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Yoga therapy for Metabolic Syndrome - A Review

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ABSTRACT

Metabolic syndrome is a collection of risk factors that increase the chance of developing heart disease, stroke, and diabetes. Lifestyle changes like losing weight, exercise, and dietary changes can help prevent or reverse metabolic syndrome. Metabolic syndrome is now considered as a serious public health problem. It is estimated that 20 - 25% of the world adult population is suffering from this disorder. Yet most recommendations currently focus on diet and exercise and do not consider stress reduction strategies. Yoga is a effective tool for stress management, that may reduce blood pressure (BP) increase parasympathetic activation. In this review, we examined the basic principles of *Pancha Kosha* (five sheaths of human existence) concept from an Indian scripture *Taittiriya Upanishad* and the pathophysiology of a disease from the Yogic approach of *Yoga Vasistha's Adhi* (originated from mind) and *Vyadhi* (ailment/disease) concept and focused on Yoga and HPA axis. Based on these concepts, a Yoga module is recommended as a remedial therapy to manage Metabolic Syndrome.

Key words: *Yoga therapy, Metabolic Syndrome, Lifestyle disorders.*

INTRODUCTION

Metabolic syndrome is a cluster of conditions like increased blood pressure, high blood sugar, excess body fat around the waist, and abnormal cholesterol or triglyceride levels that occur together which could increase risk of heart disease, stroke and diabetes.

Metabolic syndrome arises from insulin resistance accompanying abnormal adipose deposition and function. It increases a risk factor for coronary heart disease, diabetes, fatty liver and cancer. The clinical manifestations may include hypertension, hyperglycemia, hypertriglyceridemia, reduced high-density lipoprotein cholesterol (HDL-C) and abdominal obesity.[1]

Under current guidelines, revised in 2005 by the National Heart, Lung, and Blood Institute (NHLBI) and the American Heart Association (AHA), metabolic syndrome is diagnosed when a patient has at least three of the following five conditions.[1]

1. Fasting glucose ≥ 100 mg/dL (or receiving drug therapy for hyperglycemia)
2. Blood pressure ≥ 130/85 mm Hg (or receiving drug therapy for hypertension)
3. Triglycerides ≥ 150 mg/dL (or receiving drug therapy for hypertriglyceridemia)
4. HDL-C < 40 mg/dL in men or <50 mg/dL in women (or receiving drug therapy for reduced HDL-C)
5. Waist circumference ≥ 102 cm (40 in) in men or ≥88 cm (35 in) in women; if Asian American, ≥90 cm (35 in) in men or ≥80 cm (32 in) in women body mass index [BMI] >30 kg/m2 (The international diabetes federation [IDF][2]

Risk Factors

The predominant underlying risk factors for the metabolic syndrome are abdominal obesity and

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insulin resistance. Other risk factors include physical inactivity, older age and hormonal imbalance. An atherogenic diet (one rich in saturated fat and cholesterol).[3]

Low-grade inflammation Adipose tissue in obese persons exhibits abnormalities in the production of several adipokines that may cause insulin resistance. These include increased production of inflammatory cytokines, (Cytokines are proteins that are important in cell signaling) plasminogen activator inhibitor-1(*PAI-1*). Elevated PAI-1 is a risk factor for thrombosis and atherosclerosis. At the same time there is reduction in levels of the potentially protective adipokine, adiponectin (is a protein hormone which is involved in regulating glucose levels as well as fatty acid breakdown). Hence abdominal obesity correlates more strongly with insulin resistance and the metabolic syndrome. Atherogenic dyslipidemia consists of an aggregation of lipoprotein abnormalities, elevated serum triglyceride and increased small low-density lipoprotein (LDL) and a reduced level of high-density lipoprotein (HDL) cholesterol.[3]

Pharmacological Management

Abdominal obesity can be treated with a variety of lower calorie diets along with regular exercise. Indeed, all of the five components of the metabolic syndrome are improved by even modest amounts of weight loss achieved with diet and exercise. For those with impaired fasting glucose tolerance, there is good evidence that a high fibre, low saturated fat diet with increased daily exercise can reduce the incidence of diabetes by almost 60%. People who exercise the most gain the most benefit. Although therapeutic lifestyle change will help improve lipid profile, some patients may require drug therapy.[4] First-line pharmacological are statins for dyslipidemia, renin-angiotensin-aldosteron system inhibitors for arterial hypertension, metformin or sodium/glucose cotransporter 2 inhibitors or glucagon-like peptide 1 receptor agonists (GLP-1RAs) for glucose intolerance.[5]

Physiology of Stress

Stress is a helpful body mechanism which helps us to face stressful or dangerous situation and helps us to mobilize energy by the following changes;

1. Decreased blood flow to the gastrointestinal (GI) tract
2. Elevated blood pressure
3. Increased breathing rates
4. Narrows vision (sometimes called ‘tunnel vision’).
5. Contracts muscles
6. Increases sweating.
7. Hearing may become more sensitive.

The human race are hard-wired by these responses to danger and threat.

The autonomic nervous system is connected to physical processes such as digestion, respiration, heart rate, immune function, peristalsis and even sexual arousal. This system has two branches, the sympathetic system and the parasympathetic system. The sympathetic nervous system (SNS) is our fight-or-flight response. SNS is activated due to sudden release of catecholamines, which include adrenaline and noradrenaline.

The other branch of the system is the parasympathetic nervous system (PNS), often called the “rest and relax”system, which allows us to recoup from the stressors of life. After the threat is gone, it takes between 20 to 60 minutes for the body to return to its pre-arousal levels.

Physiology of the HPA Axis

HPA axis is a tightly regulated system that represents one of the body's mechanisms for responding to acute and chronic stress. In response to physiological or psychological stressors, the HPA axis is activated, resulting in secretion of corticotrophin releasing hormone (CRH) from the hypothalamus, which stimulates the anterior pituitary gland to release adrenocorticotropic hormone (ACTH). ACTH then stimulates release of cortisol from the adrenal gland, resulting in a cascade of physiological events. Once

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the stressor has resolved, the response is terminated through a negative feedback loop, in which cortisol suppresses further release of ACTH and CRH. Activation of the HPA axis is also accompanied by stimulation of the sympathetic nervous system, resulting in the release of catecholamines (epinephrine (adrenalin), norepinephrine, and dopamine) and interleukin (group of cytokines) Chronic stress may impair the feedback mechanisms that return these hormonal systems to normal, resulting in chronic elevation in levels of cortisol, catecholamines.[6]

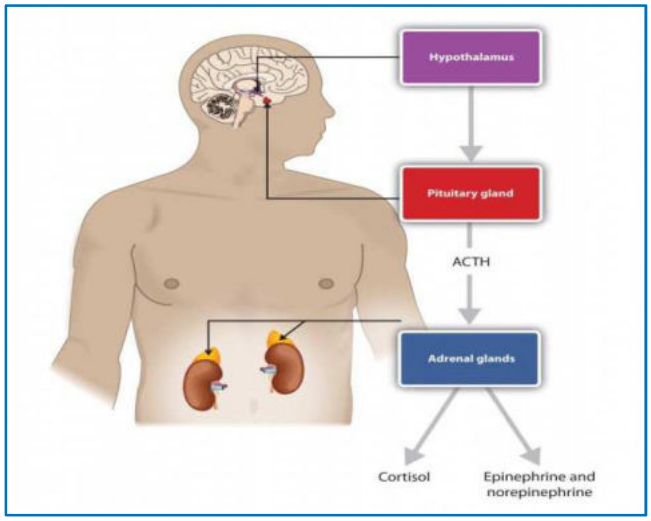

Figure 1: Image courtesy:https://bengreenfieldfitness.com

A study on 125 subjects of newly detected diabetes mellitus (NDDM) and normal glucose tolerance (NGT) subjects who were diagnosed on the basis of oral glucose tolerance test (OGTT) was conducted to evaluate if stress responses are associated with abnormalities in glucose tolerance, insulin sensitivity and pancreatic beta cell function and risk of type 2 Diabetes Mellitus. Salivary cortisol, a marker of hypothalamic-pituitary-adrenal (HPA) axis and salivary α-amylase, a marker of sympathetic nervous system (SNS). The results indicated that NDDM subjects display significantly higher chronic stress and stress responses when compared to subjects with NGT. Chronic stress and endocrine stress responses are significantly associated with glucose intolerance, insulin resistance and diabetes mellitus. Environmental influences such as chronic stress, behavioural and metabolic disturbances, dietary deficiency, and infection have now emerged as contributors to the development of metabolic disease.[7]

Prevalance

Systemic stress may contribute to insulin resistance syndrome in the intra-country and inter-country migrant Asian Indians. High prevalence of excess body fat, adverse body fat patterning, hypertriglyceridemia and insulin resistance beginning at a young age have been consistently recorded in Asian Indians irrespective of their geographic locations.[8] Asia-Pacific region is facing a significant epidemic of Metabolic Syndrome (MetS). In most countries nearly 1/5th of the adult population or more were affected by MetS.[9]

MetS is a significant public health concern even in one of the poorest states of India and needs to be tackled with proven strategies. Age-standardized prevalence rates of metabolic syndrome in Asian Indians were 33.5% overall, 24.9 % in males and 42.3% in females. Older age, female gender, general obesity, inadequate fruit intake, hypercholesterolemia, and middle-to-high socioeconomic status significantly contributed to increased risk of MetS.[10]

Though it is commonly associated with adult diseases and aging, MetS is also prevalent in childhood. Because obesity is a key component of the syndrome, the prevalence of MetS in U.S. adults is over 25%, with higher rates among race / ethnic minority groups. The population prevalence of MetS is much less in childhood at approximately 4 to 5%. However, due to the childhood obesity epidemic the prevalence of MetS among obese children and adolescents is approximately 30% with similar race and minority groups.[11]

Yoga Philosophy

Yoga, in Sanskrit means is '*Yuj*' meaning to unite the mind, body, and spirit. Yoga an ancient science has its roots in the Indus valley civilization dating back to 5000BC.[12] Ashtanga Yoga the eight limb Yoga is from the ancient text *Patanjali Yoga Sutras*, which is widely regarded as the authoritative text on Yoga. The 196

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Sutras or aphorisms describes in detail the theory and practice of Yoga.

Yogah Cittavrtti Nirodhah (Patanjali Yoga Sutra: 1.2)

Yoga is to "gain mastery over the mind or control over the mind" (consisting of development of concentration on one hand and a capacity to calm down the mind or silence it effortlessly) and, harmonizes the disturbances at each of the five levels [Figure 2][13]

These 'threads' of wisdom offer guidelines for living a meaningful and purposeful life and forms Yoga Philosophy which is one the six systems of Indian Philosophy. These eight 'limbs' are: (i & ii) rules for good conduct (*Yamas and Niyamas*), (iii) physical postures (*Asanas*), (iv) voluntarily regulated breathing (*Pranayama*), (v) sensory withdrawal (*Prathyahara*), (vi) focused thinking (*Dharana*), (vii) meditation (*Dhyana*) and (viii) experience of transcendence (*Samadhi*). These practices act on all levels like ethical, physical, energy, emotional thinking and health and happiness. This traditional style of Yoga is also known as Raja Yoga.[14]

Yoga as a Mind Body therapy for metabolic syndrome

Role of stress is established as the cause for MetS. Yoga has become a important science in lifestyle ailments therapy.

Swami Vivekananda Yoga Research Foundation specializes in using Yoga as a therapy. The institute has developed an integrated Yoga program based on *Patanjali's Yoga Sutras* and *Taittreya Upanisad Mandukya Upanisad*.

Taittreya Upanishad's *Pancha Kosha* concept describes five levels of human existence, physical level (*Annamaya Kosha*), the level of subtle life energy (*Pranayama Kosha*), the level of emotional thinking (*Manomaya Kosha*), the level of rational thinking and judgment (*Vijnanamaya Kosha*) and the level of complete health and happiness (*Anandamaya Kosha*).

Mandukya Upanishad considers the 'body' as three parts namely the physical part (*Sthula Sharira*), a subtle or inner part (*Sukshma Sharira*) and the causal body (*Kaarana Sarira*). The subtle energy, emotional and rational thinking is *Sukshma Sharira* and the health and happiness is the causal body *Kaarana Sharira*. A balance between these three parts (*Shariras*) is believed to be necessary for complete health.[14]

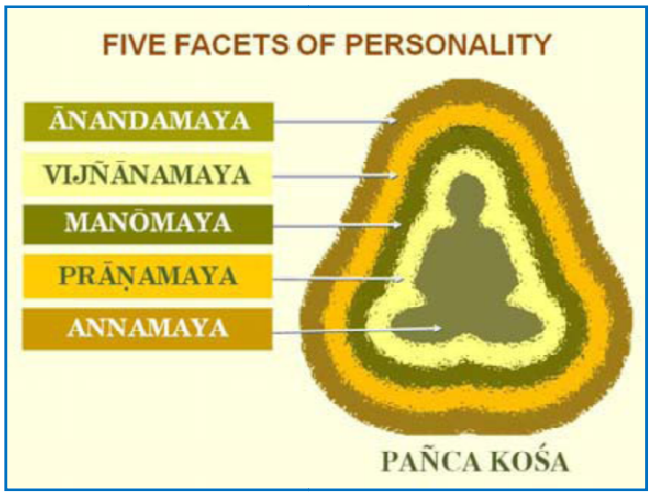

Figure 2: Image courtesy:https://in.pinterest.com

Concept of disease according to Yoga Philosophy

According to the Ancient text "*Yoga Vasistha*" (Ch II, verses 709–723), psychosomatic diseases originate from the mind, percolate to subtle energy called the *Pranamaya Kosha*, and settle in the physical body ie *Annamaya Kosha*, inflicting damage to the weakest organ in this case the pancreas affecting the physiology and functioning of those organ.

The primary diseases called the *Adhis* are two types the ordinary called the *Samanya* (psychosomatic) and the essential called the *Sara* (congenital). The *Samanya* are psychosomatic ailments which have their origin at *Manomaya Kosha*. *Vyadhis* (diseases) caused by *Adhis* originated in mind are called as *Adhija Vyadhayah*. The diseases or *Vyadhis* which are not originated in the mind are the infectious and contagious diseases are called *Anadhija Vyadhis*. These could be cured by conventional medicines. The *Samanya* (psychosomatic) have to be dealt with suitable mind relaxation techniques. The *Sara* (congenital) can be destroyed by realisation of causal states of mind and the ability live in *Vignanamaya* and *Anandamaya Kosha*.[13] When the mind is agitated it

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causes violent fluctuation in the flow of *Prana* in the *Nadis* (energy paths). The *Nadis* can no longer maintain stability. These disturbances disturb the digestion and settles in the physical layer as ailments.[15]

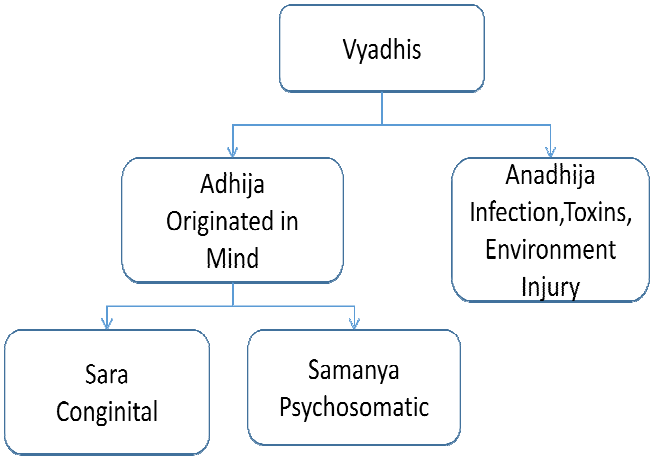

Figure 3: Types of Vyadhi

Evidence based Yoga therapy for Metabolic Syndrome.

In a study conducted on age group of 30-60 years patients with Type 2 Diabetes, serum insulin, plasma fasting and one hour postprandial blood glucose levels and anthropometric parameters were measured before and after Yoga Asanas. The results indicate that there was significant decrease in fasting glucose levels from basal 208.3 +/- 20.0 to 171.7 +/- 19.5 mg/dl and one hour postprandial blood glucose levels decreased from 295.3 +/- 22.0 to 269.7 +/- 19.9 mg/dl. A significant decrease in waist-hip ratio and changes in insulin levels were also observed, suggesting a positive effect of yoga asanas on glucose utilisation and fat redistribution. *Surya Namaskar, Trikonasana, Tadasana, Sukhasana, Padmasana, Bhastrika Pranayama, Pashimottanasana, Ardhmatsyendrasana, Vajrasana, Pawanmuktasana, Bhujangasana, Dhanurasana* and *Shavasana* are beneficial for diabetes mellitus. Yoga therapy could be integrated with diet and drugs in the management of Type 2 diabetes.[16]

A meta-analysis studied available evidence from 12 Randomised control trials (RCT) with a total of 864 patients studies yoga in patients with type 2 diabetes mellitus suggested that yoga can significantly decrease patient FBG, PPBG, HbA1c, TC and LDL-C levels, and increase their HDL-C.[16]

A study was conducted in the Department of Physiology and Diabetic clinic over period of two years on 30 male diabetic patients in the age group of 36 to 55 years with T2DM of at least one year duration and 30 healthy non-diabetic male volunteers. All the participants were trained by yoga experts and subjected to regular practice under supervision for six months. In all the participants fasting (FBS) and postprandial blood sugar (PPBS) was estimated before, during (at three months) and after (six months) Yoga training. Paired Student t-test was used to estimate difference in means calculated before and after Yoga training in a same group. A p-value of <0.05 was considered as statistically significant.[16]

A systematic review of all published studies on Yoga performed revealing 39 cohort studies, 30 non-randomized, controlled trials (NRCTs), 48 randomized, controlled trials (RCTs) and 3 case reports with durations ranging from 1 week to 4 year and involving a total of 6693 subjects. Most studies reported that Yoga effectively reduced BP and hypertensive populations.[16]

Panchakosha approach to METS

1. Annamaya Kosha

Loosening practices to help these joints maintain their healthy condition.

Asanas practices to stretch the muscles, works on muscular system and circulatory system. *Yoga* practices indicated considerable health benefits, including improved cognition, respiration, reduced cardiovascular risk, BMI, blood pressure, and diabetes mellitus. It also influenced immunity and ameliorated joint disorders.[17] Direct stimulation of the pancreas by the postures can rejuvenate its capacity to produce insulin.[11] Regeneration of pancreatic beta cells could occur by Yoga exercises that promote blood circulation in the region of the pancreas and Yoga *Asanas* that stimulate the meridian of pancreas also could assist in some diabetic patients. Muscular relaxation, development and improved blood supply

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to muscles might enhance insulin receptor expression on muscles causing increased glucose uptake by muscles and thus reducing blood sugar.[7] The improvement in the lipid levels after Yoga could be due to increased hepatic lipase and lipoprotein lipase at cellular level, which affects the metabolism of lipoprotein and thus increase uptake of triglycerides by adipose tissues.[17]

Kriyas to cleanse toxins cleansing of the nasal passages, alimentary canal, the large intestine and

Strengthening of the abdominal organs.

Diet: Strengthens all the systems of the body.

2. *Pranamaya Kosha*

Left nostril dominance is associated with parasympathetic response and the right nostril dominance is associated with sympathetic response. Brain, cardiac and respiratory functions are coupled strongly through the autonomic nervous system and manipulation of breath.[18] Regular *Pranayama* and meditation practice shows beneficial effects on cardiovascular functions irrespective of age, gender and BMI.[19] VLF and LF in n.u have reduced significantly after practice of *Pranayama* signifying reduction in sympathetic drive to heart. HF in n.u has increased significantly after practice of *Pranayama* for 2 months showing the increase in parasympathetic output to the heart. LF/ HF ratio reduced significantly after 2 months of practice of *Pranayama* indicating a better sympatho vagal balance with resting balance tilting toward better parasympathetic control.

Regular yoga practice reduced oxidative stress, improved antioxidant levels, reduced stress hormone release and improved immune function.[20] Breathing practices improve respiratory, circulatory and nervous system. Relieves stress anxiety and depression

3. *Manomaya Kosha*

Manomaya Kosha is the gross level of mind comprising emotions, thoughts, and different types of feelings and has no capacity to discriminate between right and wrong deeds. The *Vijnanamaya Kosha* governs the gross mind to take appropriate decisions with knowledge. It is based on taking intuitions from the upper realms and uses them to guide one's feelings and actions. In the *Manomaya*, the reflexes are in control; in the *Vignana*, one's higher intuitions are in control.[21]

Meditation and relaxation practices calms the hyperactive Sympathetic nervous system, Balances the endocrine system, strengthens immune system and reduces the Stress. Scientific studies on Om suggest that the repetition of OM results in physiological rest and mental alertness, and increased sensitivity to sensory transmission.[22] Significantly increase in Theta power (brainwaves which are dominant in deep meditation. Senses withdrawn from the external world Theta is gateway to learning, memory, and intuition.) was found after Om meditation when averaged across all brain regions.[23] The neurohemodynamic correlates of 'OM' chanting indicate limbic deactivation and vagus nerve stimulation.[24]

4. *Viganamaya Kosha*

Vijnana means ''certain knowledge''; it includes the three mental activities of feeling, willing, and knowing. It also represents the mind, skill and all the intelligence behind human work. This sheath represents the intelligence or the consciousness that is the discriminative part of the mind underneath the processing, thinking aspect of mind. It knows, decides, judges, and discriminates. This is the organ of philosophical thought and metaphysical intuition. It is also the seat of the human will, by which one orients life toward either unreflective bodily experience or enhanced awareness and spiritual realization.[21]

Upanishads are treasury of knowledge for redeeming of miseries and obsessions. It is the lack of that inner *Jnana* which is responsible for wrong habits and agitations. Yogic counselling helps to identify these problems and suggest life style changes. Lectures unravel the concept of health according to WHO definition and its relation to Yoga, Concept of disease according to Yoga and establishes the *Manomaya Kosha* as the root cause of lifestyle diseases called as *Vyadhis*. Imbalances at mind level emotions level and

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Prana level can be set right to prevent disease and promote normal health.

5. Anandamaya Kosha

When one transcends all the previous layers, one is bliss with life. Bliss is the highest dimension of our existence. It is a state of being in which one can detach oneself from the emotions and live in perfect health of body and mind. This is the most harmonious state of mind possible, associated with states of ecstasy and rapture.[25] This is a state characterized by positive feeling, which is not dependent on any object or events of external reality. Thus, the ‘‘experience of *Ananda*, bliss, is a qualitatively different sense of positive state and well being from that is associated with other sheaths, *Koshas*’’.[25]

Bringing bliss to our causal body (*Karana Sharira*) called *Anandamaya Kosha* through our action is the key to happy and healthy life. *Karma Yoga* is the path of selfless action. Actions which are performed without expecting any returns is the key to happy mind. The secret lies in maintaining inner silence. Not getting agitated over things which we do not like maintaining equipoise (*Samatvam*). Having blissful awareness while we are in action is the way to *Anandamaya Kosha*. The inner cleansing starts and deep seated stresses, phobias, obsessions will come out from sub consciousness paving way for manifestation of the divinity within us.

Yoga module based on integrated approach

Opening Prayer

Om Saha Naav-Avatu

Saha Nau Bhunaktu

Saha Viiryam Karavaavahai

Tejasvi Naav-Adhiitam-Astu Maa Vidvissaavahai

Om Shaantih Shaantih Shaantih.

Breathing Practice

Hands Stretch Breathing

Tiger breathing, Sectional Breathing

Sethubandasana breathing (bridge position)

Leg raise breathing (single leg and alternate leg)

Loosening Practices

Side Bending, Twisting, Jogging, Cycling, Side leg raise, Butterfly , Ankle rotation, hip rotation,

Knee rotation, Shoulder rotation.

Asana Practices

- *Ardhakati Chakrasana*
- *Trikonasana* (Triangle posture)
- *Parivritta Trikonasana* (Twisted Triangle posture)
- *Parshvakonasana* (extended side posture)
- *Vrikshasana* (Tree posture)
- *Bhujangasana* (Cobra posture)
- *Vakrasanasa* (twisted posture)
- *Ardha Matsyandrasana* (Half Spinal Twist)
- *Virabhadrasana* (Warrior posture)
- *Gomukhasana* (Cow face posture)
- *Ustrasana* (Camel posture)
- *Surya Namsakara* (12)(Sun Salutation)

Kriyas

Jalanethi, Vamana Dhouti with plain water, *Kapalabhati*, *Nauli.*

Pranayama

Nadisuddhi, Ujjayi, Bhramari

Meditation

Nadanusandhana - AAA *Kara* - 9 times, UUU *Kara* - 9 times, MMM *Kara* - 9 times. OM *Kara* - 9 times.

OM meditation. 10Mins.

Closing Prayer

Om, Sarve bhavantu sukhinaḥ

Sarve santu nirāmayāḥ

Sarve bhadrāṇi paśyantu

Mā kashchit duḥkha bhāgbhavet

Oṁ Shāntiḥ, Shāntiḥ, Shāntiḥ

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CONCLUSION

In this review article we have studied the pathophysiology of Metabolic Syndrome. The risk factors being Obesity and Insulin resistance. Yoga is presented with evidence as a therapy for Metabolic Syndrome and as a life style correction tool.

ACKNOWLEDGEMENTS

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REFERENCES

1. Metabolic Syndrome: Practice Essentials, Background, Pathophysiology [Internet]. [cited 2018 Sep 13]. Available from: https://emedicine.medscape.com/article/165124-overview#a3
2. Metabolic Syndrome and Heart Disease Connection [Internet]. [cited 2018 Sep 13]. Available from: https://www.webmd.com/heart-disease/guide/metabolic-syndrome#1
3. American Academy of Family Physicians. C. American family physician. [Internet]. Vol. 74, American Family Physician. American Academy of Family Physicians; 1970 [cited 2018 Sep 13]. 1039 p. Available from: https://www.aafp.org/afp/2006/0915/p1039.html
4. Wagh A, Stone NJ. Treatment of metabolic syndrome. Expert Rev Cardiovasc Ther [Internet]. 2004 Mar 10 [cited 2018 Sep 13];2(2):213–28. Available from: http://www.ncbi.nlm.nih.gov/pubmed/15151470
5. Rask Larsen J, Dima L, Correll CU, Manu P. The pharmacological management of metabolic syndrome. Expert Rev Clin Pharmacol [Internet]. 2018 Apr 3 [cited 2018 Sep 13];11(4):397–410. Available from: http://www.ncbi.nlm.nih.gov/pubmed/29345505
6. Joseph JJ, Golden SH. Cortisol dysregulation: the bidirectional link between stress, depression, and type 2 diabetes mellitus. Ann N Y Acad Sci [Internet]. 2017 Mar [cited 2018 Sep 13];1391(1):20–34. Available from: http://www.ncbi.nlm.nih.gov/pubmed/27750377
7. Siddiqui A, Madhu S V., Sharma SB, Desai NG. Endocrine stress responses and risk of type 2 diabetes mellitus. Stress [Internet]. 2015 Sep 3 [cited 2018 Sep 13];18(5):498–506. Available from: http://www.ncbi.nlm.nih.gov/pubmed/26303379
8. Misra A, Vikram NK. Insulin resistance syndrome (metabolic syndrome) and obesity in Asian Indians: evidence and implications. Nutrition [Internet]. 2004 May [cited 2018 Sep 13];20(5):482–91. Available from: http://www.ncbi.nlm.nih.gov/pubmed/15105039
9. Ranasinghe P, Mathangasinghe Y, Jayawardena R, Hills AP, Misra A. Prevalence and trends of metabolic syndrome among adults in the asia-pacific region: a systematic review. BMC Public Health [Internet]. 2017 [cited 2018 Sep 13];17(1):101. Available from: http://www.ncbi.nlm.nih.gov/pubmed/28109251
10. Prasad DS, Kabir Z, Dash AK, Das BC. Prevalence and risk factors for metabolic syndrome in Asian Indians: A community study from urban Eastern India. J Cardiovasc Dis Res [Internet]. 2012 Jul [cited 2018 Sep 13];3(3):204–11. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22923938
11. Falkner B, Cossrow NDFH. Prevalence of metabolic syndrome and obesity-associated hypertension in the racial ethnic minorities of the United States. Curr Hypertens Rep [Internet]. 2014 Jul [cited 2018 Sep 13];16(7):449. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24819559
12. Kavuri V, Raghuram N, Malamud A, Selvan SR. Irritable Bowel Syndrome: Yoga as Remedial Therapy. Evid Based Complement Alternat Med [Internet]. 2015 [cited 2018 Sep 21];2015:398156. Available from: http://www.ncbi.nlm.nih.gov/pubmed/26064164
13. Nagendra HR. Integrated Yoga Therapy for mental Illness. Indian J Psychiatry [Internet]. 2013 Jul [cited 2018 Sep 21];55(Suppl 3):S337-9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24049195
14. Telles S, Naveen K V, Dash M. Yoga reduces symptoms of distress in tsunami survivors in the andaman islands. Evid Based Complement Alternat Med [Internet]. 2007 Dec [cited 2018 Sep 21];4(4):503–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18227918
15. Nagendra HR. The power of Prana. Int J Yoga [Internet]. 2009 Jul [cited 2018 Sep 21];2(2):45. Available from: http://www.ncbi.nlm.nih.gov/pubmed/20842262

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16. Malhotra V, Singh S, Tandon OP, Sharma SB. The beneficial effect of yoga in diabetes. Nepal Med Coll J [Internet]. 2005 Dec [cited 2018 Sep 24];7(2):145–7. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16519085

17. Balaji PA, Varne SR, Ali SS. Physiological effects of yogic practices and transcendental meditation in health and disease. N Am J Med Sci [Internet]. 2012 Oct [cited 2018 Nov 1];4(10):442–8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23112963

18. Srinivasan TM. Pranayama and brain correlates. Anc Sci Life [Internet]. 1991 Jul [cited 2018 Oct 15];11(1–2):2–6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22556548

19. Ankad RB, Herur A, Patil S, Shashikala G V, Chinagudi S. Effect of short-term pranayama and meditation on cardiovascular functions in healthy individuals. Heart Views [Internet]. 2011 Apr [cited 2018 Oct 15];12(2):58–62. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22121462

20. Lim S-A, Cheong K-J. Regular Yoga Practice Improves Antioxidant Status, Immune Function, and Stress Hormone Releases in Young Healthy People: A Randomized, Double-Blind, Controlled Pilot Study. J Altern Complement Med [Internet]. 2015 Sep [cited 2018 Oct 17];21(9):530–8. Available from: http://www.liebertpub.com/doi/10.1089/acm.2014.0044

21. In Search Of The Cradle Of Civilisation Georg Feuerstein Subash Kak C. MLBD : nindi punj : Free Download, Borrow, and Streaming : Internet Archive [Internet]. [cited 2018 Nov 21]. Available from: https://archive.org/details/InSearchOfTheCradleOfCivilisationGeorgFeuersteinSubashKakC.MLBD

22. Telles S, Nagarathna R, Nagendra HR. Autonomic changes during "OM" meditation. Indian J Physiol Pharmacol [Internet]. 1995 Oct [cited 2018 Oct 15];39(4):418–20. Available from: http://www.ncbi.nlm.nih.gov/pubmed/8582759

23. Harne BP, Hiwale AS. EEG Spectral Analysis on OM Mantra Meditation: A Pilot Study. Appl Psychophysiol Biofeedback [Internet]. 2018 Jun 11 [cited 2018 Oct 15];43(2):123–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/29752573

24. Kalyani BG, Venkatasubramanian G, Arasappa R, Rao NP, Kalmady S V, Behere R V, et al. Neurohemodynamic correlates of “OM” chanting: A pilot functional magnetic resonance imaging study. Int J Yoga [Internet]. 2011 Jan [cited 2018 Oct 15];4(1):3–6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21654968

25. Raina MK. The Levels of Human Consciousness and Creative Functioning: Insights from the Theory of Pancha Kosha (Five Sheaths of Consciousness) [Internet]. [cited 2018 Nov 21]. Available from: http://www.indigenouspsych.org/Resources/Journal of TPPsy.pdf

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