



SRI SRI INSTITUTE FOR ADVANCED RESEARCH

Art of Living Research Wing

A White Paper Series on Sudarshan Kriya Yoga

A White Paper on Sudarshan Kriya Yoga and Cholesterol

Introduction

Cholesterol & Triglycerides

Cholesterol are waxy fat-like substances that are naturally produced by the liver, but we also get them from certain foods that we eat. Cholesterol is an essential component of cell membranes, brain, nerve cells, and bile. It helps the body absorb fats and fat-soluble vitamins. The body uses cholesterol to make vitamin D and hormones like estrogen, testosterone, and cortisol. The body can produce the entire supply of cholesterol it needs; however, it also obtains cholesterol from food like oil, meat and dairy products. Fats, such as cholesterol and triglycerides, cannot circulate freely in the blood, because blood is mostly water and accumulates in the surrounding blood vessels. To be able to circulate in blood, cholesterol and triglycerides are packaged with proteins and other substances to form particles called lipoproteins. Lipoproteins are fat and protein molecules that transport cholesterol to various parts of the body. Based on the density of these molecules, lipoproteins include Very low density lipoproteins (VLDL), Low-density lipoproteins (LDL) and High-density lipoproteins (HDL). The high density lipoproteins transport the cholesterol towards the liver where they are eliminated hence known as the “good” cholesterol while the low density lipoproteins transport cholesterol towards the artery walls, wherein they accumulate and cause plaques. These plaques do not allow sufficient blood flow and oxygen to major organs thus causing risk to life. Therefore they are known as “bad” cholesterol. On the other hand, triglycerides are another type of fat that are stored in the body, that is used up by the body for energy. However, higher amounts of triglycerides are carried by VLDL that deposit these triglycerides in the arterial walls

and in the arteries. However, high triglycerides are as bad as bad cholesterol and may pose various cardiovascular risks like heart attack and strokes.

Estimated range, monitoring and Diagnosis

Values of cholesterol, Low-density lipoprotein (LDL), High-density lipoprotein (HDL) and triglycerides are tested through the lipid profile panel of blood tests that serve as an initial screening tool. An abnormal lipid profile could help identify genetic disorders, determine approximate risks for cardiovascular disease such as atherosclerosis, stroke and heart attack, fatty liver pancreatitis and renal illness. Healthy levels of total cholesterol is less than 170 mg/dL, Low density lipoprotein cholesterol is less than 100mg/dL, high density lipoprotein cholesterol is more than 45mg/dL and triglycerides is less than 150mg/dL.

Risk factors for abnormal lipid profile

Diet and sedentary lifestyle: The most common cause of an abnormal lipid profile is excessive dietary intake of total calories, saturated fat, cholesterol, and trans fats. Further a body mass index greater than 30 is a risk factor of high cholesterol. Increased amount of fats in the body tissues means an increased amount of free fatty acids. Free fatty acids along with glucose produce more cholesterol and high triglycerides. Further, HDL contributes to decreasing cholesterol levels due to its inhibition of vascular inflammation, reducing oxidative stress and reversing the cholesterol transport to the liver from where it is eliminated. Lack of exercise can lower the HDL contents in the body whereas exercise, due to its anti-inflammatory and anti-oxidative properties improve the HDL functionality.

Stress: Stress is known to increase levels of serum total cholesterol, triglycerides, LDL-Cholesterol and VLDL-Cholesterol, and decrease HDL-Cholesterol levels through releasing hormones such as cortisol, adrenaline, and noradrenaline which affect the lipid profile. Stress also triggers inflammation that lowers the HDL amounts that are responsible for clearing LDL. Therefore, chronic stress affects the lipid profile negatively. Yoga and meditation can help to reduce the risk for heart disease as they reduce stress and induce relaxation.

Smoking and Drinking: Increased intake of alcohol causes higher levels of triglycerides. Increased consumption of alcohol also causes fatty liver disease that makes it difficult to eliminate cholesterol from the body. Further smoking damages the blood vessels surrounding

the heart and chest region. This enhances the ability to collect fatty deposits. Also, smoking lowers HDL levels in the body and raises LDL levels in the body.

Family history: Genetic predisposition such hypercholesterolemia (FH) can cause very high levels of LDL at a very young age.

Other medical conditions: Other common secondary causes include diabetes mellitus, chronic kidney disease and hypothyroidism.

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. Sudarshan Kriya Yoga 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 passage of air through the lungs. ‘Om’ is chanted three times with prolonged exhalation. Lastly, Sudarshan Kriya rhythmic breathing is done in two variations:- Long SKY that is done with recorded instruction by Gurudev Sri Sri Ravishankar and Short SKY. Short SKY 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 Cholesterol

The prevalence of Cholesterol is associated with other non-communicable diseases. Research studies in the current white paper measure the impact of SKY on the lipid profile including cholesterol, low density lipoprotein, high density lipoprotein and triglycerides. Short summaries of each research studies are presented below:

1. Sudarshan Kriya Yoga and changes in lipid profile among healthy volunteers

Sayed et al.^[1] studied the effect of SKY on the lipid profile of healthy volunteers. A total of 55 healthy participants, including the medical students, teaching and non-teaching staff of both genders, between the ages of 18-50 years, were recruited from the Krishna Institute of Medical Sciences University, Karad. SKY was taught to the participants through an 8 day workshop. Blood was collected from each subject before and after one week of practicing SKY. Lipid profile parameters such as Total Cholesterol (TC), Triglyceride (TG), Low-density Lipoproteins (LDL) and High-density Lipoproteins (HDL) were measured. When measured after one week of SKY practice, LDL- Cholesterol decreased by 13.88% and HDL Cholesterol increased by 20% for SKY practitioners, compared to their pre-intervention levels. HDL cholesterol has a cardio protective effect. Improved ability to overcome stress can be cited as a possible mechanism for the improvement in the lipid profile of SKY practitioners.

Summary: Higher serum cholesterol level increases the risk of developing cardiovascular disease. Low density lipoproteins which cause blockage in the heart vessels decreased by 13.88%, while the high density lipoproteins, also known as good cholesterol, increased by 20% after one week of SKY practice in the healthy population. This study provides evidence that patients suffering from high cholesterol, high blood pressure and other heart conditions, would benefit from integrating SKY into a heart-healthy lifestyle, often recommended as the first-line therapy for them.

2. Evaluation of Sudarshan Kriya Yoga and lipid profile in individuals between 30-60 years of age

Mungal and Bondade^[2] studied the effect of SKY on lipid profile across all age groups. A total of 60 males, who had been practicing SKY daily for 6 months, constituted the SKY group. Same number of males (n=60) who didn't practice SKY served as controls. Participants were divided into three age groups, 31-40 age group, 41-50 age group and 51-60 years. Outcomes measured were total serum cholesterol, triglycerides, LDL cholesterol, VLDL cholesterol, and HDL cholesterol. Statistical analysis of data revealed significantly lower levels of total serum cholesterol in those practicing SKY, 12.6% lower in the 31-40 age group; 16.6% in the 41-50 age group; 6.3% in the 51-60 age group compared to the control group. The results also

showed a decrease in LDL - Cholesterol, a decrease in VLDL -cholesterol and an increase in serum HDL cholesterol in the SKY group. Across all age groups, serum cholesterol was found to be lower for SKY practitioners when compared to age and gender matched controls. The authors hypothesized that these changes may occur due to reduction in stress. Stress is known to increase blood lipid levels through increasing the level of lipolytic hormones like cortisol, adrenaline, noradrenaline, and growth hormone. SKY produces a state of calm and relaxed awareness, and decreases stress, as substantiated by various other studies. A reduction in sympathetic activity and lipid peroxidation could also contribute towards this outcome. Stimulation of sympathetic innervations to adipose tissue releases norepinephrine, which acts via beta adrenergic receptors to increase lipolysis. SKY results in decreased sympathetic activity, and thus decreased lipolysis. SKY decreases the lipid peroxidation as evidenced by improvement in antioxidant profile seen in other studies. Decrease in lipid peroxidation prevents degradation of lipids.

Summary: The effect of SKY on lowering cholesterol and creating a healthy lipid profile was studied. SKY can be useful in maintaining a healthy lipid profile as observed in this study. Lower levels of total serum cholesterol by : 12.6% lower in 31-40 age group; 16.6% in 41-50 age group; 6.3% in 51-60 age group, were found in SKY practitioners when compared to the age matched control group. SKY can prevent any abnormal shifts in lipid profile or blood pressure caused by stress, which in turn reduces the risk of developing cardiovascular disease in the long term.

3. Impact of Sudarshan Kriya Yoga on physiological markers among medical college students

Ahmad et al.^[3] studied the effect of SKY on blood pressure and biochemical parameters in healthy medical students. Medical students (n=30) between the ages of 18-21 years, who met the study criteria of being in good health, non-smoking, free of cardio-respiratory diseases and not engaging in any other exercise, were included. Mean blood pressure, total cholesterol and blood sugar were measured before teaching them the SKY practice, and on the 7th, 30th and 90th day of practicing SKY. The mean blood pressure showed a 3.4% reduction, after 3 months of SKY. The study also found a significant reduction of 4.2% in cholesterol and a 4% reduction in blood glucose after SKY practice. Two important things to note were, one, although the mean values dropped, they stayed within the normal range for healthy individuals, and secondly that these changes were relatively smaller compared to other studies. This might be due to the

fact that the study subjects were healthy young individuals. The practice of SKY appears to be beneficial in improving the mean blood pressure and biochemical parameters in college students. This unique breathing practice promotes their health and also acts as a potent energizer.

Summary: Medical students experience stressful circumstances that could potentially alter their physiological parameters and adversely impact their health in the long term. A study on healthy medical students showed a significant improvement in their physiological parameters post SKY. Blood pressure (reduced by 3.4%), blood glucose (reduced by 4%) and total cholesterol (dropped by 4.2%) all improved post 3 months SKY practice. It's important to note that although the mean values of blood pressure and blood glucose dropped post SKY, they stayed within the normal range for healthy individuals.

4. Role of Sudarshan Kriya Yoga on lipid profile of engineering students during exam stress

Various studies have been conducted to examine the changes in lipids and lipoproteins under different stressors. Subramanian et al.^[4] studied the effect of SKY on the lipid profile of students experiencing exam stress. The subjects in this study included 43 undergraduate students (aged 18–23 years, males - 20, females - 23), who were randomized into two major groups (n=21) Control group, and (n=22) the study group which received SKY. Blood samples were collected for testing at four separate time points, i.e baseline (before the SKY program), 2 weeks after SKY (during exam stress), 3 weeks after SKY practice (during exam stress) and 6 weeks after SKY practice (during exam stress). It was ensured that exams coincided with the study timepoints. Lipid profile and hematological parameters were measured at all four intervals. In both the groups, the level of cholesterol, TGL, VLDL were found to spike significantly during exam stress (baseline measurements). However, in the study group a significant decrease in cholesterol level, by 12.8%, was observed after 6 weeks of SKY practice, even while experiencing the exam stress. VLDL levels also decreased by 36.7% after 6 weeks of SKY practice even with the exam stress. This study indicates that SKY practice has the potential to mitigate the adverse impact of acute stress on lipid profile and hematological parameters.

Summary: A study on the lipid profile of students demonstrated that exam stress can spike their cholesterol levels, and create abnormalities in lipid profile. However, this is mitigated with

the practice of SKY. Students who practiced SKY for 6 weeks demonstrated a 12.8% reduction in their cholesterol levels from the baseline, even while experiencing exam stress instead of an increase, as was seen in the control group that did not receive SKY. The study ascertained that the adverse impact of exam stress on health outcomes of students can be minimized with the practice of SKY.

5. Sudarshan Kriya Yoga creates immediate improvements in blood glucose and lipid profile in patients with Type 2 Diabetes Mellitus (DM)

An abnormal lipid profile is a significant comorbidity among patients with type 2 DM. It contributes to premature hardening and blockage of arteries, and developing complications such as heart and kidney disease. Elevated triglyceride and LDL, and decreased HDL (good) cholesterol concentrations are commonly seen in patients with type 2 DM. Anupama et al.^[5] studied the effect of SKY on lipid profile of patients with type 2 DM. 40 subjects with type 2 DM- 20 men and 20 women between the ages 40-60 were enrolled in the study. Blood sugar levels and lipid profile were measured before and after 6 days of Sudarshan Kriya Yoga training. Along with a drop in fasting blood sugar, the beneficial changes included a significant drop in total cholesterol by 19.7%, triglyceride levels by 24.9% and rise in HDL (good) cholesterol by 36.9% after SKY. This indicates that SKY can be a very useful adjunct to oral agents as a therapeutic agent for treating hyperlipidemia. SKY provides a holistic approach to improving glycemic control and normalizing lipid profile in diabetic patients.

Summary: A study revealed that SKY practice had an immediate effect on reducing cholesterol levels by 19.7% while HDL (good) cholesterol increased by 37% after 6 days of SKY practice. Regular practice of SKY technique can help create a healthier lipid profile among patients with type 2 DM, which in turn leads to a reduced risk of heart disease, stroke, kidney disease and eyesight complications.

6. Impact of Sudarshan Kriya Yoga on abnormal lipid profile and type 2 DM

Agte and Tarwadi.^[6] investigated the effect of SKY on patients with type 2 DM and related hypercholesterolemia. A total of 87 patients with type 2 DM between the ages 45–65 participated in the study. Each subject had previously been diagnosed with type 2 DM, had stable glucose levels, and was taking prescribed medication. The subjects were divided into treatment and non-treatment groups, with 57 in the treatment group and 30 in the

non-treatment group. Fasting and postprandial glucose levels, lipid profile, and glycosylated hemoglobin were measured before SKY practice, and again after 4 months of SKY practice. After 4 months, the fasting glucose was significantly lowered by 17.36% in the treatment group that had been practicing SKY. A 16.3% drop in triglycerides and 14.6% reduction in cholesterol levels was also observed in the treatment group after 4 months of SKY practice. It was interesting to note that subjects with higher disparities (more abnormal markers at baseline) had higher magnitudes of reduction with SKY practice than subjects with marginally high levels (lesser abnormal values at baseline) of these markers. This suggests that SKY may act as a corrective strategy and its impact is correlated with the severity of imbalance.

Summary: In a study evaluating the impact of SKY on individuals with type 2 DM, the treatment group experienced a significant reduction in the fasting blood sugar level (17.36%) and cholesterol (14.6%), along with improvement in lipid profile (16.3%) after 4 months of SKY practice. This study demonstrated the benefits of SKY on management of diabetes through improving fasting blood sugar and lipid profile in diabetic patients. It was interesting to note that subjects with higher disparities had higher uses of reduction with SKY practice than subjects with only marginally high levels of these markers.

Summary of Research findings

1. Life sustaining physiological processes are governed by Cholesterol, a waxy fat-like substance that absorbs fat and fat soluble vitamins.
2. Cholesterol plays an important part in forming cell membranes and making vitamin D and several other hormones.
3. While the human body produces Cholesterol naturally, it also obtains from oil, meat and dairy products.
4. Several predisposing factors including stress plays an important role in abnormal lipid profile and SKY helps in managing the lipid profile.
5. Higher serum cholesterol level increases the risk of developing cardiovascular disease. Low density lipoproteins which cause blockage in the heart vessels decreased by 13.88%, while the high density lipoproteins, also known as good cholesterol, increased by 20% after one week of SKY practice in a healthy population. This study provides evidence that patients suffering from

high cholesterol, high blood pressure and other heart conditions, would benefit from integrating SKY into a heart-healthy lifestyle, often recommended as the first-line therapy for them.

6. The effect of SKY on lowering cholesterol and creating a healthy lipid profile was studied. SKY can be useful in maintaining a healthy lipid profile as observed in this study. Lower levels of total serum cholesterol by : 12.6% lower in 31-40 age group; 16.6% in 41-50 age group; 6.3% in 51-60 age group, were found in SKY practitioners when compared to the age matched control group. SKY can prevent any abnormal shifts in lipid profile or blood pressure caused by stress, which in turn reduces the risk of developing cardiovascular disease in the long term.

7. Medical students experience stressful circumstances that could potentially alter their physiological parameters and adversely impact their health in the long term. A study on healthy medical students showed a significant improvement in their physiological parameters post SKY. Blood pressure (reduced by 3.4%), blood glucose (reduced by 4%) and total cholesterol (dropped by 4.2%) all improved post 3 months SKY practice. It's important to note that although the mean values of blood pressure and blood glucose dropped post SKY, they stayed within the normal range for healthy individuals.

8. A study on the lipid profile of students demonstrated that exam stress can spike their cholesterol levels, and create abnormalities in lipid profile. However, this is mitigated with the practice of SKY. Students who practiced SKY for 6 weeks demonstrated a 12.8% reduction in their cholesterol levels from the baseline, even while experiencing exam stress instead of an increase, as was seen in the control group that did not receive SKY. The study ascertained that the adverse impact of exam stress on health outcomes of students can be minimized with the practice of SKY.

9. A study revealed that SKY practice had an immediate effect on reducing cholesterol levels by 19.7% while HDL (good) cholesterol increased by 37% after 6 days of SKY practice. Regular practice of SKY technique can help create a healthier lipid profile among patients with type 2 DM, which in turn leads to a reduced risk of heart disease, stroke, kidney disease and eyesight complications.

10. In a study evaluating the impact of SKY on individuals with type 2 DM, the treatment group experienced a significant reduction in the fasting blood sugar level (17.36%) and cholesterol (14.6%), along with improvement in lipid profile (16.3%) after 4 months of SKY practice. This

study demonstrated the benefits of SKY on management of diabetes through improving fasting blood sugar and lipid profile in diabetic patients. It was interesting to note that subjects with higher disparities had higher uses of reduction with SKY practice than subjects with only marginally high levels of these markers.

Conclusion

Several life-sustaining physiological processes are impacted by stress, sedentary lifestyle and dietary habits. One of the most important physiological processes includes lipid management. It contains various components such as cholesterol, lipoproteins and triglycerides. While these lipids are important for many physiological processes, excess amounts can be deposited in arteries and other blood vessels obstructing the flow of blood, causing life-threatening problems such as stroke and heart attacks. Several mind-body interventions have been studied to manage these fats positively and provide good cardiovascular health. SKY research studies demonstrate a decrease in “bad” fats and cholesterol and increase in “good” fats and cholesterol maintaining a good lipid profile. Among healthy individuals, SKY provides physical activity and improved mental well-being to manage the lipid profiles. Among students, SKY manages the stress levels, one of the major reasons for abnormal lipid profile and controls the lipid profile. Among patients with other comorbidities like diabetes, SKY manages the comorbidity to maintain a good lipid profile. Therefore, SKY plays a significant role in preventing the progression and complications of hypertension and diabetes. The ease of the technique helps one to inculcate the practice in daily life to provide a healthier and happier 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.

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

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

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