



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 Sleep Quality**

### **Introduction**

Sleep is an essential life function. Throughout the course of human evolution, sleep has remained a necessary habit. However, until a few decades ago, very little was known about sleep – its mechanism and importance. Over the last several years, humans are sleeping lesser and lesser, leading to chronic sleep deficiency, which in turn is associated with several health risks. A 2019 survey across 12 countries (including India) found that about 62% of the population did not sleep very well, while only 10% reported sleeping extremely well.

Emerging evidence suggests that poor sleep quality may be a growing epidemic. Lack of sleep or poor-quality sleep increases the risk of developing chronic ailments like high blood pressure, cardiovascular disease, diabetes, depression, and obesity. Various sleep disorders have emerged in the past few years like insomnia, sleep apnea, narcolepsy and restless leg syndrome. This white paper examines the impact of Sudarshan Kriya Yoga (SKY) on the quality and quantity of sleep.

### **Anatomy of Sleep**

Sleep is an important daily routine. We spend one-third of our life sleeping. Hypothalamus, a part of the brain, consists of a group of nerve fibres that act as control center affecting sleep. The suprachiasmatic nucleus (SCN) in the hypothalamus is responsible for maintaining the circadian rhythm (biological rhythm). Sleep promoting cells in the hypothalamus and brain stem produce a chemical known as *GABA*, which reduces activity at arousal centers. *GABA* is associated with sleep, muscle relaxation, and sedation. *Melatonin*, a hormone produced by the pineal gland, also regulates the circadian rhythm and induces sleep. Another chemical called *Adenosine* present in the neurons inhibits arousal and induces sleep.

Sleep is regulated through a complex and sensitive mechanism involving multiple chemicals in the brain. Several life-style factors like caffeine and sugar consumption, late nights, stress, etc. affect this sensitive mechanism and can impair both the quality and duration of our sleep.

### ***Sleep Mechanism and Sleep stages***

Sleep consists of two basic stages: rapid eye movement (REM) and non-REM. The Non-REM stage is further divided into three stages, known as Non-REM-1, Non-REM-2, Non-REM-3. Each stage is linked with a particular brain pattern and frequency. These cycles repeat several times during a night's sleep.

*Non-REM-1*: Non-REM-1 sleep is the first stage of sleep and marks the changeover from wakefulness to sleep. It is short, and is characterized by alpha brain waves. This phase may last for few minutes and occurs just before the body enters the state of rest. The heartbeat, breathing and eye moments relax with occasional twitches.

*Non-REM-2*: This phase occurs after Non-REM 1. This is a period of light sleep before entering deep sleep. Brain waves in this phase are slower, with brief bursts of electrical activity, called sleep spindles. Sleep spindles are believed to mediate multiple sleep-related functions, from memory consolidation to cortical development. During this phase, the temperature drops and eye movements become negligible. This phase lasts for only 10-25 minutes in initial cycles but the length of this phase increases with each successive cycle consuming about 45-55% of the total sleep cycle itself.

*Non-REM-3*: Occurring after Non-REM 2, this is the most important phase - the phase of deep sleep. This phase lasts for long periods during the first half of the night. Brain waves slow down during this period; therefore, this phase is also called slow wave sleep. The brain exhibits high amplitude delta waves. This phase is critical for feeling restful and refreshed the next morning. Deep sleep reduces with age. This phase requires the highest arousal threshold, which means it is difficult to wake one up during this phase. Non-REM3 stage is very important for memory consolidation.

*REM*: REM sleep usually occurs 90 minutes after falling asleep. Mixed frequency brain waves (beta and theta) activity with rapid eye movements behind the eyelids is the characteristic feature of this phase. The brain activity in this phase is the most similar to then when we are awake. Most dreams occur in this phase. The increase in age reduces REM sleep. REM sleep is thought to be important for learning, memory and mood. Most of the REM sleep occurs towards the later part of the night.

Circadian rhythm (the biological clock) and sleep wake homeostasis are two internal biological mechanisms that regulate the sleep cycle. A group of nerve cells known as the Suprachiasmatic nucleus (SCN) regulate the circadian rhythm in all the organs. These nerve cells receive input from the nerve cells in the retina that act as brightness detectors. Another major determinant of the SCN is secretion of melatonin, a hormone secreted mostly at night, which also controls the sleep cycle.

### ***Importance of Good sleep***

Sleep affects almost every organ and physiological system in the body – from brain, heart, and lungs to metabolism, immune function, mood, and disease resistance. It is important because it enables the body to prepare mentally and physically for another day. Getting adequate rest improves our well-being in the following ways:

#### 1. Recharge, repair and enhanced physical well being

Sleep provides an opportunity for multiple physiological and mental processes, which get depleted during the day, to replenish themselves. Cells divide rapidly during sleep, facilitating faster repair in the body. Some of the restorations and repairs that occur during sleep are muscle repair, cell repair, tissue repair, protein synthesis and release of hormones for growth.

Sleep helps in energy conservation as metabolism drops by as much as 10% during sleep. This is accompanied by a drop in body temperature, and a lower calorie demand. Sleep deprivation alters the two appetite hormones – ghrelin and leptin. Ghrelin induces hunger while leptin triggers a feeling of fullness. Due to lack of sleep, an increase in ghrelin is triggered and the level of leptin decreases in the body. This causes increased hunger and appetite, which leads to overeating.

- Cognitive function

Sleep is important for optimal functioning of cognition and memory. Non-REM-3 sleep waves are essential for memory formation. Consolidation, retention and maintenance of memory occurs during sleep. Disruptions in sleep lead to impaired decision-making ability, increased attention deficiency and a lack of long-term memory.

- Neurological function

During non-REM sleep, new neurons are formed within the brain and the connections between them are strengthened. During the REM phase, the cerebral cortex is open and forms loose associations in the brain to increase the 'brain plasticity' or the ability of neural networks in the brain to change through growth and reorganization. REM sleep also ensures the collection of waste products like

metabolites and proteins, which are transferred into the Cerebrospinal fluid (CSF), which carries them out of the brain to sites where CSF drains.

## ***Sudarshan Kriya Yoga (SKY)***

Sudarshan Kriya is a technique taught by the Art of Living Foundation in over 156 countries with more than 6 million practitioners across the globe. It is taught in slightly different 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 a 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, followed by meditation or rest in supine position.

## ***Research studies on Sudarshan Kriya Yoga (SKY) and Sleep Quality***

The following research studies assess the impact of SKY on sleep quality and duration :

### **1. Influence of Sudarshan Kriya Yoga on the sleep quality of Indian adults**

Poor sleep quality is common among adults and unfortunately, it worsens with age. A pre-post single arm study by Kanchibhotla et al.<sup>[1]</sup> studied the influence of SKY on improving the quality of sleep among 473 Indian adults. A standardized questionnaire that measured the quality of sleep was administered at three different time points for assessment: before the intervention, i.e, at the beginning of the first day of the workshop (Pre), immediately after the workshop i.e at the end of the third day (Post), and lastly after the recommended 40-day daily practice of the Sudarshan Kriya Yoga (Day 40). Analysis of data showed that the study population with good quality of sleep almost doubled after SKY, as shown by an 82% increase in the number of people with good sleep quality post intervention. The overall mean sleep scores improved by 30.2% post SKY workshop. Improvement was seen across

both genders and all age groups. Males showed a 27% improvement in the quality of sleep post 40 days SKY practice, while females had a 18.2% improvement post 40 days SKY practice. Study participants between the ages of 18-35 years experienced a 32.6% improvement in sleep quality, while those older than 35 years experienced slight improvement. The correlation of sleep quality with the frequency of SKY practice revealed that those practicing SKY daily achieved the highest sleep quality in the group over time.

**Summary:** A study including 473 Indian adults demonstrated an improvement in the sleep quality post SKY program. A good sleep quality is a marker of whether the sleep was restful and restorative. When the sleep quality is poor, one can feel tired even after sleeping for a long duration. Sleep quality was measured by administering a standardized questionnaire to the participants before the SKY workshop, immediately after the SKY workshop and after the recommended 40-day daily SKY practice. 82% of study participants experienced improved sleep after SKY intervention. The overall mean sleep scores improved by 30.2% post SKY workshop. Males showed a 27% improvement in the quality of sleep post 40 days SKY practice, while females showed an 18.2% improvement.

## **2. Sudarshan Kriya Yoga and the sleep quality among young adults**

A pseudo randomized study conducted by Goldstein et al.<sup>[2]</sup> evaluated the effect of SKY on the overall well-being of 69 young adults at the University of Arizona, USA. Wisdom Of Wellness (WOW) program, designed specifically for this study, was used as a comparison control program and included group-based interactions, and general discussions about daily stress. The students were evaluated using the Pittsburgh Sleep Quality Index, along with scaled that measured stress, mood, social connectedness, satisfaction with life and self-esteem. The sleep quality was assessed before the intervention, immediately after the intervention, and at 3 months after the intervention. The results demonstrated a significant reduction in sleep disturbances after SKY practice. A 16.7% reduction in sleep disturbances was observed immediately after the SKY program, and it further dropped to 21.7% reduction at the 3-month follow up. The results also demonstrated a significant decrease in stress by 26.4%, an increase in social connectedness by 10.8%, and an improvement in satisfaction with life by 13.3% at the 3 month post SKY assessment. The participants in the WOW program also experienced reduced sleep disturbances and improved quality of life, however the changes were not as significant as with the SKY practice. Amongst the WOW practitioners, the decrease was observed immediately after the program, and there was a return to pre-workshop values at the 3-month follow-up assessment, i.e the improvement in sleep quality was not sustained.

**Summary:** Sleep disturbances among young adults were evaluated post SKY workshop and compared with the Wisdom On Wellness program to assess the benefits of both programs. Sleep disturbance decreased progressively and significantly for the study participants (aged 18-35 years) who practiced SKY for 3 months. A 16.7% decrease in the sleep disturbance was observed immediately post SKY program, which further dropped to 21.7% reduction in sleep disturbance at the 3-month follow up.

### **3. Effect of Sudarshan Kriya Yoga on daytime sleep and situational sleep**

It has been documented that busy schedules and late nights have reduced the sleep duration by an average of 90 mins for 20% of adults. This has led to a large number of adults experiencing daytime sleep and insomnia. A prospective controlled study by Chaudhari et al.<sup>[3]</sup> demonstrated the effectiveness of SKY in reducing excessive daytime sleep. The study assessed day time sleepiness using Epworth Sleepiness scale (ESS) for 105 participants at baseline, 4 weeks and 8 weeks after SKY practice. The ESS scale measures the frequency of dozing off during day-to-day activities. The data analysis demonstrated a significant and consistent improvement of 31.3% in ESS scores over 8 weeks of SKY practice. A comparison between the SKY group and the control group showed a 34.7% improvement in the scores of the SKY group compared to the control group. The study also demonstrated an improvement in the ESS scores among obese participants, who are more prone to day time sleepiness. The study concluded that SKY reduces daytime sleepiness and improves sleep architecture.

**Summary:** A study on the benefits of SKY in reducing daytime sleepiness documented a 34.7% reduction in day time sleepiness for SKY practitioners versus non-SKY practitioners. Among the SKY practitioners, the sleep quality improved by 31.3% over 8 weeks of SKY practice.

### **4. Association between frequency of Sudarshan Kriya Yoga practice and sleep quality - A Singapore based study**

A cross-sectional study from Singapore, by Sloan and Kanchibhotla<sup>[4]</sup>, studied the relationship between the frequency of SKY practice and the quality of sleep. A total of 385 individuals, who were practicing SKY, were enrolled in the study. The study criteria included: Practice of SKY for at least 12 months, and participation in at least one session of SKY during the last 6 weeks. Although all

participants were practicing SKY, the frequency of practice varied. The participants were divided into 3 groups based on how often they practiced SKY in a week: infrequent (once a month or less), weekly (1-3 times a week) and daily (more than 5 times/week). The study subjects were comparable in other factors that affect sleep such as diet and stress levels. Sleep quality was assessed using the Pittsburgh Sleep Quality Index. The sleep quality scores were correlated with frequency of practice using odds ratio analysis. Data analysis showed that individuals who practiced SKY daily had significantly higher odds of having a good sleep quality. The data also demonstrated an inverse association between a higher frequency of SKY practice and the odds of experiencing poor sleep quality. 76.7% of the practitioners who practiced SKY daily, 64.1% of the practitioners who practiced SKY once a week, and 60.2% of the practitioners who practiced SKY once a month experienced good sleep quality.

**Summary:** A Singapore-based study demonstrated an association between SKY practice and a good sleep quality. Better sleep quality was observed in those who practiced SKY more frequently. 76.7% of the practitioners who practiced SKY daily, 64.1% of the practitioners who practiced SKY once a week, and 60.2% of the practitioners who practiced SKY once a month experienced good sleep quality.

### **5. Evaluation of Sleep architecture in Sudarshan Kriya Yoga practitioners**

A study by Sulekha et al.<sup>[5]</sup> studied sleep architecture among SKY practitioners. A total of 78 healthy individuals were assessed using polysomnography to determine their sleep quality. The study participants were divided into two age groups; younger group (20-30 years) and middle aged (31-55 years). Each group was further divided based on whether they were practicing the SKY technique, or if they were novice to yoga. Those who were novice to any yogic technique constituted the control group. Polysomnography revealed that the sleep architecture of SKY and control group was similar in the younger population. However, among the middle aged population, the slow wave sleep (Non REM S3 and S4) was significantly reduced in the control group. The slow wave sleep (SWS) constituted only 3.7% of sleep among the control group. The middle aged SKY group did not exhibit any such reduction in the SWS duration and retained the sleep architecture similar to the younger population. SWS constituted 11.76% of sleep among the middle aged SKY population.

Slow wave sleep is considered to be the most restorative sleep stage. A good quality slow wave sleep is necessary for memory consolidation and day time function. Slow wave sleep is characterized by slow heartbeat and breathing. Brain waves also become the slowest during this sleep stage. SWS decreases among the general population with age.

It was interesting to note that the middle aged SKY group demonstrated no decline in SWS. The results also demonstrated similar sleep architecture in both the middle aged and younger population of SKY practitioners. This is important, as both sleep quality and architecture change with age. As we age, we spend less time in deep sleep, as evident by the differences in the control group. Among the SKY group, older practitioners showed no decline in sleep stages and architecture.

**Summary:** A study that evaluated the sleep architecture among SKY practitioners demonstrated a similar deep sleep architecture for the younger and middle-aged SKY practitioners, with middle aged SKY practitioners showing no age related decline in sleep quality. A decline in deep sleep was noted in the control middle aged group. SKY helps mitigate the effects of age on deep sleep, and helps maintain a robust & restful sleep architecture as we age.

### **Summary of Research Findings :**

- Quality and duration of sleep has decreased significantly over the years amongst adults.
- Practice of SKY breathing can improve sleep quality.
- Sleep enhances neurological and cognitive functions, repairs, rejuvenates and recharges the body for the next day.
- A study including 473 Indian adults demonstrated an improvement in the sleep quality post SKY program. Sleep quality was measured before the SKY workshop, after the SKY workshop and after the recommended 40-day daily SKY practice. Almost 82% people experienced better sleep after SKY intervention. The overall mean sleep scores improved by 30.2% post SKY workshop. Males showed a 27% improvement in the quality of sleep post 40 days SKY practice. People who practiced SKY daily achieved the highest sleep quality over time.
- Sleep disturbances among young adults were evaluated post SKY workshop and compared with the Wisdom On Wellness program to assess the benefits of both programs. Sleep disturbance decreased progressively and significantly for the study participants (aged 18-35 years) who practiced SKY for 3 months. A 16.7% decrease in sleep disturbance was observed immediately post SKY program, which further dropped to 21.7% reduction in sleep disturbance at the 3-month follow up.



- A study on the benefits of SKY in reducing daytime sleepiness documented a 34.7% reduction in day time sleepiness for SKY practitioners versus non-SKY practitioners. Among the SKY practitioners, the sleep quality improved by 31.3% over 8 weeks of SKY practice.
- A Singapore-based study demonstrated an association between SKY practice and a good sleep quality. Better sleep quality was observed in those who practiced SKY more frequently. 76.7% of the practitioners who practiced SKY daily, 64.1% of the practitioners who practiced SKY once a week, and 60.2% of the practitioners who practiced SKY once a month experienced good sleep quality.
- A study that evaluated the sleep architecture among SKY practitioners demonstrated a similar deep sleep architecture for the younger and middle-aged SKY practitioners, with middle age SKY practitioners showing no age related decline in sleep quality. Control group population showed a decline in deep sleep among the middle aged population. SKY helps mitigate the effects of age on deep sleep, and helps maintain a robust & restful sleep architecture as we age

## **Conclusion**

Sleep is essential for healthy functioning of numerous physiological and psychological functions in the body. Deep sleep is affected by a variety of factors like age, diet, lifestyle, and levels of stress. Deficiency of sleep is the new epidemic affecting the health of individuals globally. The sleep architecture consists of 4 different phases - Non- Rapid eye movement 1, Non- Rapid eye movement 2, Non- Rapid eye movement 3 and Rapid eye movement phase. Each phase displays a different pattern of brain waves. The sequence of 4 phases repeats few times during a night's sleep. The sleep patterns and architecture change with age and lifestyle. As we age, the duration of time spent in deep sleep decreases. Lifestyle factors can also create reduction in sleep quality and duration.

SKY practice improves both sleep quality and duration. Three research studies on SKY have demonstrated an immediate improvement in sleep quality of an individual post SKY, while one study measures the long term effect of SKY on sleep quality. Majority of the study population reported improved sleep quality scores post SKY intervention. Those who practiced SKY more regularly had better sleep quality. Another study determined the impact of deep sleep on sleep architecture young and middle aged population. While it is known that deep sleep decreases with age, it was noted that among SKY practitioners both young and middle aged population had similar sleep architecture.

Overall, in a world where good sleep is becoming a rare experience, SKY can help restore our sleep so we lead a healthy and a peaceful life.

## ***About Sri Sri Institute for Advanced Research***

**Sri Sri Institute for Advanced Research (SSIAR)** is the research wing of The Art of Living, founded under Ved Vignan Maha Vidya Peeth (VVMVP) Trust. SSIAR's mission is to apply 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.

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