, the participants who had either acidic or alkaline pre-intervention salivary pH, recorded a closer to neutral salivary pH post intervention.

There was a statistically significant shift in pH towards neutral after SKY for both categories of participants who had either acidic or alkaline pre intervention salivary pH, indicating that if the salivary pH has altered from a neutral value, perhaps secondary to stress, SKY brings it to closer to neutral pH, which is the range for optimal functioning. Neutral pH is essential for optimal functioning of saliva in the oral cavity. The results depict that mind-body interventions like SKY modulate the salivary pH to bring it to the range of optimal functioning.

Summary: Salivary pH can be an indicator of stress level in the body. A study measuring salivary pH before and after a single Long-SKY session demonstrated a statistically significant shift of pH towards neutral in groups that had either acidic or alkaline pH initially. The group with neutral salivary pH to begin with, continued to maintain neutral pH post SKY. This study clearly indicates that SKY has a highly customized effect on an individual's biomarkers based on their physiology and supports them to achieve optimum health & homeostasis.

6. Physiological stress response among students following Sudarshan Kriya Yoga practice

Individuals as young as 30 years of age can experience heart disorders if they are exposed to risk factors such as prolonged stress. A study by Goldstein et al.^[6] aimed to assess the effects of SKY on 74 young adults. Multiple measures of well-being and physiological stress response were investigated using self-reported questionnaires and electrocardiogram. The overall study was separated into two different arms. The first study consisted of 50 students. Perceived stress scale, depression scale, social connectedness and gratitude questionnaires were administered. Time points of assessments were before the program, within 1 week of completion of SKY program and at 1 month of the program. The second study consisted of 24 students. Emotional sensitivity, Positive and Negative Affect Schedule-Expanded Form, cycling challenge and heart rate variability were assessed at baseline and 4 week post SKY practice.

The results demonstrated a decrease of 48.6% in stress levels of students immediately after SKY practice and by 34.5% after 40 days of practice. The subjects also noticed an improvement of 21.1% and 16.03% in life satisfaction scores post SKY and after 40 days of SKY practice respectively. An increase in gratitude by 10% post SKY was observed. The Inter-beat interval (IBI), i.e the gap between two heart beats, is related to the recovery for heart rate. The IBI in the recovery phase increased from baseline to 4-week follow-up for the SKY group. A 48% increase in the mean IBI recovery rate was observed between baseline and 4-week assessment for SKY practitioners. Heart rate variability (HRV) measures changes in the time intervals between consecutive heartbeats, (IBIs), and is a good indicator of parasympathetic or sympathetic dominance in the body. An increase in the IBI slope during the recovery phase post the cycling challenge indicates that it took lesser time for the heart to recover its heart rate and HRV. This may be due to the enhanced parasympathetic activity and vagal tone attributable to SKY practice. These findings suggest that a life skills workshop integrating yogic breathing techniques may provide self-empowering tools for enhancing physical, mental and emotional well-being in young adults.

Summary: A study assessed the effects of SKY on psychological stress and well-being among college students before, after SKY program and after 40 days of practice. The results demonstrated a decrease of 48.6% in stress levels of students immediately after SKY practice and 34.5% post 40 days. Life satisfaction scores also improved by 21.1% post SKY. A 48% mean improvement in the Inter-beat interval recovery of students post 4 weeks of SKY practice was observed. An increase in IBI slope of recovery enhanced parasympathetic activity and vagal tone correlated with SKY practice.

7. Stress management capability among graduate and undergraduate students following Sudarshan Kriya Yoga workshop

Several factors challenge the mental and physical well-being of college students. Goldestein et al.^[7] compared the benefits of two programs, SKY and Wisdom on Wellness (WOW), on stress levels and mental well-being of graduate and under-graduate students at the University of Arizona. The study included 69 students, randomly assigned to the SKY or WOW program. The WOW program was a comparison control program specifically designed for this study, and included group-based interactions, and general discussions about daily stress. The students were evaluated using Perceived Stress scale, Mood and Anxiety Symptom Questionnaire, Pittsburgh Sleep Quality Index, Social Connectedness Scale, Personality Questionnaire, Satisfaction with Life Questionnaire and Self-Esteem Questionnaire. The assessment time points included baseline (pre intervention), immediately after the intervention and after 3 months of practice. Many beneficial outcomes across different parameters were observed. The SKY group experienced a 26.4% decrease in stress levels over the course of 3 months practice. The sleep quality also improved by 21.7% in the SKY group in comparison to WOW workshop participants at 3 month assessment. Mood and anxiety symptoms reduced by 13.16% over the course of 3 months practice. Self esteem also improved by 12.7% in the SKY practitioners. Finally, the satisfaction with life scores improved by 13.3% in SKY practitioners as compared to WOW practitioners post 3 months SKY practice.

Summary: SKY workshop was evaluated as a stress reduction program for the college students. This was compared with the Wisdom On Wellness program to assess the benefits of both the programs. The results demonstrated that stress levels in SKY practitioners reduced by 26.4% and sleep quality improved by 21.7% after 3 months of SKY practice. Mood and anxiety symptoms reduced by 13.16%, and self esteem improved by 12.7% in the SKY practitioners over the course of 3 months. Therefore, SKY practice can be employed as an effective strategy to combat stress during college years.

8. Impact of a Comprehensive Yogic Breathing Program including Sudarshan Kriya Yoga on Wellness among Healthy Adults

A study by Kjellgren et al.^[8] investigated the impact of SKY on the well being of 103 healthy adults. Of the 103, 48 participants experienced a 6 day SKY intervention. The remaining 55 individuals

comprised the control group and meditated with their eyes closed for 15 minutes daily. The study measured the following well-being outcomes: anxiety, depression, optimism, stress and energy levels. The parameters were measured before the intervention, and after 6 weeks of SKY practice. The experimental group practiced SKY daily for these six weeks. The control group meditated for 15 mins daily with their eyes closed. The results at the 6 week assessment showed a marked difference between baseline and post SKY practice for the experimental group, while no such difference was noticed in the control group. A decrease in depression scores (33.57%), stress scores (17.7%) and anxiety scores (22.76%) was noticed after 6 weeks of SKY practice. No significant change was observed in the control group after 6 weeks. Therefore the findings indicate improved wellness among individuals who practice SKY.

Summary: SKY intervention was compared with a 15 minutes self meditation practice and it was shown that SKY practice has a significant effect on reducing depression, anxiety, stress symptoms, even among healthy individuals. A reduction of 33.57%, 17.7%, 22.76% was noticed in the outcomes of depression, anxiety and stress respectively after six weeks of SKY practice. SKY was also found to increase optimism in one's life.

Summary of Research findings

SKY has multiple mental and physical benefits. Studies evaluating the impact of SKY on stress function corroborate these findings, and shed light on the way SKY helps us mitigate stress and protects our body and brain from detrimental effects of stress.

- * Stress are of three types namely acute stress, traumatic stress and chronic stress. While acute stress is beneficial during life threatening situations, chronic stress may disrupt several biological functions and cause multiple organ damage.
- * Cortisol is the primary stress hormone, and a well-known biomarker of stress. It increases sugar (glucose) levels in the bloodstream, enhances the brain's use of glucose and increases heart rate, breathing and blood pressure.
- * Chronic levels of stress are also responsible for brain damage and shrinking of brain region responsible for learning and memory. This causes stress related cognitive decline and dementia among elders.

- * Examination stress can increase serum cortisol in students. The results of a cross-sectional (one-time assessment) study on medical students, revealed a prominent reduction in the cortisol levels among the study group (14.5µg/dL), who had been practicing SKY for 6 months, in comparison to the control group (23.95µg/dL), (a 39.6% reduction) while experiencing the same stressor, leading to the conclusion that the practice of SKY can prevent the spike in serum cortisol secondary to stressors.
- * A study on the physiological and psychological benefits of the Art of Living's "APEX (Achieving Personal Excellence)" program, which includes SKY, showed a sustainable positive effect of the program on the participant's psychological health, measures of stress, life satisfaction, emotional stability and emotional regulation. It was found that the cortisol levels of employees who underwent SKY reduced by 23.02% in 3 months, and by 37% in 6 months with practice of SKY. Employees also reported a higher level of life satisfaction and emotional regulation with SKY practice.
- * The results of a study analyzing the impact of SKY on women with breast cancer, depict that a 3 month practice of SKY can reduce pain perception in women living with breast cancer by 3 points, while also reducing cortisol level by 19%. It is significant to note that while the SKY group experienced a decrease of 19% in the cortisol level, the control group experienced a growth of 11.3% in cortisol level during the same timeframe. Diseases like cancer significantly affect the quality of life and are characterized by high levels of pain and stress. Reduction of pain and stress can lead to a better management of disease and an improved quality of life for the patients.
- * SKY can be a potential yet safe antidepressant therapy in alcohol dependent subjects during the detoxification period. Achieving abstinence can be challenging. Poor mental health and depression are common comorbidities that create susceptibility to relapse and prevent achievement of long term freedom from alcohol dependence. In this study, the antidepressant effects of SKY correlated with lowering of serum cortisol. Reduction in stress-hormone levels (cortisol and ACTH), along with reduction in the depression scores support a biological mechanism of SKY in producing beneficial effects. The results show that after 2 weeks of SKY practice, participants experienced greater reduction (75.8%) in depression scores than the control group. A 56.6% drop in plasma cortisol levels and a 32.6% drop in ACTH levels was observed in the SKY group.
- * Salivary pH can be an indicator of stress level in the body. A study measuring salivary pH before and after a single Long-SKY session demonstrated a statistically significant shift of pH towards

neutral in groups that had either acidic or alkaline pH initially. The group with neutral salivary pH to begin with, continued to maintain neutral pH post SKY. This study clearly indicates that SKY has a highly customized effect on an individual's biomarkers based on their physiology and supports them to achieve optimum health & homeostasis.

- * A study by Goldestein studied the effects of SKY on psychological stress and well-being among college students before, after SKY program and after 40 days of practice. The results demonstrated a decrease of 48.6% in stress levels of students immediately after SKY practice and 34.5% post 40 days. Life satisfaction scores also improved by 21.1% post SKY. A 48% mean improvement in the Inter-beat interval recovery of students post 4 weeks of SKY practice was observed. An increase in IBI slope of recovery enhanced parasympathetic activity and vagal tone correlated with SKY practice.
- * SKY workshop was evaluated as a stress reduction program for the college students. This was compared with the Wisdom On Wellness program to assess the benefits of both programs. The results demonstrated that stress levels in SKY practitioners reduced by 26.4% and sleep quality improved by 21.7% after 3 months of SKY practice. Mood and anxiety symptoms reduced by 13.16%, and self esteem improved by 12.7% in the SKY practitioners over the course of 3 months. Therefore, SKY practice can be employed as an effective strategy to combat stress during college years.
- * SKY intervention was compared with a 15 minutes self meditation practice and it was shown that SKY practice has a significant effect on reducing depression, anxiety, stress symptoms, even among healthy individuals. A reduction of 33.57%, 17.7%, 22.76% was noticed in the outcomes of depression, anxiety and stress respectively after six weeks of SKY practice. SKY was also found to increase optimism in one's life.

Conclusion

Stress, in recent times, has become a psychological phenomenon that affects one's physical and mental well-being. SKY has shown to mitigate stress and enhance positive mental health. In several studies across various populations, SKY has been shown to reduce cortisol - in medical students, breast cancer patients, corporate professionals and those recovering from alcohol dependence. Cortisol is one of the most prominent biomarkers of stress. Elevated levels of cortisol are connected with high stress levels, and over time can lead to obesity, cardiovascular diseases, hypertension, diabetes and fatigue.

SKY can reduce cortisol levels, even when the body is under duress like advanced stage breast

cancer. SKY practice can reduce the cortisol levels in the body even during stressful situations creating a protective effect. SKY has also been shown to reduce ACTH levels- a hormone involved in stress pathway whose main function is to regulate the cortisol levels in the body.

Saliva pH is increasingly being used as a biomarker for stress. In a study it was shown that SKY modulates the saliva pH as per a person's physiology to bring it to optimum functioning. Overall SKY boosts mental and physical wellness and the studies on SKY and stress shows its importance in mitigating stress.

About Sri Sri Institute for Advanced Research

Sri Sri Institute for Advanced Research (SSIAR) is the research wing of The Art of Living. SSIAR's mission is to apply and share the science of Global Ancient Knowledge Systems to the challenges of today. Its vision is to become an internationally renowned center of excellence for scientific enquiry into Global Ancient Knowledge Systems.

This white paper is authored by SSIAR team consisting of Divya Kanchibhotla , Saumya Subramaniam and Dr Somya Ramrakhyani.

For any questions, kindly contact divya.kanchibhotla@artofliving.org

References

1. Kumar S. Effect of "Sudarshan Kriya" on serum cortisol level before terminal examination in undergraduate medical students. IJAR. 2017;3(7):533-5.
2. Mulla ZR, Vedamuthachar. Impact of a Sudarshan Kriya-based occupational stress management intervention on physiological and psychological outcomes. Management and Labour Studies. 2014 Nov;39(4):381-95.
3. Kumar N, Bhatnagar S, Velpandian T, Patnaik S, Menon G, Mehta M, Kashyap K, Singh V. Randomized controlled trial in advance stage breast cancer patients for the effectiveness on stress marker and pain through Sudarshan Kriya and Pranayam. Indian journal of palliative care. 2013

Sep;19(3):180.

4. Vedamurthachar A, Janakiramaiah N, Hegde JM, Shetty TK, Subbakrishna DK, Sureshbabu SV, Gangadhar BN. Antidepressant efficacy and hormonal effects of Sudarshana Kriya Yoga (SKY) in alcohol dependent individuals. *Journal of affective disorders*. 2006 Aug 1;94(1-3):249-53.
5. Kanchibhotla D, Ingole S, Kulkarni S, Saisudha B. Impact of Sudarshan Kriya Yoga on Salivary pH: An Exploratory Pilot Study. *Complementary Medicine Research*. 2021 Oct 7;28(5):478-81.
6. Goldstein MR, Lewin RK, Allen JJ. Improvements in well-being and cardiac metrics of stress following a yogic breathing workshop: randomized controlled trial with active comparison. *Journal of American College Health*. 2020 Jun 27:1-1.
7. Goldstein MR, Lewis GF, Newman R, Brown JM, Bobashev G, Kilpatrick L, Seppälä EM, Fishbein DH, Meleth S. Improvements in well-being and vagal tone following a yogic breathing-based life skills workshop in young adults: Two open-trial pilot studies. *International journal of yoga*. 2016 Jan;9(1):20.
8. Kjellgren A, Bood SÅ, Axelsson K, Norlander T, Saatcioglu F. Wellness through a comprehensive Yogic breathing program—A controlled pilot trial. *BMC complementary and alternative medicine*. 2007 Dec;7(1):1-8.