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Research Article

EFFECT OF SUDARSHAN KRIYA YOGA ON OXIDATIVE STRESS AND ANTIOXIDANT STATUS IN LEPROSY PATIENTS BEFORE AND AFTER INTERVENTION

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ABSTRACT

Introduction: Leprosy was eliminated from India in 2005. WHO reported that India accounts for 60% of the world's newly detected leprosy cases in 2016. In the post leprosy –elimination era, leprosy recognition and management is a challenging task. Sudarshan Kriya Yoga (SKY) is unique breathing process which includes Asanas, Pranayama, Bhastrika and Sudarshan Kriya (SK). SKY may be helps in decreasing decreases lipid per oxidation and improves antioxidant status in the blood.

Aim: The aim of this was to evaluate the effects of SKY intervention on lipid peroxidation, antioxidant vitamins and Zinc levels in leprosy patients.

Materials and Methods: Serum of leprosy patients was evaluated for Lipid per oxidation markers i.e. Malondialdehyde (MDA), antioxidant Vitamins(C and E) and Zinc were measured spectrophotometrically (Elico). A total of 152 patients of leprosy were randomised into two groups:

1. Leprosy patients (post treatment)
2. Leprosy patients (post treatment) performing SKY and monitored for regular practice. Interventional group underwent for SKY for a period of 3 months. The Malondialdehyde, antioxidant vitamins (C and E) and zinc levels were assessed at baseline and after 3 months in both the groups.

Results: Results showed that serum MDA, the marker of oxidative stress was significantly reduced, and on the other hand antioxidant vitamins (C and E) and zinc levels showed significant rise in the post interventional group as compared with the control without SKY.

Conclusion: This indicates a possible beneficial role of SKY in enhancing the body's defense mechanisms by decreasing the oxidative damage in leprosy patients.

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INTRODUCTION

Leprosy is a chronic granulomatous infectious disease caused by *Mycobacterium Leprae*, an obligate intercellular bacillus that attacks cutaneous tissues and peripheral nerves producing skin lesions, nerve degeneration, anesthesia, infection and deformities. The *M. leprae* has a long incubation period of on an average 5 years or more. The disease affects nerve endings and destroys the body's ability to feel pain and injury (according to WHO).¹

Leprosy can be classified on the basis of clinical manifestation and microscopic results. In the classification based on smears, patients showing negative smear at all sites are known as Paucibacillary Leprosy (PB), while those showing positive smear at any site have Multibacillary Leprosy (MB) (1).

Leprosy was declared eliminated from India in 2005, yet the recognition and management of these reactions continues to be the most significant challenging task in the times after declared post elimination era.²

India accounts for 60% of the world's new leprosy cases. WHO observed that New Delhi is among regions in India that has an increased prevalence of the curable diseases recorded till date which often attracts social ostracism because of ignorance?³ The pathogenesis of leprosy has been found to be influenced by many factors including oxidative stress (OS).^{4, 5} The major defence mechanism against microbial infections is the macrophage system. All infected macrophages show increased phagocytosis and oxygen consumption i.e. "Respiratory Burst" which result in increased production of free radicals like

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reactive oxygen species (ROS), such as superoxide anions, hydrogen peroxide and hydroxyl radicals.⁶ These free radicals not only kill the bacteria but also damage proteins, lipids and nucleic acids of host tissues^{4, 5} leading to necrotic changes in the affected tissues.

Cell has the “antioxidant defense” system that scavenges the free radicals. Humans are well enriched with enzymatic antioxidants like Superoxide Dismutase (SOD), catalase, peroxidase and non-enzymatic antioxidants like vitamin A, E, C and glutathione (6). Normally, the antioxidants scavenge the free radicals in circulatory system and clean the generated ROS from the cells. The main targets of peroxidation by ROS are polyunsaturated fatty acids (PUFA) in the membrane lipids that are degraded to MDA.⁶ The estimation of MDA serum levels in association with the determination of antioxidant status can represent an important mechanism in prognosis, treatment and control of leprosy or other degenerative diseases.⁷

Meditation, *Sudarshan Kriya* (SK) and other techniques have been known to relieve stress by causing a relaxation response, which is a complex compensatory mechanism. We have observed that SK lowers oxidative stress and provides better antioxidant defense.⁸ The objective of this study was to get further insights into the effect of SK on antioxidant vitamins and oxidative stress.

MATERIAL AND METHOD

The present study was carried out in the department of Biochemistry, JNMC, Datta Meghe Institute of Medical Sciences (DU), Sawangi (M) Wardha, Maharashtra, India. The plan of this study was approved by Institutional Ethics committee for Human Research. (Letter no. DMIMS (DU) IEC/2015-16/1790 Dated 31/12/2015. The informed consent was obtained from patients after having explained the study design and their role in this study.

Study design

This study was done during the period from June 2017 to March 2018. Leprosy patients (post treatment) residing in Anandvan Warora, Maharashtra were selected as cases. Total 152 patients were enrolled in the present study and randomised into two major groups.

Group I- control (n=76)-leprosy patients without performing *Sudarshan Kriya Yoga*.

Group II- Interventional (n=76) - leprosy patients performing *Sudarshan Kriya Yoga*.

There were 3 dropouts from interventional group.

The patients having prior history of major illness, smoking, infectious diseases, Hypertension, Diabetes and ulceration were excluded from the study. Under aseptic precautions, 5ml venous blood samples were collected and 3ml in plain tube was allowed to stand for 30 minutes, centrifuged, serum separated for the assay of Malondialdehyde (MDA), Vitamin E and Zinc and then remaining 2ml of blood was collected in another bulb of potassium oxalate, centrifuged and plasma separated for vitamin C assay. Malondialdehyde measured by thiobarbituric acid reactive substances (TBARS) assay, according to Okhawa *et al.*⁹

Serum vitamin E was estimated by Baker and Frank method, vitamin E was oxidized in the presence of FeCl_3 (Fe^{3+}) to give an intermediate, which then reacted 2,2'-dipyridyl reagent to form a pink colored product.¹⁰

Serum vitamin C estimated by Aye Kyaw method. The Phosphotungstic acid used serves the dual purpose of a protein precipitant and ascorbic acid extractant color developing agent where, phosphotungstic is found to be specific and sensitive for ascorbic acid determination in the plasma.¹¹

Serum Zinc by colorimetric Kit method – manufactured by Tulip Coral Ecosystem. Zinc in an alkaline medium reacts with Nitro-PAPS to form a purple colored complex.¹²

Before intervention (i.e. start of SKY) blood samples were collected from all leprosy patients. Those samples are known as baseline sampling. Then the interventional group underwent for *Sudarshan kriya Yoga* training for 6 days (3hours daily) organized in Anandvan, Warora Maharashtra, India. They participated in 6 days *Sudarshan kriya* training held at Anandvan Warora which includes *Sudarshan kriya yoga* and meditation.

Description of intervention

The breathing techniques that are part of *Sudarshan kriya Yoga* are,

1. Asanas
 2. Three stage Pranayama with “Ujjayi” or “Victory of Breath”
 3. Three sets of Bhastrika or “Bellow’s Breath”
 4. Three times chanting “OM”
 5. *Sudarshan Kriya* (SK) or the “Healing Breath Technique
- All the above were practiced in above mentioned order.

Asanas includes neck rotations, shoulder rotations, wrist rotation, waist rotations, knee rotations, ankle rotations (all are joint rotations), peacock pose, cat pose and mountain pose.

The breathing practices (Pranayama and Bhastrika) were done in Vajrasan posture, on the carpet spread over the floor. Eyes were closed throughout the session. Normal breathing was at the rate of 14-16 breaths per minute. Ujjayi (Victorious of Breath) is slow and deep breathing technique at 2 to 4 breaths per minute.

Three stages Pranayama with ujjayi breath is an advanced form using a specific ratio of inhalation and exhalation and breath holds. Interventional group who participated in this breathing exercise were instructed to do a specific arm position with breath regulation for approximately 10 minutes in total. It involves taking a breath for a period of 4-6 seconds holding one’s breath (4-6 seconds) and then exhalation (4-10 second).¹³

The Second breathing component of SKY is Bhastrika. Here the breathing is vigorous and faster about 20 to 22 respiratory cycles per minute. Three sets of Bhastrika round followed by a few minutes of normal breathing. Arm movements, up and down, used to increase the force and depth of inhalation and exhalation and this technique was done for approximately 5 minutes. Then the “OM” was chanted three times using a prolonged expiration and 15 seconds rest after each chant.

The central component of *Sudarshan Kriya* is an advanced cyclic breathing exercise of slow, medium and fast rates in succession. Slow breaths in SK are about 40-50 respiratory

cycles per minutes and the fast breathing about 60-80 cycles per minutes. The participants rotate through these breathing patterns during *Sudarshan Kriya*. The number of breaths, the intensity, and the sequence of cycles varies depending upon whether the kriya is done with an instructor or whether it is done as a short home practice (three repetitions of 20 slow, 40 medium and 40 rapid cycles)¹³. Last component is Meditation or Yognidra. Which is practiced under instructions from the instructor in the beginning after SKY, participants often describe that they feel peaceful, energetic and happy. It has very strong impact on relieving the stress levels.

Again the blood samples were collected after 3 months from initiation of SKY and processed for investigations under the study.

Then the blood samples were collected from control group after 3 months who did not practice SKY and were assessed.

Statistical Analyses: for statistical analysis software SPSS 21.0 Version were used.

Result

Table 1 Showing values of MDA, Vitamin C & E, and Zinc levels in leprosy patients (control and interventional group) of baseline sampling.

Baseline characteristics of Leprosy patients (Control group and Intervention group)					
Variable	Control (n=76) leprosy patients without SKY		Intervention (n=76) leprosy patients before SKY		p- value
	Mean ± Std. Dev.	95% Conf. Interval	Mean ± Std. Dev.	95% Conf. Interval	
MDA (nmol/ml)	4.76±0.47	4.64 4.87	4.73±0.41	4.64 4.81	P=0.73, NS
Vitamin C (mg/dl)	0.46±0.07	0.438 0.473	0.46±0.07	0.441 0.469	P=0.99, NS
Vitamin E (µmol/L)	8.87±1.69	8.45 9.28	8.82±1.50	8.50 9.14	P=0.87, NS
Zinc (µg/dl)	47.94±7.22	46.16 49.71	48.66±0.73	47.18 50.12	P=0.53, NS

Table 2 showing values of MDA, Vitamin C& E, and zinc levels in leprosy patients (control and interventional group (after 3 months of SKY)

End line characteristics of Leprosy patients (Control group and interventional group)					
Variable	Control (n=76) leprosy patients without SKY after 3 months		Intervention (n=73) leprosy patients with SKY after 3 months.		p- value
	Mean ± Std. Dev.	95% Conf. Interval	Mean ± Std. Dev.	95% Conf. Interval	
MDA (nmol/ml)	4.78±0.48	4.65 4.89	2.82±0.38	2.74 2.90	P<0.001**
Vitamin C (mg/dl)	0.44±0.06	0.425 0.453	0.82±0.121	0.79 0.84	P<0.001**
Vitamin E (µmol/L)	8.64±1.54	8.25 9.01	15.57±3.32	14.86 16.28	P<0.001**
Zinc (µg/dl)	41.46±4.61	40.32 42.59	66.28±7.41	64.69 67.87	P<0.001**

Data are expressed as mean ±SD.

** Significant p<0.001.

DISCUSSION

Over centuries, Yoga has been adopted as an alternative therapy to prevent or alter our reaction to stress and maintenance of health. Yoga, meditation and Pranayama (P) are well known as a means to keep good mental, emotional and physical health. *Sudarshan Kriya* (SK) a novel breathing technique has been introduced by His Holiness Sri Sri

Ravishankarji¹⁴. In one of the report of *Sudarshan Kriya* it is claimed that *Sudarshan Kriya* has been used to relieve stress, anxiety, insomnia, depression and post-Traumatic Stress Disorder (PTSD) after mass disaster such as war (Kosovo, Bosnia, Iraq and Sudan), earthquakes (Gujarat, India earthquake 2000), flood (Iran 2004), Hurricane Katrina¹⁵ and southeast Asia tsunami (2004)¹⁶. By this we can see after natural calamities result into post-traumatic diseases. SKY has a huge impact to heal the affected individuals.

In one of our studies we found that SK has a strong tendency towards an increase in total antioxidant capacity and decreased MDA (Malondialdehyde) and nitric oxide levels in fibrocystic breast disease.⁸ MDA is the major end product formed during the lipid peroxidation. These reactions are mediated through Reactive Oxygen Intermediate such as superoxide and hydroxide and hydroxyl radicals.¹⁷ PUFA is degraded by free radicals to form MDA. The level of MDA in serum serves as a marker of cellular damage due to free radicals.¹⁸ MDA serves as an index of lipid peroxidation. It was evaluated in leprosy patients to estimate the extent of damage caused by lipid peroxidation. MDA levels were significantly reduced in interventional group (after 3 months of SKY) as compared to control group.

Increased lipid peroxidation can occur if rate of production of ROS is higher or the antioxidant level is lower.¹⁸ Vitamin E or tocopherol is fat soluble vitamin and it protects lipid peroxidation efficiently through its chain breaking antioxidant action. Apart from the antioxidant action vitamin E also has membrane stabilizing effects¹⁹. The present study shows significant increase (P<0.001) in vitamin E levels in the leprosy patients after SKY for 3 months as compared to the controls.

Osadolar HB *et al* found that there is statistically significant decrease levels of vitamin E (P<0.05) in leprosy patients as compared with controls.²⁰

Vitamin C is a water soluble non enzymatic antioxidant. Its role as an antioxidant is indicated by its known free radical scavenging action. As a reducing antioxidant agent, it directly reacts with superoxide and hydroxyl radical and various lipid hydroperoxides. In addition, it can restore the antioxidant properties of oxidized vitamin E suggesting that a major protecting function of vitamin C is to recycle the vitamin E radicals.

The present study shows significant increase in serum vitamin C levels (P<0.001) in interventional group (after 3 month of SKY) as compared with the control group (after 3 months).

Osadolar HB and Ihongbe JC,²⁰ found that there is significant decrease in the plasma vitamin C levels (P<0.05) in leprosy patients as compared with controls. As leprosy patients are mostly from low socioeconomic status, they do not get balanced diet with rich antioxidant food like fresh vegetables, fruits, eggs, dairy products, legumes, whole grains and nuts every day. Decreased vitamin E and C levels in leprosy patients may be improved by vitamin E and C supplementations.¹⁹

Zinc is an important antioxidant element with great nutritional and metabolic value. Zinc is involved in many metabolic reactions, such as formation of antioxidant enzyme Cu-Zn SOD; it is also associated with thiol containing protein, metallothionin (MT) which is an excellent scavenger of

hydroxyl radicals.²¹ Despite so many important functions, body does not store Zn and so required daily through the diet.

In the present study, we observed that there is an increase in serum zinc level in interventional group (after 3 months of SKY) as compared to the controls. This suggests that there could be a correlation of serum zinc levels and oxidative stress. Moreover, it suggests that SKY has an overall effect on mineral metabolism particularly in Zinc. It might be due to decrease stress level which leads to less utilization of zinc in the study group.

Sher *et al* reported that mechanism of alteration in trace elements level could be due to redistribution of these metals from blood to other tissues, and then release of leukocyte endogenous mediators by continuing phagocytosis by macrophages in leprosy patients.²²

Pramila Jain *et al* suggested that leprosy patients with increased bacterial load have low serum zinc levels.²³ This suggests that zinc is consumed in protecting the body tissue against pathogenic bacterial population.

The reduced level of antioxidants may expose the tissue to oxidative stress mediated inflammatory episodes, depressed cell mediated immune response, organ damage and degeneration of nerves in leprosy patients.²⁴

A study carried out in All India Institute of Medical Sciences (AIIMS), New Delhi, showed better antioxidant status both at the enzyme activity and RNA level was seen in SK practitioners. Thus it was established that SKY practice may exert a positive stimulating effect on immunity, aging, cell death and stress regulation through transcriptional regulation.²⁵

From the above discussion, we may suggest that one factor increased lipid peroxidation in all types of leprosy patients is due to decreased action of antioxidant defense mechanism which leads to increased oxidative damage in these patients. Our data shows, SKY has strong influence to enhance the body's defense mechanisms by decreasing the oxidative damage in leprosy patients after 3 months of regular practice of *Sudarshan Kriya Yoga*. Reduced stress level help to increase antioxidant levels by decrease utilization of the antioxidants. Thus, the regular practice of SKY without any other supplementation may play an important role in enhancing body's defense mechanisms, increasing antioxidant levels and improving quality of life by preventing damage caused by reactive oxygen species.

CONCLUSION

Regular practice of *Sudarshan Kriya Yoga* may be helpful in decreasing the formation of reactive oxygen species leading to decrease in lipid peroxidation. As decrease in ROS formation in leprosy patients may ultimately lead to less utilization of antioxidants, which has an important role in increasing the antioxidant levels in interventional group. So, we conclude that a potential beneficial role in enhancing body's defense mechanisms by decreasing the oxidative damage in leprosy patients by practicing SKY. However, further extensive and long term studies would be needed to prove and understand the basic mechanism of SKY at the cellular and biochemical levels.

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Conflict of interest: None declared.

References

1. World Health Organization available from www.who.int/lep/disease/en.
2. Singal A, Sonthalia S, Leprosy in post-elimination era in India: difficult Journey a head. *Indian J Dermatol* 2013;58: 443-6.
3. WHO. Weekly Epidemiological Record No.35, 1st September;2017:501-20.
4. Agnihotri N, Ganguly NK, Kaur S, Khullar M, Sharma SC, Chugh KS. Role of reactive oxygen species in renal damage in experimental leprosy. *Lep Rev* 1995; 66: 201-9.
5. Vijayaraghavan R, Suribabu CS, Oommen PK, Panneersevam C, Vitamin E reduces reactive oxygen mediated damage to bio-molecules in leprosy during multi-drug therapy. *Curr. Trends Biotechnol Pharm.* 2009; 3: 428-39.
6. Yu BP. Cellular defense against damage from reactive oxygen species. *Physiol Rev.* 1994; 74: 139-62.
7. Reddy Y N, Murthy S V, Krishna DR, *et al*. Oxidative stress and antioxidant status in leprosy patients. *Indian. J. Lepr.* 2003; 75: 307-316.
8. Vagga A, Meshram A, Anjankar A. Lipid peroxidation and antioxidants status in fibrocystic breast disease with and without Sudarshan Kriya Yoga. *International Journal of Anatomy Physiology and Biochemistry.* 2016; 3(3): 1-5.
9. Ohkawa H, Ohishi N, Yogi K. Assay of lipid peroxides in animal tissues by thiobarbituric acid reaction. *Annal Biochem* 1979; 95: 351-8.
10. Baker H, Frank O. Determination of serum Alpha-Tocopherol. In: Gowenlock AH, McMurray JR, Mchauchian DM. *Varley's Practical Clinical Biochemistry*, 6TH Edition London 1968:902-3.
11. Aye Kyaw. A simple colorimetric method for ascorbic acid determination in blood plasma. *Clinica Chemica Acta.* July 1978; 86(2): 153-157.
12. Tetsuo Makino. Serum Zinc *Clin. Chem. Acta.* 1991; 197:209-220.
13. Anupama N, Varun Malhotra, Rinku Garg, Venkiduswami, Ranganath. Beneficial effects of Sudarshan Kriya in type II diabetes mellitus. *JEMDS.* July 2014; 3 (27): 7492-7496.
14. A Vagga and N R Akarte. Sudarshan Kriya a novel breathing technique. *International Journal of Anatomy Physiology and Biochemistry.* 2017; 4(7):7-14.
15. Gerbarg PL, Brown RP. Yoga: A breath of relief for hurricane Katrina refugees. *Curr Psychiatr.* 2005; 4: 55-67.
16. Descilo T, Vedamurtachar A, Gerbarg PL, Nagaraju D, Gangadhar BN, Damodaran B, *et al*. Effects of a yoga breath intervention alone and in combination with an exposure therapy for post traumatic stress disorder and depression in survivors of the 2004 south-East Asia Tsunami. *Acta Psychiatr Scand.*2010; 121: 289-300.
17. D Beno DP. Free radicals and antioxidants in vascular biology. *Q J Med* 1994; 87: 445-453.

18. Bhadwat VR, Borade VB. Increased lipid peroxidation in lepromatous leprosy. *Indian J Dermatol Venerol Lepro.* 2000; 66: 121-5.
19. Sangeeta B Trimbake, Alka Sontakke, Vaishali V Dhat. Oxidative stress and antioxidant vitamins in leprosy. *Int J Res Med Sci.* 2013 Aug; 1(3): 101-104 Osadolar HB, Ihongbe JC. Effect of leprosy on non-enzymatic antioxidants (Vitamin C, Vitamin E and uric acid) in (Edo state) Nigerian leprosy patients. *Continental Bio-medical Sciences.* 2008; 2: 1-5.
20. Bray TM and Bettger WS. The physiological role of zinc as an antioxidant. *Free Radical Biology and Medicine.* 1990; 8: 281-291.
21. Sher R, Shulman G, Bailey P, Politzer WM. Serum trace elements and vitamin A in leprosy subtypes. *Am J Clin Nutr* 1981; 34: 1918-1924.
22. Jain P, Khare V, Koshti A, Malik R and Bhimte B. Serum zinc levels estimation-comparison between normal control and in leprosy patients. *Int J Biol Med Res.* 2014; 5(1): 3847-3849.
23. Vijayraghavan R, Paneersevalm C. Erythrocyte antioxidant enzymes in multibacillary leprosy patients. *International J of Applied Biology and Pharmaceutical Technology.* 2011; 2: 409-12.
24. Sharma H, Datta P, Singh A, Sen S, Bhardwaj NK, Kochupillai V, *et al.* Gene expression profiling in practitioners of Sudarshan Kriya. *J Psychosom Res.* 2008; 64: 213-8.

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