

 <p>ISSN NO. 2320-5407</p>	<p>Journal Homepage: - www.journalijar.com</p> <h2 style="text-align: center;">INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)</h2> <p style="text-align: center;">Article DOI: 10.21474/IJAR01/5068 DOI URL: http://dx.doi.org/10.21474/IJAR01/5068</p>	 <p>INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR) ISSN 2320-5407 Journal Homepage: http://www.journalijar.com Journal DOI: 10.21474/IJAR01</p>
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RESEARCH ARTICLE

ROLE OF YOGA AND MEDITATION IN PREVENTION OF OBESITY.

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Manuscript Info

Manuscript History

Received: 04 June 2017
Final Accepted: 06 July 2017
Published: August 2017

Key words:-

Obesity; yoga; meditation; non communicable diseases; unhealthy diet; physical inactivity; alcohol; tobacco; stress; anxiety

Abstract

Non communicable diseases (NCDs) kill 40 million people annually, 82% of which is contributed by four groups of diseases – cardiovascular diseases (17.7 million), cancers (8.8 million), respiratory diseases (3.9 million), and diabetes (1.6 million).

Several behavioural risk factors – tobacco use, physical inactivity, harmful use of alcohol and unhealthy diets – increase the risk of dying from NCDs. These risk factors, in turn precipitate some physiologic/metabolic risk factors – obesity, raised blood pressure, raised blood glucose, dyslipidemia.

Obesity, a major contributor to mortality and morbidity, has more than doubled in the world since 1980. In 2014, 39% of adults aged 18 years and over, were overweight and 13% were obese.

Stress is a single major parameter that is individually related to all the risk factors as well as to the major NCDs. Stress is also intimately related to obesity through release of glucocorticoids and catecholamines which alter appetite regulation and metabolism, and through increased intake and unhealthy diet, and harmful use of alcohol.

Yoga and meditation trace their origin to India, the first references of these having been found in scriptures as far back as the sixth century BC. Since then these have been cultivated over centuries and have gained popularity to develop a more positive attitude and thus reduce stress.

Role of healthy diet and increased physical activity in weight management has been established since long. Present review throws light upon the role of yoga and meditation in both primary and secondary prevention of obesity, through regulation of release of stress hormones and reduction of harmful behavioral risk factors.

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Introduction:-

Non communicable diseases (NCDs) are on the rise and have been reported to kill about 40 million people annually, equivalent to 70% of all deaths globally. Along with the already existing communicable diseases increase of non communicable diseases is pushing the world towards facing a double burden of diseases.¹

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NCDs, also termed as life style disorders, are associated with various behavioral risk factors, which in turn precipitate several physiological and metabolic risk factors.² These risk factors also are intimately related and any one factor is often associated with one or more other factors.

Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health. Obesity is a growing epidemic. The World Health Organization has described obesity as one of today's most neglected public health problems, affecting every region of the globe.

Obesity poses a great threat as it is a major risk factor of many non communicable diseases, the most important of these being:³

- cardiovascular diseases (mainly heart disease and stroke)
- diabetes;
- musculoskeletal disorders (especially osteoarthritis);
- some cancers (endometrial, breast, and colon).

Obesity, a major contributor to mortality and morbidity, has more than doubled in the world since 1980. In 2014, 39% of adults aged 18 years and over were overweight and 13% were obese. With increasing Body Mass Index (BMI), risk of the associated NCDs also increases.³

Main behavioral risk factors related to obesity are inadequate physical activity and unhealthy diet. Excessive intake of alcohol on a regular basis also leads to obesity. Stress too is intimately related to obesity directly through release of glucocorticoids and catecholamines which alter appetite regulation and metabolism, and indirectly through increased intake and unhealthy diet, and harmful use of alcohol.³

Yoga and meditation trace their origin to India, the first references of these having been found in scriptures as far back as the sixth century BC. Since then these have been cultivated over centuries and have gained popularity in the entire world, to develop a more positive attitude towards life and thus reduce stress. There is growing evidence that these may be cost effective interventions to prevent and control risk factors for NCDs including obesity.⁴

Role of several factors like healthy diet and increased physical activity in weight management has been established since long. Present review throws light upon the role of yoga and meditation in prevention and control of obesity, through regulation of release of stress hormones, reduction of harmful behavioral risk factors and development of healthy lifestyle.

Materials and methods:-

A narrative review was undertaken with the objective of studying the role of yoga and meditation in the primary and secondary prevention of obesity, with particular attention to some of the factors that are directly or indirectly related to obesity, like stress, eating behaviour and alcohol intake. It included literature published in English language in the past 50 years, of intervention studies conducted on healthy adult individuals who were not suffering from any chronic disease or health disorder other than the outcome variables under study. The outcomes considered were reduction/control of stress related disorders, eating disorder with overeating, alcohol use or dependence, and obesity.

Interventions under consideration were yoga and/or meditation, without any other intervention given simultaneously. Control groups included those who did not receive any intervention. However, continuation of treatment as usual was considered for ethical reasons. A combination of key words for intervention related term (yoga/ meditation) AND outcome related term (obesity/ anthropometry/ stress/ anxiety/ depression/ eating disorder/ eating behavior/ alcohol use/ alcohol dependence) AND study design related term (randomized/ controlled/ intervention/ experiment/ trial) was used to locate articles. Most commonly used scientific search engines were searched for identification of studies. Cross references were also searched for suitability of inclusion.

The title of each citation was screened based on definite pre-specified inclusion criteria. Abstracts and full texts of relevant articles were read, from which articles fitting into the exclusion criteria were removed. The criteria for exclusion were:

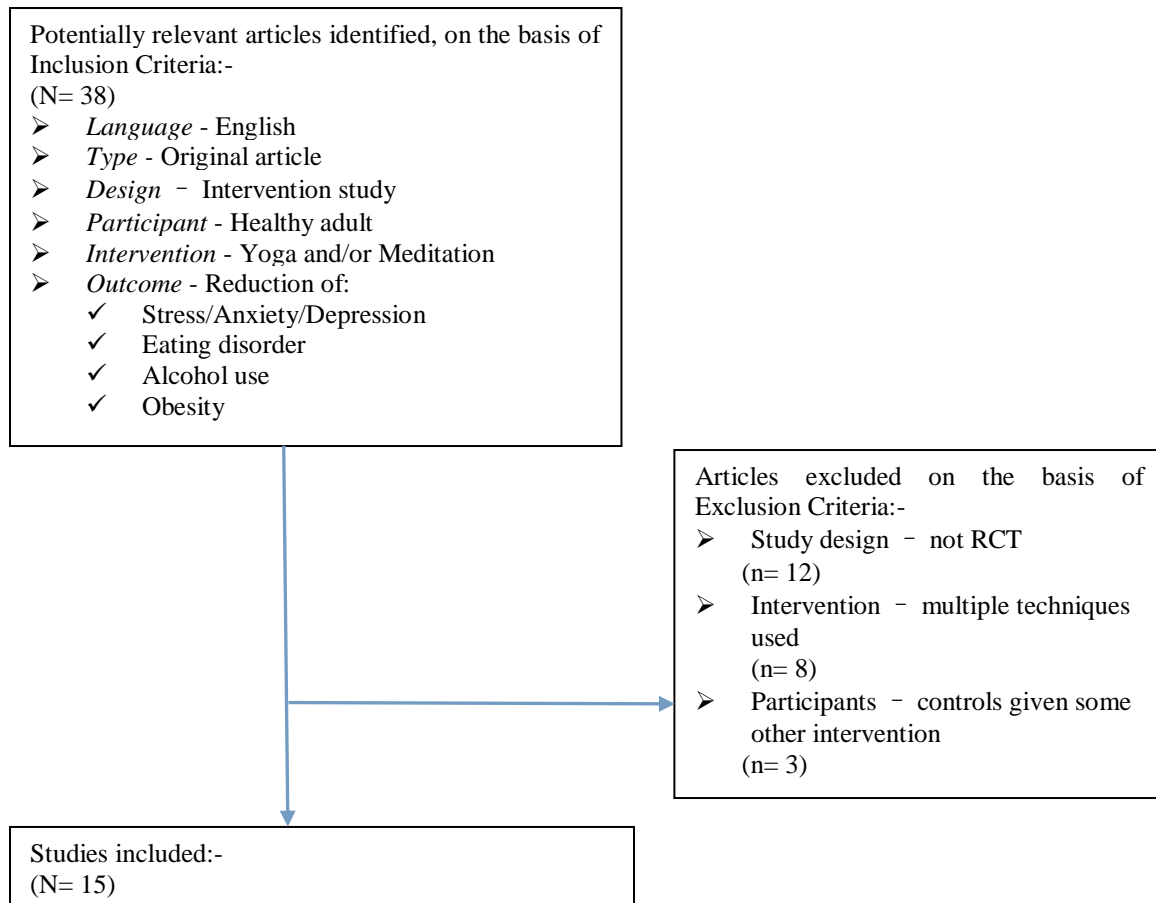
- studies other than Randomized Controlled Trial
- multiple interventions given simultaneously to study group

- control groups receiving some other intervention

Finally 15 articles were eligible to be included for review.⁴⁻¹⁸

Data was extracted from the selected articles and sorted according to outcomes studied and arranged in tables in chronological sequence. Though inclusion criteria were kept as publications in past 50 years, only 2 studies published in the last millennium were eligible to be included.^{5,6}

Figure 1:- Flowchart showing selection of studies based on inclusion and exclusion criteria



Results:-

Yoga and meditation are techniques that bring about relaxation of mind and body and hence reduce stress. Both these techniques have been reported to reduce stress and anxiety in subjects of the intervention group significantly more than that in the control group, by several authors.⁴⁻¹⁰ (Table 1)

Researchers have reported improvement in eating behavior following intervention with yoga and meditation. They have also shown significant reduction of eating disorder and Binge Eating Disorder.^{8,10-13} (Table 2)

Following courses of yoga and meditation reduction in outcomes under study viz. alcohol use, craving for alcohol and dependence on alcohol, was reported. There was improvement in symptoms and AUDIT scores too. However, in some of the studies the differences observed were not statistically significant.^{9,14-17} (Table 3)

Research done to assess the effect of yoga and meditation on obesity showed statistically significant reduction in body weight, percentage of body fat, lean body mass, body mass index, waist circumference and visceral fat area, by several authors. However, there was no difference between the two groups in overall weight and abdominal fat/trunk-leg fat ratio as reported by one researcher.^{10,12,18} (Table 4)

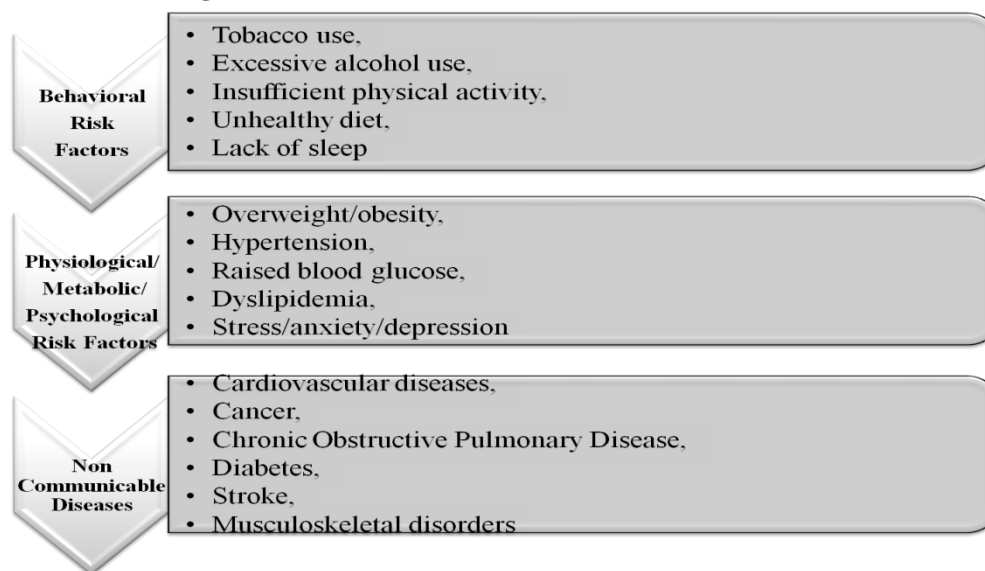
Discussion:-

Changing demographic structure and population aging, industrialization, modernization and urbanisation, with consequent improvement in socioeconomic conditions, altered dietary pattern, along with lack of exercise due to automation and transport, have led to significant change in disease pattern all over the world. Due to these factors obesity is on the rise, not only among adults but in adolescents and children too. This has led to drastic rise in non communicable diseases, pushing the world to a catastrophic condition, more so in developing countries.

Risk factors of Non Communicable Diseases:-

Several major NCDs have been identified which share some common behavioral risk factors, that precipitate some physiological/metabolic/psychological risk factors. WHO has advocated targeting these risk factors for prevention of NCDs which are currently on the rise.² The diseases and their various risk factors are outlined as follows: (Figure 2)

Figure 2:- Risk factors of Non Communicable Diseases

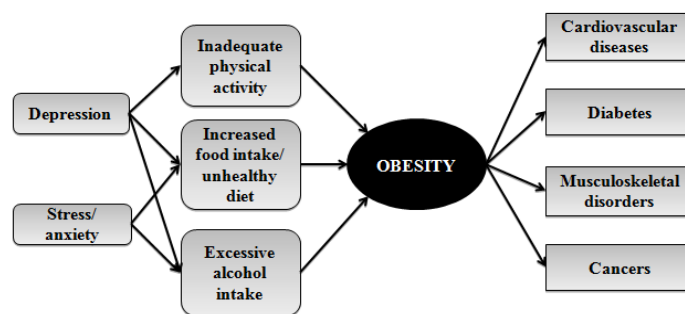


There is an intimate inter-relationship between several of the risk factors with resultant web of causation of the multifactorial life style disorders. Hence obesity, though mainly caused by behavioural risk factors like insufficient physical activity, unhealthy diet and excessive use of alcohol, also indirectly results from stress which leads to precipitation or aggravation of these contributory behavioural risk factors. (Figure 3)

Daubenmier et al have explained the link between stress and obesity through dietary intake. They said that animal studies have shown a link between stress, eating more fat and sugar termed as “comfort foods”, and fat distribution. Abdominal fat depots showed correlation with reductions in HPA reactivity to acute stressors, which indicate the presence of a metabolic negative feedback signal. This may be applicable for humans too so that ingestion of “comfort foods” provides a short-term relief of stress leading to increased abdominal adiposity.¹⁰

The link between stress and addiction to various substances is also well established. Alcohol and drug use have been seen to increase with stress. Stress can also precipitate relapses following treatment of substance use disorders.⁹

Alcohol is high in energy content and along with its appetite enhancing effect the energy intake is increased. Alcohol also suppresses lipid oxidation and thus enhances positive fat balance. The non oxidized fat is deposited mainly in the abdominal region resulting in weight gain and central obesity. This effect has been seen to be more pronounced in moderate non-daily alcohol consumers, in combination with a high-fat diet, and in overweight and obese subjects, than in regular drinkers.¹⁹

Figure 3:- Inter relationship between risk factors of obesity**Yoga and Meditation:-**

Yoga and meditation are the most widely used complementary and alternative medicine practices for prevention and control of various illnesses, and have recently been introduced into mainstream medicine as well. These have developed in the eastern culture and have a documented history of several thousand years. Only recently have these been under research and gained popularity for their many benefits in several lifestyle disorders, all over the world. There are several techniques of both yoga and meditation.

The term Yoga is derived from the Sanskrit word *yuj* meaning to unite or to yoke.²⁰ It is a psycho-somatic-spiritual discipline for achieving union and harmony between our mind, body, and soul and the ultimate union of our individual consciousness with the universal consciousness.²¹ Yoga is a discipline to improve one's inherent power in a balanced manner. It offers to attain complete self realization. Eight traditional forms of yoga have been described. These are bhakti yoga, gyana yoga, japa yoga, karma yoga, kundalini yoga, nadi yoga, raja yoga, swara yoga.²² Other common forms are kripalu yoga, kriya yoga, laya yoga, mantra yoga, vinayasa yoga and many more.

Meditation comes from the Latin word *meditor* meaning, to reflect, ponder over, consider.²³ It is a mind-body practice with many methods and variations, all of which are grounded in the silence and stillness of compassionate, nonjudgmental present moment awareness.²⁴ Main types of meditation include transcendental meditation, mindfulness and Sahaja yoga.²⁵ Other common types are amrita meditation, omkara meditation, zen meditation and many more.

Another traditional method followed is Pranayama. The word pranayama is derived from two Sanskrit words, namely, *prana* which means vital force or life energy and *ayama* means to prolong. It is basically a combination of several forms of breathing exercises.²¹

Yoga was systemized by the ancient Indian sage Patanjali in the *Yoga Sutras* (300–200 B.C.). Patanjali defined the purpose of yoga as knowledge of the true “Self” (God) and outlined eight steps for direct experience of “Self.”²⁶ According to him, yoga consists of eight steps or limbs, which are all equally important and are related as parts of a whole. The purpose of these eight limbs is discriminative enlightenment or self realization. The eight steps or limbs of yoga are as follows:²⁷

- **Yama:** Codes of restraint, abstinences, self-regulations
- **Niyama:** Observances, practices, self-training
- **Asana:** Meditation posture
- **Pranayama:** Expansion of breath and prana, regulation, control
- **Pratyahara:** Withdrawal of the senses, bringing inward
- **Dharana:** Concentration
- **Dhyana:** Meditation
- **Samadhi:** Deep absorption, meditation in its higher state, the state of perfected concentration

Yoga and meditation techniques have been combined together as integrated yoga practice or yoga of transformation that incorporates physical postures (asanas), breathing exercises (pranayamas), and meditation or relaxation exercise, along with spiritual teaching.²⁸ This is an adaptation of the concept of yoga by Patanjali, which includes

physical postures, breathing exercises and meditation. It is also known as hatha yoga, which includes asana, mudra, pranayama, and is very commonly practised all over the world.²⁹ Similar to this is the technique of Qigong, which is an ancient Chinese health care system that integrates physical postures, breathing techniques and focused intention. The integrated form has been found to be more beneficial for physical, psychological and spiritual well-being than yoga practiced primarily as a form of exercise.

Yoga and meditation have been under research in the past few decades for primary and secondary prevention of modern epidemic diseases like mental stress, obesity, diabetes, hypertension, coronary heart disease, and chronic obstructive pulmonary disease. These can be used as non-pharmaceutical measures or complement to drug therapy for treatment of these conditions. Practice of these techniques can bring about a holistic way of life leading to a state of complete physical, mental, social, and spiritual well-being, as recommended by the World Health Organization.^{4,27}

Worldwide, it is estimated that yoga is regularly practiced by about 30 million people. Nearly 14 million Americans (6.1% of the United States of America's population) reported that yoga had been recommended to them by a physician or therapist.³⁰ In 2002 use of relaxation techniques and yoga were reported by 14.2% and 5.1% of US adults respectively.³¹ In the United Kingdom, yoga is even promoted by the National Health Service as a safe and effective approach, in health and illness, for people of all ages.³⁰

In India, traditional systems of medicine have been promoted by the government since long. In March 1995 the Department of Indian Systems of Medicine & Homeopathy (ISM&H) was created under the Ministry of Health & Family Welfare which, in November 2003, was renamed as Department of Ayurveda, Yoga, Unani, Siddha & Homeopathy (AYUSH). The department was finally given Ministerial status and thus the Ministry of AYUSH was formed in November 2014.²²

Mechanism of action of yoga and meditation in primary and secondary prevention of obesity:-

Yoga – Stress can lead to abdominal adiposity through repeated activation of the hypothalamic-pituitary-adrenal (HPA) axis, resulting in hypersecretion of cortisol. Regular yoga practice decreases circulating cortisol. By acting upon the sympatho-adrenal system and the HPA axis yoga promotes a feeling of well-being and alleviates the effects of stress, thereby having positive effects on metabolism. Also, by directly stimulating the vagus nerve, yoga may enhance parasympathetic activity and lead to positive changes in mood and energy state, and metabolism. In addition, by encouraging healthy lifestyle changes yoga may lead to weight loss and reduced visceral adiposity.³² (Figure 4)

Meditation – Meditation has been thought to modify activity of ascending reticular activating system and thereby also interact with autonomic centres in the brainstem thus affecting metabolic pathways. The health promoting effects of meditation may also occur by raising melatonin levels.²¹ Meditation may reduce stress, thereby reducing the craving for and intake of “comfort foods” as explained by Daubenmier et al and thus reduce abdominal fat deposition.¹⁰

Mindfulness exercises make a person alert to the feelings of hunger and satiation; enable to make decisions about quality and quantity of food; be aware of the act of eating and swallowing; and feel the texture and taste of particular foods. It thereby reduces binge eating and increases self-control of food and food choices. Thus mindfulness enhances weight reduction through portion awareness and self-monitoring, satiation and satisfaction awareness, and stress reduction.³³

Yoga and meditation can target multiple brain regions, and change the functional connections between them, that lead to addictive behaviors.³⁴ It also acts by increased present moment and self awareness, greater self regulation and reduced reactivity to substance cues.³⁵ Khanna S, in a narrative review suggested that the skills, insights, and self-awareness learned through yoga and mindfulness practice can target multiple psychological, neural, physiological, and behavioral processes implicated in addiction and relapse.³⁴

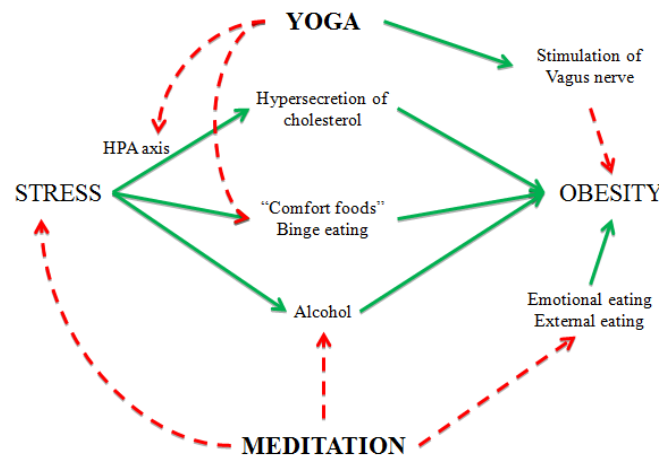
As described by Bernstein, yoga and meditation may also act by targeting the comorbid conditions of obesity and assist with weight loss or maintenance in the following ways:²⁸

- Increasing energy expenditure during yoga sessions;
- Allowing for additional exercise outside yoga sessions by reducing back and joint pain;

- Heightening mindfulness, improving mood, and reducing stress, which may help reduce food intake;
- Allowing individuals to feel more connected to their bodies, leading to enhanced awareness of satiety and the discomfort of overeating;
- Decreasing emotional eating (eating in response to negative emotions such as boredom, stress, or sadness) and external eating (eating in response to food-related stimuli such as the taste, sight, or smell of palatable foods);
- Achieving relaxation that helps to cope with stressful situations which cause addictive behaviors, like comfort food overconsumption and alcohol intake.

Hatha Yoga reduces stress, improves overall physical fitness and reduces some risk factors for cardiovascular diseases. Ross *et al*, as cited by Ramos-Jiménez, postulated that the frequency of yoga practice at home favorably predicted mindfulness, subjective well-being, healthy body mass index, fruit and vegetable consumption, vegetarian status and vigor.³⁶

Figure 4:- Mechanism of action of yoga and meditation in primary and secondary prevention of obesity



Effect of yoga and/or meditation on obesity and its determinants under study:-

Though wide research has been done on this arena, Randomized Controlled Trials are very few. Without a control group comparison cannot be made and in the absence of randomization of subjects into intervention and control groups results can be biased. In case of RCTs too the presence of multiple interventions done simultaneously makes the effect of any particular intervention difficult to assess. Also if control subjects are given some other intervention the ultimate effect size of the interventions under study may be reduced. Hence such research work was excluded from the present review.

Many of the RCTs that have been done and could be included in the present review had small sample size, which might have compromised the validity of the results achieved. Yet one point consistently seen across all studies was the improvement of the morbid condition that was most of the times statistically significant.

Many researchers observed reduction of stress, anxiety and depression.⁴⁻¹⁰ Eating disorders including Binge Eating Disorder, abnormal eating behaviour, emotional eating and overeating were all shown to have improved.^{8,10-13} Alcohol use and relapse of alcohol addiction were also reported to have decreased significantly.^{9,14-17} Reduction of obesity and overweight too was achieved by several researchers.^{10,12,18}

Yoga and meditation are originally areas of Alternative Medicine practice. However, recently these are being widely accepted by modern medicine as effective measures for prevention and non-pharmacological management for several disease conditions, and research studies have been published in a wide variety of international journals. These are increasingly recognized as a form of Mind Body Medicine that can address the physical, psychological, and spiritual aspects and assist with behavioral change, weight loss, and maintenance, thus playing an important role in prevention of obesity.

Table 1:- Effect of yoga and meditation on stress/anxiety/depression

Author Year	Number of participants	Intervention	Outcome	Result	Significant/ Not Significant (S/NS)
Puryear 1976 ⁵	159	Meditation	Anxiety	Reduced	S
Dillbeck 1977 ⁶	33	Meditation	Anxiety	Reduced	S
Javnabhakt 2009 ⁷	65	Yoga	Anxiety	Reduced	S
Carei 2010 ⁸	53	Yoga	Anxiety Depression	Reduced Reduced	NS NS
Garland 2010 ⁹	53	Meditation	Stress	Reduced	S
Daubenmier 2011 ¹⁰	47	Meditation	Cortisol awakening response	Reduced	S
Vandana 2011 ⁴	150	Meditation	Adrenaline Cortisol	Reduced Reduced	S S

Table 2:- Effect of yoga and meditation on eating disorder/eating behavior

Author Year	Number of participants	Intervention	Outcome	Result	Significant/ Not Significant (S/NS)
Mitchell 2007 ¹¹	93	Yoga	Eating Disorder	No change	-
Mclver 2009 ¹²	90	Yoga	Binge eating Physical activity	Reduced Increased	S S
Carei 2010 ⁸	53	Yoga	Eating disorder	Reduced	S
Daubenmier 2011 ¹⁰	47	Meditation	Emotional eating External eating	Reduced Reduced	S S
Alberts 2012 ¹³	26	Meditation	Food cravings Dichotomous thinking Body image concern Emotional eating External eating Problematic eating behaviour	Reduced Reduced Reduced Reduced Reduced Reduced	S S S S S S

Table 3:- Effect of yoga and meditation on alcohol use

Author Year	Number of participants	Intervention	Outcome	Result	Significant/ Not Significant (S/NS)
Bowen 2009 ¹⁴	168	Meditation	Alcohol use Craving	Reduced Reduced	S S
Garland 2010 ⁹	53	Meditation	Alcohol cues Alcohol attentional bias	Reduced Reduced	S S
Witkiewitz 2010 ¹⁵	168	Meditation	Craving Alcohol use	Reduced Reduced	S S

Reddy 2014 ¹⁶	38	Yoga	AUDIT score Symptoms Symptom management	Reduced Reduced Improved	NS NS S
Hallgren 2014 ¹⁷	18	Yoga	Alcohol consumption	Reduced	NS

Table 4:- Effect of yoga and meditation on overweight and obesity

Author Year	Number of participants	Intervention	Outcome	Result	Significant/ Not Significant (S/NS)
Mclver 2009 ¹²	90	Yoga	BMI Waist circumference Hip circumference	Reduced Reduced Reduced	S S S
Daubenmier 2011 ¹⁰	47	Meditation	Abdominal fat/trunk-leg fat ratio Overall weight	No difference No difference	- -
Jeong-Ah 2012 ¹⁸	16	Yoga	Body weight Percentage of body fat Lean body mass Body mass index Waist circumference Visceral fat area	Reduced Reduced Reduced Reduced Reduced Reduced	S S S S S S

Limitations of the study:-

Systematic Review and Meta-analysis could not be done due to inconsistency in the study methodologies, small sample size and lack of complete information in many studies. Other factors are inadequate description of methods, failure to adjust for lifestyle characteristics, large variation in the nature, duration, intensity, and delivery methods of the interventions used. Also not much research has been done in this aspect that is required to draw validated results and conclusive evidence.

Conclusion:-

Though quite a number of research work has been undertaken to assess the role of yoga and meditation in various parts of the world, ambiguity still remains. Most of the studies have several limitations that compromise the validity, most important of which are lack of adequate control population and small sample size. More randomized controlled trials with large sample size are required to be conducted in various settings, to confirm these findings.

However, existing knowledge does point to the benefits of yoga and meditation which are cost-effective techniques without side effects. These are also feasible to be implemented and sustained by the community. Hence focus may be given on mainstreaming yoga/meditation for primary and secondary prevention of obesity, which in addition will provide double benefit by helping to control the risk factors as well as the major non communicable diseases.

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