EFFICACY OF INTEGRATED APPROACH OF YOGA THERAPY ON COGNITIVE MEASURES AND PSYCHOPATHOLOGIES AMONG ELDERLY PERSONS WITH MILD COGNITIVE IMPAIRMENT

Dissertation Submitted by

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Towards the partial fulfillment of

Doctorate of Medicine

In

Yogic Sciences

MD (Yoga & Rehab.)

To

S-VYASA

Swami Vivekananda Yoga Anusandhana Samsthana

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CERTIFICATE

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DECLARATION

I, Pukar Lohani, hereby declare that this study was conducted by me at Arogyadhama holistic health center, Prashanthi Kutiram, SVYASA under the guidance of Dr Kasthinath Metri and Dr. Apar A Saoji.

I also declare that the subject matter of my dissertation entitled **"Efficacy of integrated approach of yoga therapy on cognitive measures and psychopathologies among elderly persons with mild cognitive impairment"** has not previously formed the basis of the award of any degree, diploma, associate-ship, fellowship or similar titles.

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Place: Praśāntikuṭīram

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ACKNOWLEDGEMENT

I am thankful to all the gurus, who directly and indirectly enlightened my path through their words of wisdom and blessings.

I am thankful to the almighty, who is the guru of all the gurus, for selecting me to perform this work at this esteemed institute.

I would like to express my deepest gratitude to Dr. R Nagarathna, Dr Kasthinath Metri and Dr. Apar A Saoji for their guidance and encouragement. I am unable to adequately articulate their contribution in my development.

I am also very much thankful to my Coordinator, Dr. Apar A Saoji for guiding me the whole semester periods of my education and cooperate for my study.

I am thankful to my parents and brothers for their kind and warm support that they extended to me throughout.

I am thankful to the participants who participated in the study.

My thanks to all the members of the faculty and my friends for their help at different stages of this work. I will be always grateful to my university, Swami Vivekananda Yoga Anusandhana Samsthana (S-VYASA), for the support in promoting my career.

Date Dr. Pukar Lohani

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Bengaluru

STANDARD INTERNATIONAL TRANSLITERATION CODEUSED TO TRANSLITERATE SANSKRIT WORDS

a	=	अ	ṅa	=	ङ	pa	=	प
ā	=	आ	ca	=	च	pha	=	फ
i	=	इ	cha	=	छ	ba	=	ब
ī	=	ई	ja	=	ज	bha	=	भ
u	=	उ	jha	=	झ	ma	=	म
ū	=	ऊ	ñ	=	ञ	ya	=	य
ṛ	=	ऋ	ṭa	=	ट	ra	=	र
ṝ	=	ॠ	ṭha	=	ठ	la	=	ल
e	=	ए	ḍa	=	ड	va	=	व
ai	=	ऐ	ḍha	=	ढ	śa	=	श
o	=	ओ	ṇa	=	ण	ṣa	=	ष
au	=	औ	ta	=	त	sa	=	स
ṁ	=	अ	tha	=	थ	ha	=	ह
ḥ	=	अः	da	=	द	kṣa	=	क्ष
ka	=	क	dha	=	ध	tr	=	त्र
kha	=	ख	na	=	न	jña	=	ज्ञ
ga	=	ग	gha	=	घ			

Abstract

Background

Cognitive impairment is a most common condition reported by elderly person and is one of the important risk factors for severe form of neurodegenerative problems such as dementia and Alzheimer's disease. Present study measures the efficacy of integrated approach of yoga therapy on working memory, selective attention, concentration and psychopathologies like anxiety and depression among elderly persons with mild cognitive impairment.

Materials and Method

A total of 49 participants were included in the study. 27 (14 male and 13 female) participants with age range 66.22 ± 5.45 years were included in yoga group from Arogyadhama Banglore and 22 (10 male and 12 feamle) participants with age range (70.45 ± 3.88) years, were included in control group from Theerthashram JP nagar Banglore. A brief screening test was done using 6CIT to evaluate mild cognitive impairment . The intervention group followed residential IAYT technique daily for 6 days and the control group followed their normal daily routine. The assessments were done at baseline and after one week in both groups. The assessments included Dass 21 for evaluating stress, anxiety and depression, Digit span forward and backward to assess working memory and D2 attention to assess selective attention, sustained attention and concentration. Data were analysed using paired sample t test for within group comparison and independent sample t test was used to assess between group comparisons.

Result: within group comparison showed IAYT was effective to reduce stress ($p<0.001$,ES= 0.74), anxiety ($p<0.001$, ES=0.76), and depression ($p<0.001$, ES=0.74) along with improvement in working memory ($p<0.001$, ES=0.61), selective attention and concentration ($p<0.001$, ES=1.09) in yoga group. Between group comparison showed significant improvement of working memory ($p<0.001$, ES=0.42) and concentration ($p<0.001$, ES= 0.34) in yoga group compared to control group.

Conclusion:

One week of IAYT intervention showed improvement in mental health and cognitive function among elderly with mild cognitive impairment.

Key words : Elderly, IAYT, Cognition, 6CIT

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1. INTRODUCTION

1.1. AGEING

Ageing is ever changing continuous process of living beings. It is natural and unavoidable. Human body undergoes complex changes in body cells and molecules which attributes to ageing. There are changes at physical, psychological, emotional and social levels of being with growing age. Ageing causes progressive deterioration of physiological processes, thereby leading to diseases and ultimately cause death (López-Otín, Blasco, Partridge, Serrano, & Kroemer, 2013). Hippocampus a vital part of the brain and its associated cortical regions functions and activities have been studied to distinguish normal ageing than ageing which leads to Alzheimer's disease. Normal ageing is due to reduce metabolic activity in subiculum and dentate gyrus, but entorhinal cortex activity has been linked to pathological ageing (West, Coleman, Flood, & Troncoso, 1994). Seniors, senior citizens, older adults, elderly, and elders are the common terms used for old age people. Elderly is defined according to chronological age, change in social role and change in functional abilities. People, 60 years and above are considered to be elderly population (World health organisation, 2001).

1.1.1 Epidemiology of elderly

The population of people 60 years and above in world is estimated to be 962million in 2017, which comprises 13 percent of the global population. The growing rate of the people 60 years and above is 3 percent per year. By 2025, the population with age 60 years and above will be 1.2 billion and further rise to over 2 billion by 2050. Europe has

highest percentage (25%) of old age population. In Europe, by 2050 the number of old age people is expected to triple from 137 million in 2017 to 425 million (World Health Organisation, 2012). In developing countries the number of people age 60 and above is 62% and by 2050 it is estimated to rise by 80% (International Labour Organization et al., 2014) among which 400 million of them will be aged 80+ (World Health Organisation, 2012). The number of old age people is increasing because of improved health facilitates, decline in mortality rate, speed of ageing and lower fertility rates (Lutz, Sanderson, & Scherbov, 2008). The life expectancy at birth also has increased (United Nations - Department of Economic and Social Affairs Population Division, 2000). Disability among people aged 65 to 74 years is 44.6% and it increases to 84.2% in people aged 85 and over (Ferrari et al., 2013). India is estimated to have over 104 million elderly at present, of which about 53 million are female (National Sample Survey Office, 2016).

1.1.2 Pathophysiology of Ageing

Constant growth, maintenance, reproduction and activities accumulate molecules and cells over time. These accumulations are the factors responsible for ageing. Human genes also plays a major factor in ageing (Kirkwood, 2002). Loss of genome maintenance has been associated with ageing (Garinis, van der Horst, Vijg, & Hoeijmakers, 2008). Mitochondrial functions also have been linked with ageing, as mitochondria regulate cells that cause ageing. The decline in functions and quality of mitochondrial cells leads to diseases in old age and ageing process (Sun, Youle, & Finkel, 2016). Hypothalamus plays vital role in maintaining homeostasis and functioning of human body. Research shows impact of hypothalamus in ageing progression through immune-neuro-endocrine system. This system is related with human lifespan and health problems in old age (Zhang et al.,

2013). Lack of physical exercises, poor hygiene, improper diet habits, tobacco use and alcohol consumptions has been associated to cause inflammation in the body which in long term causes early ageing (Prasad, Sung, & Aggarwal, 2012).

1.1.3. Changes associated with ageing

Physical changes associated with ageing

Human body undergoes different physiological changes with ageing. There are structural changes in chest wall associated with age related spinal deformities which decrease lung compliance and cause difficulty in breathing (G. Sharma & Goodwin, 2006). With ageing the strength and volume of skeletal muscle decreases and causes weakening thereby impair mobility (Porter, Vandervoort, & Lexell, 1995). There are irreversible and progressive changes in sensory functions that leads to visual impairment and auditory impairment (Carabellese et al., 1993). The age related structure and functional changes in heart and circulatory system are associated with cardiovascular diseases in elderly (Kurpesa & Krzemińska-Pakuła, 2008).During ageing the immune system also undergoes a lot of changes which makes older adults vulnerable to variety of infectious diseases due to decreased immunity and increase level of chronic inflammation (Leng, 2016).

Cognitive changes associated with ageing

Cognitive decline in ageing is attributed to the changes in brain structures and neuronal connectivity. Functional imaging techniques of human brain suggests that the co-ordination of different parts of the brain that are associated with cognition are reduced with ageing and this results in reduction of cognitive abilities (Andrews-Hanna et al., 2007). Increased atherosclerotic changes in cerebral arteries cause impairment in cerebral

perfusion. It affects the nourishment of deep brain tissues and leads to subsequent decline in cognitive function. Cerebral hypo perfusion yields capillary damage in the hippocampal CA1 area that correlates with spatial memory impairment (De Jong et al., 1999). Further mitochondrial functions are an important predictor of ageing process and diseases like Alzheimer's disease. The decline in functions of mitochondria reduces neuronal activity and leads to defects in its functions in brain (Wallace et al., 1988). Cognitive decline in elderly include decline in conceptual reasoning, memory, cognitive speed, attention, language, visual spatial ability and executive functioning (Harada, Love, & Triebel, 2013).

Psycho-physiological changes associated with ageing

Elderly persons often experience loneliness due to lack of communication and connection with friends and family. Also the lack of interest to initiate new friends relationship leads elderly people to psychological symptoms such as depression and anxiety (Singh & Misra, 2009). Mobility restrictions further separates elderly peoples from social interactions, makes them economical dependent and isolated which contributes to changes in psychological status and vulnerable to depression (Rantakokko, Mänty, & Rantanen, 2013). Anxiety disorders like generalized anxiety disorders are common in old age (Blay & Marinho, 2012). Post-traumatic stress disorders has been associated to have negative impact in physical health and cognition in old age (Jakel, 2018). Along with anxiety elderly with chronic stress have pathological changes which include increase oxidative stress, reduced telomere length, reduced immunity and inflammation .These changes have impact on cognitive health in elderly people (Bauer, Jeckel, & Luz, 2009).

1.1.2. Health issues in elderly

Coronary artery disease, arrythmias, heart failure and hypertension are the most common health problems with age. The thickness of left ventricle wall increases with high blood pressure which causes increase in size of myocytes and decrease myocyte numbers. In old age there is fibrosis and calcification of valves which impairs the flow of blood from the heart. These conditions make older adults vulnerable to cardiovascular diseases (Y. Wei & Gersh, 1987). Constipation is another problem in old age and its prevalence increases with age. The causes for constipation includes improper food intake, reduced intake of dietary fibers, impaired gastric mobility and certain medicines side effects (Gallagher, O'Mahony, 2009). In ageing there will be changes in structure of chest wall, respiratory muscles and lung structures. The lung capacity also decreases in old age. Also due to osteoporotic changes there might be fracture of ribs which causes difficulty in breathing (Miller, 2010). Senile emphysema is the dilatation of alveolar space without inflammation or alveolar wall destruction. Changes in lung parenchyma is associated with senile emphysema (Thurlbeck & Angus, 1975). Heart diseases, malignant neoplasm, chronic obstructive lung diseases, cerebro- vascular accidents, Alzheimer's disease, Diabetes mellitus, Pneumonia, Nephritis, nephrotic syndrome and suicides are the leading health related problems in old age that leads to mortality (Abajobir et al., 2017).

1.2. COGNITION

Cognition is a process of human brain to identify, select the appropriate, interpret the information received, store, and use the information to interact with surroundings in day to day living (Kielhofner, 2009). Cognition has several domains such as perception,

attention, memory, language, executive function and psychomotor speed (Wahlund et al., 2011). 24.3 million people are estimated to have dementia and cognitive impairment globally with incidence of 4.6 million every new year which accounts to one new case in every 7 seconds. By 2040 the numbers of people affected with dementia and cognitive impairment is estimated to be double 81.1 million. The data in developing countries like India, china and other neighboring countries is more problematic as it seems to increase by 300%.

Cognitive impairment is caused by life style disorders such as diabetes, depression, cardiovascular diseases, alcohol dependency, vitamin B12 and folic acid deficiency and stress. Neurodegenerative diseases such as Alzheimer disease (AD), frontotemporal dementia, Parkinson disease, and multiple sclerosis can also cause cognitive impairment (Wahlund et al., 2011, Fastbom et al., 2014). Cognitive decline leads to impaired activities of daily living including personal hygiene, toileting, clothing and feeding (Katz, Ford, Moskowitz, Jackson, & Jaffe, 1963). Instrumental activities such as handling money, shopping and transportation are also affected (Lawton & Brody, 1969). Treatment options for cognitive decline includes drugs like anti-hypertensive (Gąsecki, Kwarciany, Nyka, & Narkiewicz, 2013), lipid lowering drugs (Etminan, Gill, & Samii, 2003), cholinesterase inhibitors (Lee, Hsiung, Seitz, Gill, & Rochon, 2011), dietary modifications (Solfrizzi, Panza, & Capurso, 2003), behavioral therapy (Antony, Ledley, & Heimberg, 2005), occupational therapy (Hoffmann, Bennett, Koh, & McKenna, 2010) and yoga (N. P. Gothe, Keswani, & McAuley, 2016). New technology and advancement could help to prevent cognitive decline, following early detection and planning the appropriate strategy (Gauthier et al., 2006).

1.3. MILD COGNITIVE IMPAIRMENT (MCI)

Mild cognitive impairment is a condition where an individual has minor problems with cognitive functions like thinking or memory (Gauthier et al., 2006). It is an transition phase between normal cognition and dementia (Greutmann & Tobler, 2013).

1.3.1. Types

1.3.2. Cognitive impairment not demented

The characteristics of people with CIND include, decline in cognitive abilities but do not meet the criteria for MCI. The people have cognitive impairment in one or more of the domains of cognition. The causes of CIND are stoke, psychiatric illness, depression, chronic alcohol, certain medications and mental retardation (Plassman et al., 2008).

1.3.3. MCI due to Alzheimer's disease

It is based upon the symptoms and clinical presentation of MCI with changes in imaging techniques and biomarkers from cerebrospinal fluid. Conformation for the diagnosis include, 1) evidence of amyloid β accumulation in the brain assessed by positron emission tomography (PET), decreased cerebrospinal fluid (CSF) levels of amyloid β (Aβ42), and 2) evidence of neuronal injury assessed as increased CSF tau (total and phosphorylated), brain hypometabolism assessed from fluorodeoxyglucose PET, and hippocampal atrophy from structural magnetic resonance imaging (Greutmann & Tobler, 2013).

1.3.1.1. Subtypes

I. Amnestic Complain of memory impairment is categorized under amnestic mci. It is caused due to neurodegenerative disease. It leads to Alzheimer's disease (Dubois & Albert, 2004).

II. Non-amnestic

Absence of memory impairment with presence of impairment in one or more non-memory cognitive domains including executive function/attention, language, and visouspatial skills domains, is characterized as non-amnestic MCI. It is caused due to vascular damage and cerebrovascular disease. It leads to non-Alzheimer's, vascular dementia and Lewy body dementia (Busse, Hensel, Gühne, Angermeyer, & Riedel-Heller, 2006).

1.3.1.2.Prevalence of MCI in elderly

The prevalence of mild cognitive impairment is estimated to be 21.5–71.3 per 1,000 person (Ward, Arrighi, Michels, & Cedarbaum, 2012). The cognitive decline in elderly is known to increase with age (Christensen, 2001). The prevalence is estimated to grow from 4.5% at age of 60 years to about 7.1% at age of 80 years.

1.3.6. Diagnosis Criteria of MCI

a. The person is neither normal nor demented
b. There is evidence of cognitive deterioration shown by either objectively measured decline over time and/or subjective report of decline by self and/or informant in conjunction with objective cognitive deficits

c. Activities of daily living are preserved and complex instrumental functions are either intact or minimally impaired (Winblad et al., 2004).

1.4. PROBLEMS DUE TO COGNITIVE DECLINE

Cognitive decline leads to impaired activities of daily living including personal hygiene, toileting, clothing and feeding (Katz et al., 1963). Instrumental activities such as handling money, shopping and transportation are also affected (Lawton & Brody, 1969).

1.5. TREATMENT OF COGNITIVE IMPAIRMENT

Treatment options for cognitive decline includes

Drugs

Cholinesterase inhibitors and N-methyl-d-aspartate glutamate receptor antagonists (donepezil) (Wolozin et al., 2007), Hormonal therapies (Estrogen, Testosterone, Dehydroepiandrosterone), Miscellaneous substances like Ginkgo biloba (Birks & Grimley Evans, 2009), Vitamins (vitamin B6, E, omerga3 fatty acid), candesartan, naproxen, rofecoxib, celecoxib, and rivastigmine are the drugs suggested for preventing cognitive decline in elderly but no clear benefits has been achieved (Petersen et al., 2005).

Physical exercise

Physical activity plays vital role to lower the risks of mild cognitive impairment and other types of dementia. As physical activity improves cerebral blood flow, lower the metabolic waste from stagnant cerebral blood and improves nutrients supply to the brain. Physical activity also improves the oxygen level in brain which is vital for normal brain functioning (Laurin, Verreault, Lindsay, MacPherson, & Rockwood, 2001). Evidence suggests

physical activity helps to delay the onset of cognitive impairment (Rockwood & Middleton, 2007).

Diet

Diet has its importance in cognitive health. B complex vitamins like B12, B6 and vitamin B9 are required to maintain healthy brain function and memory. Homocysteine levels are a responsible factor for reduction in cognitive abilities and B complex vitamins helps in its regulation (E. Moore et al., 2012). Oxidative stress is another factor that causes early ageing, decreases immunity and causes cognitive decline. Fruits and vegetables rich in antioxidants like vitamin C and beta carotenes fight against cell damage caused by oxidative stress (Schrag et al., 2013). These antioxidants play a vital role in maintaining cognitive abilities during old age, as antioxidants like polyphenols interacts with neurons and their functional capacities(Van Dyk & Sano, 2007). Consumption of Omega- 3 fatty acids also has been liked to reduce age related cognitive decline(Gómez-Pinilla, 2008).

Yoga

Yoga is an ancient Indian traditional practice and its health benefits are widely studied in various health problems (Verrastro, 2014). Yoga uses different physical postures (asana), breathing technique (Pranayama) and meditation techniques (dhyana), which have shown to improve several cognitive functions (A. Saoji, Mohanty, & Vinchurkar, 2017; Sivakumar et al., 2013).

1.6. YOGA AND ITS EFFECT ON ELDERLY PROBLEMS

The enhanced cognitive functions with yoga include executive functions, memory, attention, intelligence and concentration (N. K. Manjunath & Telles, 2001). Also yoga

has shown promising effects on emotional stability and stress reduction (Rocha et al., 2012). Yoga has shown to be beneficial in improving quality of sleep and reducing depression symptoms in elderly people (Wang, Chang, & Lin, 2014). Yoga also has beneficial effect on respiratory function and cardiac autonomic modulation in elderly people (Santaella et al., 2011). Yoga reduces stress and exhaustion in elderly people (Lindahl, Tilton, Eickholt, & Ferguson-Stegall, 2016). Yoga also helps to improve flexibility and quality of life of elderly people (Goncalves, Vale, Barata, Varejao, & Dantas, 2011). Structural changes in hippocampus are related to age related cognitive decline (Bettio, Rajendran, & Gil-Mohapel, 2017). Yoga helps to increase hippocampus volume in elderly people (Hariprasad, Varambally, et al., 2013).

1.7. INTRODUCTION TO IAYT

The concept of IAYT is initiated in Swami Vivekananda Yoga Anusandhana Samasthana (SVYASA). The principle is based upon the concept of all diseases (vyādhi) which is due to uncontrolled speed of mind that disturbs emotional stability (ādhi) because of the stressful and demanding situations of everyday life. The conflict first arises in the emotional level (manomaya kośa), which disturbs the intellect (vijnanamaya kośa) and manifests in gross levels (prāṇamayākośa and annamayakośa) as imbalance. IAYT deals with not only corrections at gross level but includes different techniques to correct all levels of existence.Based upon the concept of ādhi and vyādhi, pancakośa model adressing all levels of existence and and there related disorders have been designed (Nagarathna R, 2000).

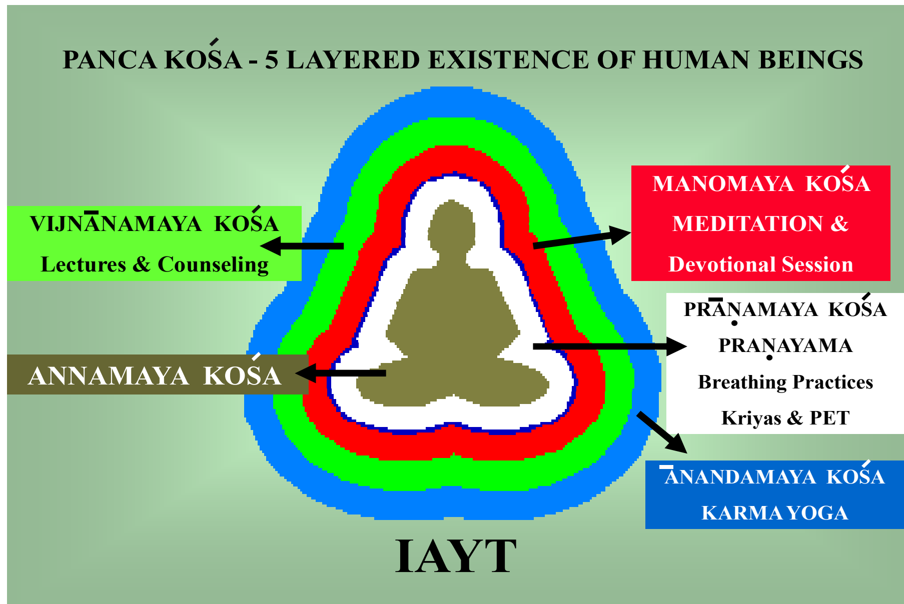


Fig: 1 Pancakoça model

1.7.1. Pancakośa model

The first level of existence is annamayakośa, the practises at this level includes loosening practises, yogāsanas, yogic diet and yogic kriyās. The second level is prāṇamayākośa, the practises include breathing practices, breathing kriyas and *prāṇayāma.* The third level *manomayakośa,*the practices are meditations (Cyclic Meditation, OM Meditation), devotional sessions and happy assembly, where as lectures, counseling and *Satsang* correct the notions about one's life ambitions and goals at *vijñānamayakośa* the fourth level that form the basic conceptual root for the life style of the individual. *Karma yoga* and tuning to nature are the practices that help one to get established in *anandamayakośa* the fifth level bringing bliss in our lives. On this basis IAYT module for various disorders were followed to correct imbalances from the root (Nagarathna R, 2000).

1.7.2. Studies on IAYT

Various studies have been conducted on IAYT and its beneficial effect on health is well known. Metri et al reported the efficacy of IAYT on cardiac variables and mental health in hypertensive patients with elevated anxiety and depression. In this study one week of IAYT showed significant reduction in pulse rate, systolic blood pressure, diastolic blood pressure, anxiety and depression (Metri, 2017). In another study by Manjunath et al showed significant reduction in fasting plasma glucose and improved autonomic functions in 15 type 2 diabetes patients following one week of IAYT (N. Manjunath, Vinutha, & Raghavendra, 2015). Ebnezar et al reported the efficacy of IAYT in failed post total knee replacement of bilateral knees and showed significant recovery with 3 weeks of IAYT (Ebnezar & Balli, 2014). Radhakrishna and Shantha conducted IAYT study on 6 children diagnosed with Autism spectrum disorder. IAYT was given 45mins, 5times weekly for 10 months. There results showed beneficial effect of IAYT to increase imitation, cognitive skills and social communication (Radhakrishna, 2010). In another by Bali et al showed the efficacy of IAYT in 120 patients undergoing conventional treatment for chronic lower back pain which resulted in significant reduction in pain (Ebnezar, 2016).

1.7.3. IAYT at SVYASA

Yogic sukshmavyayamas (loosening and strengthening practices): These are slow and focused repetitive movements that were synchronized with breathing. These practices reduce joint stiffness, helps to mobilize joints and activities sets of muscle groups.

Relaxation techniques: Guided relaxation techniques are given between the physical practices of *sukshmavyayamas* and *asanas*.

Asanas (physical postures): Asanas are firm and pleasant postures that enable an individual to overcome physical discomfort and restlessness. Asanas were done at standing, sitting and lying down positions Asanas improves attention and memory (Mishra, Mishra, & K.V, 2016) .

Pranayama: Praṇā on the physical plane is connected with the functioning of the mind. Controlled regulation of breath during inhalation and exhalation is pranayama. These practices promote autonomic balance through mastery over the mind and improves cognitive functions (Santhakumari, Reddy, Reddy, & Archana, 2013).

Meditation: Meditation consists of continuous flow of thought towards the object of concentration as explained by Sage Patanjali pratyayaekatānatadhyanam. This practise helps to improve attention, memory and exexutive functions in elderly (Marciniak et al., 2014).

1. LITERARY RESEARCH FROM ANCIENT TEXTS

2.1 AIM

To understand the concept Cognition in Ancient Indian scriptures.

2.2 METHODOLOGY

Two ancient scriptures Yoga and Ayurveda were searched.

2.3. PROCESS OF COGNITION

Cognition takes place with a set of processes which involves Manas, Indriya and Buddhi, which leads to controlled systemic actions:

करणानि मनो बुद्धिर्कर्मेन्द्रियाणि च ।

कर्तुः सम्योगजं कर्म वेदना बुद्धिरेव च ॥ च । शा । १-५६

karaṇāni mano buddhirkarmendriyāṇi ca |

kartuḥ samyogajaṁ karma vedanā buddhireva ca || ca | śā | 1-56

Mind, intellect, cognitive and conative organs are the functional aspects of cognition. Combination of these with the doer i.e. empirical soul results in action, sensation and understanding (Shastri, 2003).

मनः पुरः सराणि इन्द्रियाण्यर्थ ग्रहणसमर्थानि भवन्ति । च । सु । ८-७

manaḥ puraḥ sarāṇi indriyāṇyartha grahaṇasamarthani bhavanti । ca । su । 8-7

Indriya receives Arthas when associated with Manas

भेदात् कार्येन्द्रियार्थानाम् बह्व्यो वै बुद्धयः स्म्रिताः।

अत्मेन्द्रियमनोर्थानामेकैका सन्निकरर्षजा॥ च। शा। १-३३

bhedāt kāryendriyārthānām bahvyo vai buddhyaḥ smritāḥ ।

atmendriyamanoarthānāmekaikā sannikararṣajā ।। ca । śā । 1-33

Artha, Indriya, Manas and Atma combines together and perception happens. After which analysis starts by Manas, i.e., Chintya, Vicharya, Uhya, Samkalpa are performed. It gives the purpose to perception. That is the journey from perception to determination, Adhyavasaya or Nischayatmaka. Buddhi is the first half of the functioning of Manas.

The second half of the functioning of Manas is related with Karmendriyas. Manas being Ubhayatmaka Indriya, it has to coordinate with both Jnanendriya and Karmendriya in harmony with each other. After determination of the knowledge perceived by Jnanendriyas, essential desired reflex action is to be carried out, which is coordinated by Manas with the help of determined knowledge, i.e. Nischayatmaka Buddhi. Further initiation of the action is carried out by Karmendriyas. (Carak Sharir 1/20-23)

संकल्प विकल्पनात्माकः मनः।

saṅkalpa vikalpanātmākaḥ manaḥ ।

The information received is analyzed by the intellect (Buddhi), and channelized them to different regions. The power of discrimination by Buddhi is highest intellect of human beings. From Buddhi emerges memory (Smriti). The store house of information is sorted but by the intellect - the buddhi - and whatever is decided to be stored is passed on to the

memory. Not all information needs to be stored. Only those important thoughts, which the Buddhi decides, will find entry into memory.

2.4 CONCEPT OF SMRITI

2.4.1. Smriti according to yoga

Memory is the measure of ability to reproduce the knowledge that is known", says Yogacharya Vishwas (Ballantyne, 1852) "Memory is holding on to that which has been known." - The Hindu Texts.

According to Patanjali Memory is defined as:

अनुभूतविषयासम्प्रमोषः स्म्रितिः ।

anubhūtaviṣayāsampramoṣaḥ smritiḥ ׀ PSY 1.11

The capacity to retain and recall past and present incidents is memory. Memory capacity is the ability to analyze and synthesize the assimilated information. It is a process to recall the objects and events experienced previously in both conscious and unconscious response. Memory power is different in different individuals (Nagendra, 1999).

The brain has four important components which are Manas (Mind), Buddhi (Intellect), Ahankara (Ego) and Memory (Smriti). Manas is often called mind, which is unstable and changes frequently. These changing states of mind once is directed to a goal all the energies flow towards that direction.

Patanjali explains mind as:

प्रमाण-विपर्यय-विकल्प-निद्रा-स्म्रितिः

pramāṇa-viparyaya-vikalpa-nidrā-smritiḥ PYS 1.6

These five kinds of thought-waves are:

1. Pramana- State of right knowledge (like seeing actual water in a lake)

2. Viparyaya- State of wrong knowledge (like a mirage or hallucination)

3. Vikalpa- Random State. Verbal delusions arise when words do not correspond to reality

4. Nidrä- Deep Sleep. Sleep is a wave of thought about nothingness.

5. Smriti- Memory is when perceived objects are not forgotten. But come back to consciousness.

In Patanjali Yoga sutra mind is defined as fluctuation of thoughts and he explains the five types of mental fluctuations. He defines the fifth Vritti memory, as the retention of images of sense objects that have been experienced. The sequential order of perceiving memory depends on foremost Vrittis. The mind forms an impression of an object through sense organs which is called pratyaya. Every object perceived forms Samskara, an imprint in the citta. Once this pratyaya or active image of this object is no longer of active interest to the mind, it becomes an inactive, or latent.

Thus Vritti, and their pratyaya content, are retained as saṁskāra when they fade. Memory consists of the retrieval of these saṁskāra; memories are the reactivation of the imprints of sense objects that one has experienced and recognized in the past that are not too covered by forgetfulness. However, it is important to note that these saṁskāra are not just passive imprints but vibrant latent impulses that can get activated under conductive

circumstances and can exert influence on a person's thoughts and behaviors (Patañjali., Hariharānanda Āraṇya Swami., & Mukerji, 1983).

2.4.2. Smriti according to Yoga Vasishta

स्मरणात्वान् अत्मनोज्ञः स्वभाव्यात् न्याय दर्शना

smaraṇātvān atmanoojñaḥ svabhāvyāt (nyāya darśanā)

Buddhi, channelizes the information received and analyze them. This information later is stored as memory and are recollected once the similar stimuli is perceived. Memory is important for spiritual seekers also to clear the past impressions to attain liberation ("The Essence Of Yogavaasishtha - Sri Jnanananda Bharati,").

संस्कार मात्र जन्यम् ज्ञानं

saṁskāra mātra janyam jñānaṁ (Tarka sāstra)

Tarka Shastra explains smriti as Atma. It is knowledge in the form of remembering. It is a dharma of Atma.

2.4.3. Smriti According to Upanishad:

गुण अन्तर्धान इति संस्कार

guṇa antardhāna iti saṁskāra

"The knowledge which is gained due to Samskara"

2.4.4. Smriti according to ayurveda

The Sanskrit terms smriti, smarana and medha can be encompassed under word "Memory". Medha is power of retention of knowledge and Smarana is process of remembering. As already described, cognition encompasses all the activities and processes that leads to knowledge such as memory, attention, information processing speed, executive functions etc. Ayurvedic science says that, retention of cognition takes place under the area of Medha (power of retention of knowledge / storage device). Whenever there are any stimuli the previously stored experiences come in mind and recollection happens with the help of Smriti (memory or recall). In modern science the memory and its processes are still undefined. The Ayurvedic philosophy of Mana (mind), Buddhi (intellect), Atma (sole) definitely plays an important role in the processes of cognition and memory (Gulhane & Thakar, 2014).

2.4.4. Origin of the word Memory:

मनोबुद्धि अह्ंकार चितं करणमन्त्रम् संशयो निश्रयो स्मणरनम् विषय इमे ।

manobuddhi ahnṅkāra citaṁ karaṇamantram saṁśayo niśryo smaṇaranam

viṣaya ime (vedānta pāribhāṣa)

The manas, the intellect, the ego and the chitta (memory) constitute internal instrument (mind). Doubt, certitude, egoism and memory these are their objects.

द्रिशटश्रुतानुभूतानां स्मरणात् स्म्रितिरूच्यते । च ।शा । १-१४९

driśaṭaśrutānubhūtānāṁ smaraṇāt smritirūcyate । ca ।śā । 1-149

“The process by which people encode, store and retrieve information”. The ability to remember and forget is one of the most complex and fascinating functions of the brain (Rao, 1994).

Caraka defines “capacity to remember the past or to recollect the past which are directly perceived, heard or experienced earlier is called Memory”. The registration that occurs on the mind of the past experience, ideas and thoughts is called as Memory (Shastri, 2003)

अत्ममनसोः सम्योग विशेस्षात् संस्कारवच्च स्म्रितिः।

atmamanasoḥ samyoga viśesṣāt saṁskāravacca smritiḥ । (Vaisheshika 11)

“The saàskära which arises because of the special conjunction between Ätma (soul) and the manas, mind is termed as Smriti. In Ayurvedic science, the concept of Smriti (memory) is more related with Buddhi (intellect), Mana (mind), and Medha (power of retention of knowledge).

2.4.5. Recollection of memory:

Memory is recollected once the similar situations are experienced. Memory recall requires conscious effort to recollect the past experiences (“The Essence Of Yogavaasishtha - Sri Jnanananda Bharati,”).

Manovishaya:

चिन्त्यं विचार्यमोहं च ध्येयं संकल्प्यमेव च ।

यत्किंचिन्मनसो ह्येयं तत् सर्वं ह्यार्थसज्ञकं ॥ शा । १-२०-२१

cintyaṁ vicāryamoohaṁ ca dhyeyaṁ saṅkalpyameeva ca ।

yatkiñcinmanaso hyeyaṁ tat sarvaṁ hyārthasajñakaṁ ।। śā । 1-20-21

Components of the mind are:

Cintyaà – Thinking

Vicäryam - Planning

Uhyaà - Imagination/ Hypothesis

Dhyeyaà - Concentration/Attention

Sankalpyam - Thinking of the action to be taken

Control of sense organs, self-restraint, hypothesis and consideration represent the action of the mind. Beyond that flourishes the domain of intellect. Antah karana catushtaya (Shastri, 2003).

मनो बुद्धि अहंकर चित्तं करण मनंतरम् ।

संशय निश्चय गर्वः स्मरणं विशाया अमेह् ॥

mano buddhi ahaṅkara cittaṁ karaṇa manantaram ।

saṁśaya niścaya garvaḥ smaraṇaṁ viśayā ameh ।।

Memory is one of the four of the inner sense.

Manas – (sense of) suspicion – samshaya

Buddhi – Discretion – nihchaya

Ahankaara – Pride – Garva

Chitta – Memory – Smarana

This Ahankaara is of 3 kinds of depending on the predominance of anyone of the trigunas viz, Satva, Rajas, and Tamas. Smriti is one of the Saatwika ahankara laksana. Memory is also one of the characters of an individual with the predominance of satvaguna.

2.4.6. Causes of loss of Memory

ध्यायतो विषयान् पुंसः संगस्तेषूपजायते ।

संगात् संजयते कामः कामात् क्रोधोभिजायते ॥२ । ६२

dhyāyato viṣayān puṁsaḥ saṅgasteṣūpajāyate।

saṅgāt sañjayate kāmaḥ kāmāt krodhobhijāyate ।।2। 62

क्रोधाद् भवति सम्मोहः सम्मोहात् स्म्रिति विभ्रमः ।

स्म्रिति भ्रंशाद् बुद्धिनशो बुद्धिनाशात् प्रणश्यति । २ । ६३

krodhād bhavati sammohaḥ sammohāt smriti vibhramaḥ ǀ

smriti bhraṁśād buddhinaśo buddhināśāt praṇaśyati ǀ 2 ǀ Bha. Gi. 2.63

When dwelling sense objects, a person develops attachment for them and from such attachments lust develops and from lust anger arises. From anger complete delusion arises and from delusion bewilderment of memory. When memory is bewildered intelligence is lost and when intelligence is lost one falls down again into the materialistic pool. The importance given to smriti in the ancient scripture is evident from the above lines (Swami Prabhupada, 2011).

Acharya Charaka has clearly mentioned, Dharanam (retention), Dhrti (resolution), Buddhi (intellect) and Smriti (memory) while describing the list of Atmaja Bhavas (factor associated with soul) (Shastri, 2003).

Medha (power of retention of knowledge) is the faculty of Buddhi (intellect) and Buddhi (intellect) is the Guna (property) of Atma (soul). It manifests with the combination of Atma (soul) and Manas (mind). So, Medha (power of retention of knowledge) can be said to be an inherent ability. In each individual, production of knowledge starts with the perception of the subject.

Indriya (senses) perceives the subject and carry the information from the environment to the Manas (mind). Received information is given a certain form as it passes through the Chintaya (things requiring thought), Vicharya (consideration), Uhya (hypothesis) etc. and

is then sent to Atma (soul). After the knowledge is known by Atma (soul) it is stored in Medha (power of retention of knowledge), it transmigrates in another body along with Atma (soul) for many births. Here commentator Gangadhara, while explaining the word Dharana (retention), says it is that which is retained for a long time by Manas (mind). Thus Medha (power of retention of knowledge) is the Bhava (factor) of Atma (soul) which is manifested during gestation (Aathavale, 2008).

Mana (mind) plays an important role in the process of retention of knowledge and it also coordinates with the external environment with the brain through the different Gyanendriyas (sense organs) (Aathavale, 2008).

From above description it is confirmed that manas is an important factor in the origin of prajnya or buddhi and hence, all activities (karmas) which are being done. However, mana itself is regulated by vata and in old age (vriddhavastha) and persons afflicted with vata vyadhi, vatavaigunya is already present, hence functions of manas is also affected physiologically to a great extent.

2.4.7. Types of loss of Memory

As described earlier, medha comprises of the following faculties – dhi, dhriti and smriti and any alteration in any of these faculties will ultimately affect the medha (power of retention of knowledge). Maharishi Charaka described the character of altered dhi, dhriti and smriti in following words:

विषमाभिनिवेशो सो नित्यानित्ये हिताहेते ।

ज्ञेयः स बुद्धिविभ्रंशः समं बुद्धिर्हि पश्यति ॥ च । शा । १-९९

viṣamābhiniveśo so nityānitye hitāhete ।

jñeyaḥ sa buddhivibhraṁśaḥ samaṁ buddhirhi paśyati ।। ca । śā । 1-99

Dhivibhramsha: Dhivibhramsha refers to derangement of understanding where by the eternal and the non-eternal (Nityanitya), good and evil (Hitahita) are mistaken one for the other, for true understanding always perceive things in proper prospective (Shastri, 2003)

विषयप्रवणं सत्त्वं ध्रितिभ्रमशन्ना शक्यते ॥

नियन्तुमहितादार्थद्धृतिर्हि नियमात्मिका ॥ च ॥ शा । १-१००

viṣayapravaṇaṁ sattvaṁ dhritibhramaśannā śakyate ।।

niyantumahitādārthaddhrtirhi niyamātmikā ।। ca ।। śā । 1-100

Dhritivibhransha: In the event of the derangement of the will (Dhriti), the psyche (Sattva) which is always reaching out for its favorable objects, is incapable of being restrained from undesirable objects, for the will (Dhriti) is the controller and regulator (Shastri, 2003)

तत्त्वज्ञाने स्म्रितिर्यस्य राजोमोहाब्रितात्मनः ।

भ्रश्यते स स्म्रितिभ्रंशः स्मर्तव्यं हि स्म्रितौ स्थितम्॥च। शा। १-१०१

tattvajñāne smritiryasya rājomohābritātmanaḥ |

bhraśyate sa smritibhraṁśaḥ smartavyaṁ hi smritau sthitam |a | śā | 1-101

Smritivibhransha: When on account of the psyche (Manas) being clouded with passion and delusion, i.e. Rajomohavritatmanah, the retention of true knowledge is destroyed. The state is called the derangement of memory (Smriti); for indeed the memorable things abode in the memory (Shastri, 2003)

Most memory problems are related to kapha dosha, with its dense qualities, thick, soft and sticky qualities. Images, experiences, and feelings are recorded and retained on the "film" of the brain's white matter, tarpaka, a sub-dosha of kapha. This special tissue nourishes and protects the brain cells and other nerve tissue. Stagnation of kapha typically results in a heavy feeling and a dull mind. An example of high kapha could be a thick, oily quality to the blood due to high triglycerides, or fat in the blood, allowing low flow of blood across the blood-brain barrier (Shastri, 2003).

Other memory problems can be related to a vata disturbance with its light and airy qualities. In the condition of excess vata, a person may be so scattered or spacy, due to stress or anxiety, that they cannot remember a conversation they had even an hour earlier. Typically, in this example the person is not able to focus enough attention, detrimentally affecting the quality of nerve impulse, to record a memory and information goes in one ear and out the other. There can be many causes of having a dull mind and poor memory. Most commonly, the brain does not receive necessary nutrients from the blood. Other

possible causes can be a chemical imbalance in the brain's neurochemistry or certain toxic drugs that have affected the brain detrimentally. Unprocessed thoughts, feelings, experiences and emotions can result in mental indigestion (Nagarathna R, 2000).

2.4.8. Causes of decrease in Memory:

Bhagavad Gita:

यततो ह्यपि कौन्तेय पुरुषस्य विपश्चति ।

इन्द्रियाणि प्रमाथिनि हरन्ति मनाह् ॥२-६० ॥

yatato hyapi kaunteya puruṣasya vipaścati |

indriyāṇi pramāthini haranti manāh ||2-60 ||

Turbulent by nature, the senses even of a wise, who is practicing self-control forcibly, carry away his, mind, Arjuna.

Brihadaranyaka Upanishad- I.V.III

कामः सन्कल्पो विचिकित्स श्रद्धा ध्रितर् ह्रिर् धिर् भिर् इत्य् एतत सर्वम् मन एव ॥ १-५-३ ॥

kāmaḥ sankalpo vicikitsa śraddhā dhrtir hrir dhir bhir ity etata sarvam mana eva || 1-5-3 ||

Desire, determination, uncertainty, faith, lack of faith, perseverance, and lack of perseverance, humility, intelligence, and fear are all products of the mind.

Charaka Samhita:

Charaka Samhita explains methods for longevity and the role of promotive health care: From promotive treatment, one attains longevity, memory, intelligence, freedom from disorders, youthful age, excellence of luster, complexion and voice, optimum strength of physique and sense organs, successful words, respectability and brilliance. Rasayana (promotive treatment) means the way to attain an excellent life.

कालबुध्दिन्द्रीययार्थाना योगो मिथ्या न चाति च ।

द्रव्याश्रयाणां व्यधीना श्रिविधो हेतुसंग्रह ॥५४ ॥

kālabudhdindrīyayārthānā yogoo miathdyā na cāti ca |

dravyāśrayāṇāṁ vyadhīnā śrividho hetusaṅgraha ||54 ||

The causes of the diseases relating to both (mind & body) are atiyoga-excessive utilization or indulgence; heena yoga- less utilization & Mithya yoga- wrong utilization of *kala-time (like prolonged summer, short summer or heat of summer in other months) *artha-objects of sense organs (smell, touch & so on) like excessive smelling or not at all smelling or seeing in the dark areas, seeing sharp objects etc.*buddhi- mental faculties, like excessive thinking or wrong thinking & doing etc.”

प्रशाम्यत्यैषधौः पूवो दैवयुक्ति व्यपश्रयैः ।

मनसौ ज्ञविज्ञानधैर्यस्म्रितिसमाधिमिः ॥ ५८ ॥

praśamyatyaiṣadhauḥ pūvo daivayukti vyapaśrayaiḥ I

manasau jñavijñānadhairyasmritisamādhimiḥ || 58||

The psychological doshas- Rajas & Tamas are balanced by spiritual & scriptual knowledge, patience, memory & meditation. These treatments help to win over the weakness of the min. Hence it is called Satva Avajaya chikitsa.”

Hatha Yoga Pradapika:

चाले वाते चलं चितं निश्चलं भवेत ।

योगी स्थाणुत्वमाप्नोति ततो वयुं निरोधयेत् ॥२-२ ॥

cāle vāte calaṁ citaṁ niścalaṁ bhaveta I

yogī sthāṇutvamāpnoti tato vayuṁ nirodhayet ||2-2 ||

When the prana moves, chitta (mental force) moves. When prana is without movement, chitta is without movement. By this (steadiness of prana) the yogis attain steadiness and should thus restrain the vayu.

The breathing is directly connected with the brain and central nervous system and its one of the most vital process in the body system. It also has some connection with the

hypothalamus, the brain centre which controls emotional responses. The hypothalamus is responsible for transforming perception into cognitive experience. For many years, people have known that through pranic restraint you can control the influx of the mind and through mental restraint you can control the influx of prana, but various spiritual systems have been debating which method is the best to harness the two energies and induce unity. Christ and Lord Buddha said the same thing- 'Lead a good life and your mind will be controlled' However, it has been found that through pranayama, mudras, bandhas and certain postures which regulate the pranas, the mind can be brought under control.

भवेत्सत्त्वं च देस्य सर्वोपद्रववर्जितः ।

आनेन् विधिना सत्ययं योगीद्रो भुमिमंडले ॥५३ ॥

bhavetsattvaṁ ca desya sarvopadravavarjitaḥ ǀ

ānen vidhinā satyayaṁ yogīdro bhumimaṇḍale ǀǀ53 ǀǀ

The sattwa in the body becomes free from all the distrubance. Truly, by the formentioned method one becomes lord of yogis on this earth. Most of the people in this kali yuga are tamasic (dull & lethargic) or Rajasic (dynamic & ambitious) by nature, but through yoga and other evolutionary sciences, sattwa (balance, harmony and one-pointnedness) can be developed. It represents the highest point in the evolution of the human kind.

2.4.10 Yogic management of reduced memory

Yogic practices help to channelize Nadis which are the source of energy. These Nadis are blocked due to impurities which leads to reduced memory. When one clears all the impurities these Nadis are channelized. He develops self-satisfaction and attains the state of bliss which helps him to recollect all the past experiences.

महा-भूतान्यहंकारो बुध्दिरव्यक्तमेव च ।

इन्द्रियाणि दशौकं च पञ्च चेन्द्रियगोचराः ॥१३-६ ॥

mahā-bhūtānyahaṅkāro budhdiravyktameva ca ।

indriyāṇi daśaukaṁ ca pañjae cendriyagocarāḥ ।।13-6 ।।

इच्छा द्वेषः सुखं दुखं सध्ङातश्ताचेता ध्रितिः ।

एतात् क्षेत्रं समासेन सविकारमुदाह्रतम् ॥१३-७ ॥

icchā dveṣaḥ sukhaṁ dukhaṁ sadhṅātaśtācetā dhritiḥ ।

etāt kṣetraṁ samāsena savikāramudāhratam ।।13-7।।

"The five great elements, false ego, intelligence, the unmanifested, the ten senses and the mind, the five sense objects, desire, hatred, happiness, distress, the aggregate, the life symptoms, and convictions—all these are considered, in summary, to be the field of activities and its interactions."

The characteristics and components of the ksetra are being elucidated by Lord Krishna beginning with the five fundamental elements which are earth, water, fire, air and ether. The false ego, the intellect, the unmanifest element of existence, the five perceptual senses being the eye, ear, nose, tongue and sense of touch. The five objects of the perceptual senses being sight, sound, smell, taste and touch form the five senses of activity being the voice, the hands, the legs, the genitals and the anus. The internal sense being the mind - desire, aversion, happiness, unhappiness, the body, the intuition, patience and the six material modifications being birth, sustenance, growth, maturity, declination and destruction. Thus, the Supreme Lord Krishna has enumerated the 24 categories which comprise the field of activity known as the ksetra. In this way the qualities of the ksetra are introduced and enumerated by Lord Krishna. Thus, the ksetra along with its modifications such as the perceptual senses, etc. has been described in brief.

Ayurveda is not just another system of medicine, but a science of total health care based on the strong pillars of positive health incorporating the role of the following four aspects:

(i) Character - achaar, (ii) thought or mind - vichaar, (iii) interpersonal relations - vyavahaar. and (iv) diet - ahaar.

(ii)

2.4.11. Management of reduced memory according to Susruta samhita sutrasthana:

समदोषः समग्नीश्च समधातुमल क्रियः।

प्रसन्नातमेन्द्रियमनाः स्वस्थ इत्यभिधीयते॥ १५-४८॥

samadoṣaḥ samagnīśca samadhātumala kriyaḥ |

prasannātamendriyamanāḥ svastha ityabhidhīyate || 15-48 ||

"Ayurveda is concerned with the concept of the absolute balance which involve not only the dosas, dhatus, body, organs but the pysche and the spirit in tune with the sense faculties." The text of ayurveda emphasize mainly on right thinking, right behaviour, right action, right response as a wholesome regime. Health is defined as svasthya in ayurveda. This svasthya, involves the total personality of man including the body, mind and soul.

शरीरं सत्त्वसंज्ञं च वयाधीनामाश्रायो मतः।

त थ सुखानां योगस्तु सुखनां कारणं समः॥ ५५॥

śarīraṁ sattvasañjñaṁ ca vayādhīnāmāśrāyo mataḥ |

ta tha sukhānāṁ yogastu sukhanāṁ kāraṇaṁ samaḥ || 55||

The body and Mind constitute the substrata of diseases & happiness. Balanced utilization of time, mental facilities & object of sense organs is the cause of happiness.

हठस्य प्रथमांगत्वदासनं पुर्वमुध्यते

कुर्यात्तदासनं स्थैर्यमारोग्यं चांगलाघवम् ॥१-१७ ॥

haṭhasya ptathamāṅgatvadāsanaṁ purvamudhyate

kuryāttadāsanaṁ sthairyamārogyaṁ cāṅgalāghavam ||1-17||

The hatha yogis found that by developing control of the body through asana which gives steadiness, disease lessness and lightness, the mind gets controlled (Muktibodhananda, 2009).

2.4.12 Means to Improve Smriti

According to Hatha Yoga Pradapika

उत्तनं शववट्भूमौ शयनं तच्छवासनम् ।

शवासनं क्षन्तिहृहरं चित्तविक्षन्तिकारकम् ॥ १-३२ ॥

uttanaṁ śavavaṭbhūmau śayanaṁ tacchavāsanam |

śavāsanaṁ kṣantihharaṁ cittavikṣantikārakam || 1-32 ||

Lying flat on the ground with the face upwards, in the manner of a dead body is shavasana. It removes tiredness and enables the mind (and whole body) to relax. When the body is completely relaxed, awareness of the mind develops. In fact, shavasana is beneficial no matter what the condition is, even in perfect health, because it brings up the latent impressions buried in the sub conscious mind. The mind operates during waking consciousness relaxes and subsides.

किमन्यैर्बहुभिः पींठैः सिध्टे सिध्दासने सति ।

प्रणानिले सावधाने बध्टे केवलकुंभके ।

उत्यधते निरायासात्स्वयमेवोन्म कला ॥ १-४१ ॥

kimanyairbahubhiḥ pīṭhaiḥ sidhṭe sidhdāsane sati ǀ

praṇānile sāvadhāne badhṭe kevalakumbhake ǀ

utyadhate nirāyāsātsvayamevonma kalā ǀǀ 1-41 ǀǀ

When perfection is attainable through siddhasana, what is the use of practicing many other asanas? When the flow of prana is stabilized, the breath stops spontaneously (kevala Kumbhaka) and a mindless state (unmani) arises by itself. If the mind is basically tamasic or rajasic, it needs a proper outlet of expression, otherwise during meditational practice, it will cause havoc, wander here and there or just become dull and sleepy.

प्रानायामं ततः कुयान्नित्यं सात्त्विकया धिया ।

यथा सुषुम्नानाडीस्या मलाः शुधिदं प्रयांति ॥ १-६ ॥

prāṇāyāmaṁ tataḥ kuyānnityaṁ sāttivakayā dhiyā ।

yathā suṣumnānāḍīsyā malāḥ śudhidaṁ prayānti ।। 1-6 ।।

Therefore, pranayama should be done daily with a sattwic mind. So that the impurties are driven out of sushumna nadi and purification occurs. During pranayama practice the mind should be steady and aware and not moving from thought to thought. Then the whole system is receptive. Factors which influence pranis flow in the naids are; life style, diet, desires, thoughts, and emotions. Hatha yoga influences the nadis directly, but one entire external life should be taken into consideration. When the personality is balanced and there are no extreme conditions in the mind and body, the breath will also be harmonized.

कर्मषट्कमिदं गोप्यं अधटशोधनकरकम् ।

विचित्रगुणसंधायि पूज्यते योगिपुंगवैः ॥ २-२३ ॥

karmaṣaṭkamidaṁ gopyam adhaṭaśodhanakarakam

vicitraguṇasandhāyi pūjyate yogipuṅgavaiḥ ।। 2-23।।

These shatkaram which effect purification of the body are secret. They have manifold, wondrous results and are held in high esteem by eminent yogis. The effect of shatkarma can be summed up in one word- purification, when the different systems of the body have been purified, the overall results is that energy can flow through the body purified, the

overall results is that energy can flow through the body freely. One's capacity to work, think, digest, taste, feel, experience etc., increases and greater awareness develops.

Moorchha Pranayama:

पूरकांते दीर्घ गाढतरं बद्रध्वा जलंधरं शनै ।

रेचयेन्मूर्च्छनाख्येयं मनोमूर्च्छा सुखप्रदा ॥२-६९॥

pūrakānte dīrgha gāḍhataraṁ badradhvā jalandharaṁ śanai ।

recayenmūrcchanākhyeyaṁ manomūrcchā sukhapradā ।।2-69।।

At the end of inhalation gradually become fixed in jalandhara, and then exhale slowly. This is called the fainting or swooning as it makes the mind inactive and (thus) confer pleasure.

प्राणस्य शून्यपदवी राजपथायते ।

तदा चित्तं निरामंबं तदा कालस्य वंचनम् ॥३-३॥

prāṇasya śūnyapadavī rājapathāyate ।

tadā cittaṁ nirāmambaṁ tadā kālasya vañcanam ।।3-3 ।।

Then indeed sushumna becomes the pathway of prana, mind is free of all connections and death is averted. With the awakening of kundalini, both the hemispheres and the dormant areas of the brain become active, perception becomes independent of the sense organs, deeper states of consciousness are entered, and then there is a cosmic experience.

मरुतस्य् विधि सर्व मनोयुक्तं समभ्यसेत् ।

इतरत्र न कर्तव्या ननोव्रित्तिर्मनीषीणा ॥ ३-१२७ ॥

marutasy vidhi sarva manoyuktaṁ samabhyaset ।

itaratra na kartavyā nanovrittirmanīṣīṇā ।। 3-127।।

All the pranyama methods are to be done with a concentrated mind. The wise men should not let his mind be involved in the modification (vrittis) During the practice of pranyama the mind has a natural tendency to run away in the multitude of thoughts and emotions which arises. There must be concentration upon the present movement. Mind, body and prana must co-operate together so that the three start to work in unison.

Mind devoid of thoughts:

मारुते मध्यसंचारे मनःस्थैर्यं प्रजायते ।

यो मनःसुसिरीभावः सैवावस्था मनोन्मनी ॥२-४२ ॥

mārute madhyasañcāre manaḥsthairya prajāyate |

yo manaḥsusirībhāvaḥ saivāvasthā manonmanī ||2-42||

The breath (prana) moving in the middle makes the mind still. This steadiness of mind is itself called the state of manonmani- devoid of thoughts.

2. LITERATURE SURVEY OF SCIENTIFIC INVESTIGATION

3.1. YOGA AND COGNITION

Yoga uses different physical postures (āsanas), breathing technique (Prānāyāma) and meditation techniques and these have been shown to improve several cognitive functions (Hariprasad, Sivakumar, et al., 2013) such as executive functions, memory, attention, intelligence and concentration (N. K. Manjunath & Telles, 2001).

A number of reviews and studies on scientific research on yoga have been published. Meta-analysis on effects of yoga on different cognitive domains including attention and processing speed, executive functions and memory has shown moderate effect on cognitive functions (N. P. Gothe & Mcauley, 2015). The efficacy of yoga on treatment of major psychiatric disorders that included depression, schizophrenia, attention deficit hyperactive disorder (ADHD), eating disorder, sleep complaints and condition influencing cognition has shown effective role in treating sleep complaints and depression and suggests yoga as adjunct therapy in treatment of schizophrenia and ADHD (Balasubramaniam, Telles, & Doraiswamy, 2013). A clinical research review showed yoga posture effects on anxiety, depression, pain syndromes, autoimmune, immune cardiovascular and pregnancy. The effects of yoga was seen in psychological conditions and reduction in cortisol level which enhances immunity (Field, 2011).

3.2. YOGA AND ATTENTION

There is large data available on efficacy of yoga on attention in both clinical and non-clinical population. A study by Saoji et al reported the efficacy of Mind sound resonance technique on sustained attention, information processing speed and concentration among

42 healthy university medical students. In this study 10days orientation of MSRT intervention produced significant improvement in cognition tasks of university medical students (A. Saoji et al., 2017).

In another study in children suffering from ADHD following 8 week yoga intervention revealed beneficial effect on sustained attention (Chou & Huang, 2017). Integrated yoga module was performed in 66 university students and accessed sustained attention. The study showed improvement in psychosocial functioning (Ganpat, Sheela, & Nagendra, 2013). In another study 60 underprivileged girl students were given integrated yoga module (IYM) and attention and self-esteem were accessed. IYM had significant improvement in attention and self-esteem (Ganpat, Sethi, & Nagendra, 2013). In another study Attention and hemodynamic changes on prefrontal cortex following meditation as intervention was accessed by Deepeshwar et al. Healthy males with 12 months of experience in meditation were included in study. The oxygen level was increased in prefrontal cortex during meditation and improved task performance related to attention (Deepeshwar, Vinchurkar, Visweswaraiah, & Nagendra, 2015). In another study of yogic visual concentration (trataka) 30 participants were tested using stroop colour word test and found increased selective attention , cognitive flexibility and response inhibition after practicing trataka (Raghavendra & Singh, 2016). Isha yoga meditation was assessed in 82 meditators through stroop task, attentional blink task and global local task. The author concluded that isha yoga has negligible effect on visual attention as it involves more focus and self-transcending (Braboszcz et al., 2013). But practices like kapalbhati showed no significant change from baseline pre and post intervention on sustained attention (Pradhan, 2013). (See Table 1).

Table: 1. SUMMARY OF SCIENTIFIC STUDIES DONE ON YOGA AND ATTENTION

S N	Author / Year	Title	Sample	Intervention and assessment	summary of findings
1	Chien Chih Chou and Chung Jung Huang 2017	Effects of an 8-week yoga program on sustained attention and discrimination function in children with attention deficit hyperactivity disorder	49	Not specified eight-week yoga program twice per week, 40 min per session Visual Pursuit Test and Determination Test accuracy rate and reaction time	Yoga helped to reduce attention and inhibition problems
2	Sheela, H.R. Nagendra, Tikhe Sham Ganpat 2013	Efficacy of Yoga for sustained attention in university students	66	Integrated Yoga module 21 days Digit vigilance test	Improvement of psychosocial functioning and reduce response inhibition
3	B R Raghavendra and Prashanth Singh 2014	Immediate effect of yogic visual concentration on cognitive performance	30	Yogic visual concentration technique (trataka) Stroop color–word test	Increased selective attention, . cognitive flexibility, and response inhibition
5	Claire et al 2014	Plasticity if visual attention in Isha yoga meditation practitioners before and after a 3- month retreat	82	Isha yoga Stroop task, an attentional blink task, and a global-local letter task	Reduction of the attentional blink

6	Jaspal Kaur Belthi, H.R. Nagendra, Tikhe Sham Ganpat 2013	Yoga improves attention and self-esteem in underprivileged girl student	60	Integrated Yoga Module Rosenberg Self-esteem D2 test	Significant improvement in the attention and SE
7	Balaram Pradhan 2013	Effect of kapalabhati on performance of six-letter cancellation and digit letter substitution task in adults	36	Kapalbhati Six letter cancellation task (SLCT) Digit-letter substitution task (DLST).	There were no significant differences on SLCT and DLST between groups
8	Apar saoji,Sriloy Mohanty and Suhas A Vinchurkar 2016	Effect of a Single Session of a Yogic Meditation Technique on Cognitive Performance in Medical Students: A Randomized Crossover Trial	42	MSRT Supine rest Digit Letter Substitution Test (DLST) Six-Letter Cancelation Task (SLCT)	A single session of MSRT, a Mind–Body Practice, may positively impact the performance in cognitive tasks
9	Deepeshwar Singh et al 2014	Hemodynamic responses on prefrontal cortex related to meditation and attentional task	22	Not specified FNIRS Color-word stroop task	Increased oxy-hemoglobin concentration because of enhanced neural activity and cerebral blood flow in the prefrontal area during meditation compared to random thinking

3.3. YOGA AND RESPONSE INHIBITION

A study was conducted on yoga breathing to access its relation with response inhibition. 37 healthy individuals were tested using stop signal task. Beneficial effect of yoga breathing and breath holding time was seen in neuronal activity and hemodynamics changes in areas like frontal cortex, prefrontal cortex and other parts of the brain (A. A. Saoji, Raghavendra, Rajesh, & Manjunath, 2018).

3.4. YOGA AND EXECUTIVE FUNCTIONS

A randomized control trial conducted in 72 individuals using 3 cognitive test Stroop Color Word Task, Digit Symbol Substitution Test (DSST), Digits Span Test and Trial Making Test (TMT) following 3months of yoga program, showed moderate effect on executive functions, attention and processing speed measures (Purohit & Pradhan, 2017). In another study on 118 participants following 8 weeks Hatha yoga intervention, hatha yoga practise improved executive functions (N. P. Gothe, Kramer, & Mcauley, 2014). In another study involving 24 subjects, yoga group and physical skill training group were assessed and found that there was decrease in perceived speed in the yoga group (Richter, Tietjens, Ziereis, Querfurth, & Jansen, 2016).(See Table 2)

Table: 2. SUMMARY OF SCIENTIFIC STUDIES DONE ON YOGA AND EXECUTIVE FUNCTIONS

SN	Author / Year	Title	Sample	Intervention and assessment	summary of findings
1	Shirley Telles, Nilkamal Singh, Abhishek kumar Bhardwaj and Acharya Balkrishna 2013	Effect of yoga or physical exercise on physical, cognitive and emotional measures in children: a randomized controlled trail	98	Yoga and physical exercise Eurofit physical fitness test battery, Stroop color word task for children, Battle's self-esteem intentory, teachers rating for children's obidence, attention punctuality and behavior with friends and teachers.	Yoga and physical exercise are useful additions to the school routine with physical exercise improving social self-esteem.
2	Satya Prakash Purohit and Balaram Pradhan 2017	Effect of yoga program on executive functions of adolescents dwelling in an orphan home: A randomized controlled study	72	Yoga program for 3-months Stroop ColorWord Task, Digit Symbol Substitution Test (DSST), Digits Span Test and Trial Making Test (TM	Moderate effect on executive functions, attention and processing speed measures
3	Neha P. Gothe, Arthur F. Kramer and Edward McAuley	The Effects of an 8-Week Hatha Yoga Intervention on Executive Function in Older Adults	118	Hatha yoga intervention or a stretching–strengthening 8-week (Psychology Software Tools, Inc., Sharpsburg, PA) executive functions of working memory and task switching	Hatha yoga practise improved executive functions

4	Stefanie Richter et al	Yoga training in Junior primary school aged children has an impact on physical self-perceptions and problem related behavior	24	Yoga group and the physical skill training group Flankertest Physical Self-Concept Questionnaire for Chil Anxiety Questionnaire	Decrease in perceived speed in the yoga group

3.5. YOGA AND MEMORY

A study on 3 different sessions yoga session, an aerobic exercise session, and a baseline assessment on 30 participants showed post-exercise state anxiety scores were significantly lower for the yoga session and improvement in working memory was noted (N. Gothe, Hillman, & Mcauley, 2012). Another study on different domains of cognition on 87 individuals were assessed following 3 months yoga practices and offered to practice at home for 3 months after which assessments were done. The authors concluded that Yoga based-intervention appears beneficial to improve several domains of cognitive function (Hariprasad et al., 2017) (See Table 3)

Table 3: SUMMARY OF SCIENTIFIC STUDIES DONE ON YOGA AND MEMORY FUNCTIONS

SN	Author / Year	Title	Sample	Intervention and assessment	summary of findings
1	Devon Brunner, Amitai Abramovitch and Joseph Etherton 2017	A yoga program for cognitive enhancement	43	Hatha yoga Digit Span Forward, Backward and Sequencing, and Letter-Number Sequencing) Mindfulness Attention Awareness Scale working memory	Improved WM functions and mindfulness
2	Harris A Eyre et al 2016	Changes in Neural Connectivity and Memory Following a Yoga Intervention for	14	Kundalini yoga Hopkins Verbal Learning Test–Revised Rey-Osterrieth Complex Test	Yoga group improved significantly in depression (GDS) and in visuospatial memory

		Older Adults: A Pilot Study			
3	R Rangan, HR Nagendra and G Ramachandra Bhat 2009	Effect of yogic education system and modern education system on memory	49	Not specified Standard tests of Baddley	GES meant for total personality development adopting yoga way of life is more effective in enhancing visual and verbal memory scores than the MES
4	N Gothe, C Hillman and E McAuley 2012	The effect of acute yoga and aerobic exercise on word memory and anxiety	30	Yoga session, an aerobic exercise session, Spielberger's State Trait Anxiety Inventory	The post-exercise state anxiety scores were significantly lower for the yoga session
5	V R Hariprasad et al 2013	Randomized clinical trial of yoga-based intervention in residents from elderly homes: Effects on cognitive function	6month	Rey's Auditory Verbal Learning Test Rey's complex figure test Wechsler's Memory Scale (WMS)-digit and spatial span, Controlled Oral Word Association (COWA) test Stroop Color Word Interference Test	Yoga based-intervention appears beneficial to improve several domains of cognitive function
6	Rinku Garg, Varun Malhotra, Yogesh Tripathi, And Ritu Agarwal 2016	Effect of Left, Right and Alternate Nostril Breathing on Verbal and Spatial Memory	51	Right nostril breathing, Left nostril breathing and Alternative nostril breathing for 1 week 45 minutes daily Wechsler Adult Intelligent Scale	There was increase in recall of digit span-forward, digit-span backward, associate learning and spatial memory scores with RNB, LNB and ANB

3.6. ROLE OF YOGA IN COMMON HEALTH PROBLEMS THAT CAUSES COGNITIVE IMPAIRMENTS

Non-communicable diseases are major health problems are in modern society that causes cognitive impairments, disability and deteriorates quality of life. (Ricci, Pirillo, Tomassoni, Sirignano, & Grappasonni, 2017). The burden is worldwide but more in developing countries (Boutayeb, 2006). Physical inactivity is one of the major cause for developing non communicable diseases and cause cognitive impairment (Balbus et al., 2013). Thus yogic practices can play a beneficial effect to reduce the burden of cognitive impairment and non-communicable diseases (R. Sharma, Gupta, & Bijlani, 2008)

3.7. YOGA AND DIABETES

Diabetes has an impact on brain metabolism and affects cognition. A study was on role of yoga in memory decline due to diabetes and changes in brain metabolites in frontal lobe. The author concluded that yoga brings control on glycosylated hemoglobin by balancing the ANS and upgrading the parasympathetic dominance (Santhakumari, Reddy, Archana, & Rajesh, 2016). In another similar study Yogasana and Pranayama was found beneficial in controlling HBA1c and improving cognitive functions (District & State, 2017).

3.8. YOGA AND CARDIOVASCULAR DISEASE

A study comparing yoga and walking exercise on cardiac functions which included 60 individuals. The researchers found that yoga has significant effect on diastolic function and minimal change in systolic function. They concluded that yoga was effective in improving cardiac functions (Patil, Patil, Aithala, & Das, 2017). In another study Mondy et al reported the effect of yoga and cardiovascular problems in HIV patients who were 20 weeks yoga, concluded that yoga was effective in reducing the blood pressure, which is a risk for cardiovascular disease (Cade et al., 2010).

3.9. YOGA AND STRESS REDUCTION

Stress is one the component that is responsible for cognitive decline and studies suggest the effectiveness of yoga to reduce stress. A study was conducted to see the effect of yoga on work related stress and stress adaptation. A total of 12 weeks yoga sessions was given. The researchers found that yoga was effective to reduce work related stress and balance autonomic functions (Lin, Huang, Shiu, & Yeh, 2015). In another study yoga sessions were effective to reduce stress among employee and also improve psychological wellbeing (Maddux, Daukantaite, & Tellhed, 2018). Study on yoga and cortisol levels found that yoga had significant reduction in cortisol level (Sullivan, Carberry, Evans, Hall, & Nepocatych, 2017).

3.10. YOGA AND OBESITY

Obesity is one of the risks for cognitive decline. Study was conducted on effect of yoga in 72 male obese patients reported that yoga group had significant improvement in anthropometric measures and psychological parameters (Rshikesan & Subramanya, 2016). In another study showed yoga was significant impact to reduce body weight (Priya & Samaga, 2014). In another study on effect of 8 weeks yoga sessions on body composition, insulin resistance and lipid profile in obese adolescent boys found that there was reduction in total cholesterol and significant improvement in body composition of yoga group (Seo et al., 2012).

4. SCIENTIFIC STUDY

4.1. TITLE: EFFICACY OF INTEGRATED APPROACH OF YOGA THERAPY ON COGNITIVE MEASURES AND PSYCHOPATHOLOGIES AMONG ELDERLY PERSONS WITH MILD COGNITIVE IMPAIRMENT

4.2. AIM

To assess the efficacy of one-week integrated approach of yoga therapy on cognitive measures and psychological states among elderly people with mild cognitive impairment.

4.3. OBJECTIVES

(a) To assess the effect of integrated approach of yoga therapy on memory in elderly people with mild cognitive impairment.

b) To measure the impact of integrated approach of yoga therapy on attention in elderly people with mild cognitive impairment.

c) To evaluate the effect of integrated approach of yoga therapy on psychological states in elderly people with mild cognitive impairment

4.4. HYPOTHESIS AND NULL HYPOTHESIS

4.4.1 Hypothesis

Integrated yoga therapy has influence on cognitive measures and psychological functions in elderly.

4.4.2. ***Alternative hypothesis***

Integrated yoga therapy will improve cognitive measures and psychological functions in elderly.

4.4.3. ***Null hypothesis***

Integrated yoga therapy will not improve cognitive and psychological functions in elderly.

5. METHODS

5.1. STUDY PARTICIPANTS

Elderly persons (age>60 years) within age range 60-75 years with mild cognitive decline were enrolled in the study. Participants of both genders were considered.

5.2. SOURCE:

***5.2.1.* IAYT group**: Therapy participants from Arogyadhama holistic health center, Prashanthi Kutiram, Bangalore were recruited for the study.

***5.2.2* Control group**: Normal routine; Elderly people from Theerthashram J.P Nagar, Bangalore were recruited for the study.

5.3 DESIGN

Two groups pre-post design was followed

5.4. SAMPLE SIZE:

The samples collected were 49 (27 in yoga group and 22 in control group). Sample size was calculated based on previous study by Eyre et al with title "A randomized controlled trial of Kundalini yoga in mild cognitive impairment". Effect size 0.54, α value 0.05, and power 0.95. (Eyre et al., 2017). Calculated sample size is 47. With 15% drop out rate sample size was 60.

5.5 STUDY PROCEDURE

Total 85 elderly persons were screened for study criteria. 30 participants had exclusion criteria and 6 participants declined for participation.

5.5.1 Six Item Cognitive Impairment Test (6CIT)

6CIT is a brief cognitive screening tool with a limited cognitive domain (Katzman et al., 1983). Studies has been conducted and reported on the utility of 6CIT (Jefferies & Gale, 2013). Its utility also has been tested in older patients (Tuijl, Scholte, De Craen, & Van Der Mast, 2012). 6CIT has been validated in use for screening cognitive impairment (Brooke & Bullock, 1999) . It comprises one memory question, two calculation questions, and three orientation questions. The diagnostic criteria are 0–7: Normal cognition, 8–9: Mild cognitive impairment, 10 or more: Impairment consistent with dementia. Thus 6CIT was used in screening for mild cognitive impairment (Abdel-Aziz & Larner, 2015).

5.6. INCLUSION CRITERIA:

1) Elderly persons within age range 60-75 years both male and females
2) Elderly persons diagnosed with mild cognitive impairment using six item cognitive impairment test (8-9/28)
3) Capable of following yoga-instructions mentally and physically
4) Patients who were willing to participate and who can read, write and understand English language
5) Elderly individuals of both gender, who had co-morbidities

5.7. EXCLUSION CRITERIA:

1) Those that cannot follow yoga instructions

2) Those with severe cognitive decline

3) Subjects with history of head injury or stroke

4) Previous history of practicing yoga regularly in the past 6 months

5) Subjects who cannot perform the assessment tasks

6) Patients on antipsychotic medications

7) Patients with neurological conditions such as Parkinson's disease, Alzheimer's etc

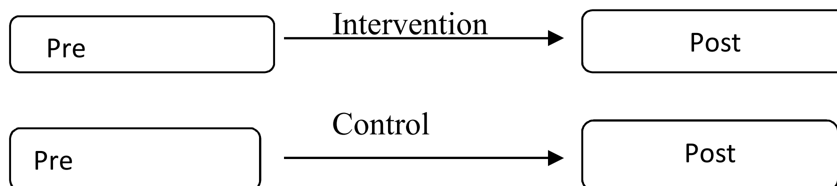
5.8. ETHICAL CONSIDERATIONS:

The study was approved by the Institutional Ethics Committee (IEC) of Swami Vivekananda Yoga Anusandhana Samsthana, Bangalore. The IEC approval letter is enclosed as **Appendix 1.**

Explanation was given to the participants about the study in detail, and a written informed consent was signed by all participants (a sample copy is enclosed in **Appendix-2**).

5.9. DESIGN:

Pre-post control design was followed



5.10. INTERVENTION

- **IAYT Group**

The patients followed the daily schedule of IAYT as follows, for 6 days

TABLE 4: Integrated approach of yoga therapy (IAYT): Daily schedule

TIME	SCHEDULE
05:30 am	Om meditation
06:00 am	Yogasana Practice
07:00 am	Breakfast
08:00 am	Spiritual discourse
09:00 am	Parameters & Counseling
10:00 am	Pranayama
11:00 am	Yogasana Practice
12:00 pm	Lecture
01:00 pm	Lunch
02:00 pm	Rest
03:00 pm	Cyclic Meditation
04:00 pm	Yogasana Practice
05:00 pm	Malt & Tuning to Nature
06:00 pm	Bhajana
06:30 pm	Trataka, Mind Sound Resonance Technique (MSRT)
07:30 pm	Dinner
10:00 pm	Bed Time

5.11 ASSESSMENTS

5.11.1 DASS-21

The Depression Anxiety Stress Scales 21 (DASS-21) is a short form of Lovibond and Lovibond's 42-item self-report measure of depression, anxiety, and stress. The reliabilities estimated using Cronbach's alpha. a are .88 for the Depression scale, .82 for the Anxiety scale, .90 for the Stress scale, and .93 for the Total scale (Henry & Crawford, 2005).

5.11.2 D2 test of Attention

The D2 test of attention is essentially a cancellation task, which measures selective attention and concentration. The d2 test is a timed test of selective attention and concentration (Brickenkamp &Zillmer, 1998). D2 test idices TN, TN-E and CP are reliable at r>0.70 and its validity has been documented by multiple clinical tests in a large number of studies.

5.11.3 Wechsler Memory Scale-Revised – Digit span forward and back ward

The Digit Forward and Digit Backward tests measure the span of attention, concentration, and mental control. It contains of two domains viz., Digit forward and digit backward test WMS-III Technical Manual indicates that internal consistency for the primary subtest scores ranges between .74 and .93 for all age groups (Groth-Marnat, 2003)

6. DATA EXTRACTION AND ANALYSIS

6.1. DATA EXTRACTION

DASS-21

There are three sub-scales: (DASS21-D), Anxiety (DASS21-A), and Stress (DASS21-S) has seven items. Each item comprises a statement and four short response options to reflect severity and scored from 0 (Did not apply to me at all) to 3 (Applied to me very much, or most of the time). In order to yield equivalent scores to the full DASS 42, the total score of each scale is multiplied by two and ranges from 0 to 42.

D2 test of attention

The test, consist of 14 lines, each comprised of 47 characters for a total of 658 items. The test items are composed of the characters "d" and "p" with one to four dashes, arranged either individually or in pairs above and below the letter. The subject is required to scan across each line to identify and cross out all "d's" with two dashes. The subject is allowed 20 seconds per line. Scoring is done with the help of two scoring keys. TN (total number of items processed) is a quantitative, timed measure of all items (both relevant and irrelevant items) that were processed. E (errors) is the sum of all mistakes which includes errors of omission (E1) and the less common errors of commission (E2). TN-E is the total number of items scanned minus error scores (E1+E2). CP (concentration performance) is derived from the number of the correctly crossed out relevant items ("d" with two dashes) minus the errors of commission (E2). E % (percentage of errors) corresponds to the accuracy and the carefulness of performance. TN-E (total performance), and CP (concentration performance) are measures of overall performance on the test.

Wechsler Memory Scale-Revised – Digit span forward and back ward

The participants listen to verbally present digits' sequences (e.g., 6 -9 -4) at a rate of one per second. After every sequence, the participants were asked to reproduce the string in the same order as given by the examiner (forward span; e.g., 6 -9 -4), or in the reverse order (backward span; e.g., 4 -9 -6). The digit sequences consist of a randomly picked number from 0 to 9, so that no calculation or serial association can perform. The first span included two numbers. The consecutive span has one more digit and so on until the last span included nine digits in forward test. While two to eight digits in the backward test. The score was the total number of correct trials, before failing two consecutive trials at any one span size or when a full digit number repeated successfully (P. M. Moore & Baker, 1997).

6.2. DATA ANALYSIS

The data were tabulated and analysed using SPSS statistical package version 16 (IBM Corp., Chicago). The data those were normally distributed using Shapiro-Wilk's test was used. Paired samples t-test was performed to assessed the within group changes for the assessments at baseline and following one week of intervention period. Independent sample t- test was performed to assess two group comparison at baseline and following one week of intervention.

7. RESULTS

In present study, variables were taken at baseline and after one week of IAYT intervention in yoga group and after one week of normal daily routine in control group. Table 5 shows the demographic characteristics and baseline line comparison of two groups. There were 27 participants in yoga group (14 males and 13 females) and 22 (10 males and 12 females) participants in the control group. There was no significant difference in both yoga and control group at baseline in terms of age, gender distribution and anxiety depression, stress and cognitive assessment score, suggesting that both groups were comparable (See Table 5).

Table 5: Demographic characteristics of participants

VARIABLE	YOGA	CONTROL	P value	TOTAL
Number of participants	27	22		49
Gender	Male - 14 Female - 13	Male- 10 Female- 12		
Age(years)	66.22 ± 5.45	70.45 ± 3.88		68.09 ±5.20
Education (Years)	5- 18 (14.53)	5-18 (12.22)		13.59 ± 3.16
Handed Right	27	22		49

Left	0	0		0
SBP	124.94 ± 6.94	126.09 ± 14.22	0.79	
DBP	76.69 ± 8.34	79.36 ± 8.40	0.26	
PR	77.13 ± 10.55	72.95 ± 7.14	0.28	
Dass_S	12.81± 8.49	12.09 ± 5.67	0.87	
Dass_ A	8.44 ± 6.94	9.82 ± 6.41	0.38	
Dass_D	8.87 ± 7.13	9 ± 5.81	0.84	
DS_F	8.31 ± 1.55	6.62 ± 1.40	0.62	
DS_B	7.03 ± 1.38	5.86 ± 1.28	0.12	
TN	183.63±32.27	170.27 ± 21.56	0.1	
E	153 ± 37.84	165.09 ± 20.11	0.18	
TN-E	30.84± 45.98	11.64 ± 48.15	0.15	

CP	158.88 ± 22.40	141.41 ±35.11	0.13	

7.1. WITHIN GROUP COMPARISONS

Yoga Group

Within group comparisons showed significant decrease in stress (p<0.001, ES= 0.74), anxiety (p<0.001, ES=0.76), depression, (p<0.001, ES=0.74) in the yoga group after one week compared to baseline. Working memory which was assessed through digit forward and backward also significantly improved (p<0.001, ES=0.61) in yoga group compared to baseline. Selective and sustained assessed through D2 attention was also improved (p<0.001, ES=1.09) in yoga group after one week of intervention compared to baseline. Variables Systolic Blood pressure (SBP), Diastolic Blood pressure (DBP) and Pulse rate (PR) did not show any significant changes. (See table 6)

Table 6, showing changes in Yoga group

Variable	Yoga Group		% change	95% CI		P value	Effect size
	Baseline (M±SD)	Follow up (M±SD)		Lower	Upper		
SBP	124.94 ± 6.94	123.81± 13.24	-1%	-3.316	5.566	.609	0.11
DBP	76.69 ± 8.34	78.06 ± 13.19	2%	-5.390	2.640	.490	0.12
PR	77.13 ± 10.55	75.88 ± 6.69	-2%	-1.535	4.035	.367	0.14
Dass_S	12.81± 8.49	7.56 ± 5.37**	-41%	-1.851	-.586	P<0.001	0.74
Dass_A	8.44 ± 6.94	4.06 ± 4.20**	-52%	-1.725	-.650	P<0.001	0.76
Dass_D	8.87 ± 7.13	3.81 ± 6.43**	-57%	1.598	3.527	P<0.001	0.74

DS_F	8.31 ± 1.55	9.53 ± 2.38**	15%	0.918	2.894	P<0.001	0.61
DS_B	7.03 ± 1.38	8.22 ± 1.88**	17%	.876	3.249	.001	0.72
TN	183.63 ± 32.27	193.94 ± 30.68	6%	-20.942	.317	.057	0.33
E	153 ± 37.84	111.31 ±29.04**	-27%	28.337	55.038	P<0.001	1.24
TN-E	30.84± 45.98	80.59 ± 55.58**	161%	-66.013	-33.487	P<0.001	0.98
CP	158.88 ± 22.40	185.94 ±26.95**	17%	-35.543	-18.582	P<0.001	1.09

Abbreviations: **: p<0.001, M: Mean, SD: Standard Deviation, CI: Confidence interval, SBP: ES: Effect size, Systolic Blood Pressure, DBP: Diastolic Blood Pressure, PR: Pulse Rate, Dass_S: Stess, Dass_A: Anxiety, Dass_D: Depression, DS_F: Digit Span Forward, DS_B: Digit Span Backward, TN: Total Number, E: Error, TN-E: Total Number- Error, CP: Concentration performance.

Control Group

In control group, stress (p=0.03, EF= 0.10) was reduced significantly after the duration of one week. Other variables Systolic Blood pressure (SBP), Diastolic Blood pressure (DBP), Pulse rate (PR), Anxiety (Dass_A), Depression (Dass_ D), Digit span forward (DSF), Digit span backward (DSB), Total number processed (TN), Error (E), TN-E and Concentration performance (CP) did not show any significant changes. (See table 7)

Table 7, showing changes in Control group

Variables	Control Group		% change	95% CI		Pvalue	Effect Size
	Baseline (M±SD)	Followup (M±SD)		Lower	Upper		
SBP	126.09 ± 14.22	125 ± 13.02	-1%	0.45	4.035	.450	0.08
DBP	79.36 ± 84.40	78.82 ± 6.92	-1%	0.586	2.597	.586	0.01
PR	72.95 ± 73.14	73.14 ± 16.81	0%	0.911	3.160	.911	0.00
Dass_S	12.09 ± 5.67	11.54 ± 5.38*	-5%	0.03	.517	.030	0.10
Dass_ A	9.82 ± 6.41	7.64 ± 5.29	-21%	0.162	.079	.162	0.37
Dass_D	9 ± 5.81	7.09 ± 4.08	-25%	0.435	.986	.435	0.38
DS_F	6.62 ± 1.40	6.55 ± 2.84	-1%	0.092	2.177	.092	0.03
DS_B	5.86 ± 1.28	6.05 ± 1.40	3%	0.101	2.111	.101	0.14
TN	170.27 ± 21.56	172.86 ± 3.38	2%	0.384	3.222	.384	0.17
E	165.09 ± 20.11	166.09 ± 24.01	1%	0.811	7.580	.811	0.05
TN-E	11.64 ± 48.15	6.59 ± 41.38	-43%	0.578	23.599	.578	0.11
CP	141.41 ± 35.11	148.14 ± 20.59	5%	0.38	8.874	.380	0.23

Abbreviations: M: Mean, SD: Standard Deviation, CI: Confidence interval, EF: Effect Size, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, PR: Pulse rate, Dass_S: Stess, Dass_A: Anxiety, Dass_D: Depression, DS_F: Digit span Forward, DS_B: Digit span backward, TN: Total Number, E: Error, TN-E: Total Number- Error, CP: Concentration performance.

7.2. BETWEEN GROUP COMPARISONS

In between group comparison working memory assessed through digit span forward and backward ($p<0.001$, ES=0.42), selective and sustained attention ($p<0.001$, ES= 0.34) assessed through D2 attention, was significantly improved. But there was no significant

change in variables Systolic Blood pressure (SBP) (p= 0.794, ES= 0.10), Diastolic Blood pressure (DBP) (p= 0.26, ES=0.32), Pulse rate (PR) (p= 0.28, 0.46), Stress (Dass_S) (p= 0.874, ES=0.10), Anxiety (Dass_A) (p=0.87, ES=0.21) ,Depression (Dass_D) (p= 0.84, ES=0.02), Total number processed (TN) (p= 0.096, ES=0.49), Error (E) (p= 0.177, ES=0.40) and TN-E (p= 0.145, ES=0.41) showed no significant difference in between group comparison. **(See Table 8)**

Table 8 showing post between group changes

Variables	Yoga_Post (M±SD)	Control_Post (M±SD)	95% CI		P value	Effect size
			Lower	Upper		
SBP	124.94 ± 6.94	126.09 ± 14.22	-8.49	6.12	0.79	0.10
DBP	76.69 ± 8.34	79.36 ± 84.40	-6.92	5.41	0.26	0.32
PR	77.13 ± 10.55	72.95 ± 73.14	-3.86	9.33	0.28	0.46
Dass21 S	12.81± 8.49	12.09 ± 5.67	-3.64	-0.60	0.87	0.10
Dass21 A	8.44 ± 6.94	9.82 ± 6.41	-3.32	-.023	0.38	0.21
Dass 21 D	8.87 ± 7.13	9 ± 5.81	-2.57	0.75	0.84	0.02
DSF	9.53 ± 2.38**	6.55 ± 1.40	1.84	4.12	P<0.001	0.42
DSB	8.22 ± 1.88**	6.05 ± 1.43	1.22	3.13	p<0.001	0.69
TN	183.63 ± 32.27	170.27 ± 21.56	5.71	36.80	0.10	0.49
E	153 ± 37.84	165.09 ± 20.11	-69.85	-39.70	0.18	0.40
TN-E	30.84± 45.98	11.64 ± 48.15	46.03	101.97	0.14	0.41
CP	185.94 ± 26.95**	148.14 ± 20.59	24.14	51.46	P<0.001	0.34

Abbreviations: **: p<0.001, M: Mean, SD: Standard Deviation, CI: Confidence Interval, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, PR: Pulse rate, Dass_S: Stess, Dass_A: Anxiety, Dass_D: Depression, DSF: Digit span Forward, DSB: Digit span backward, TN: Total Number, E: Error, TN-E: Total Number- Error, CP: Concentration performance.

Figure 2 Pre-post changes in Systolic blood Pressure (SBP) in the yoga and control group following one-week intervention

Values are group Mean±SD

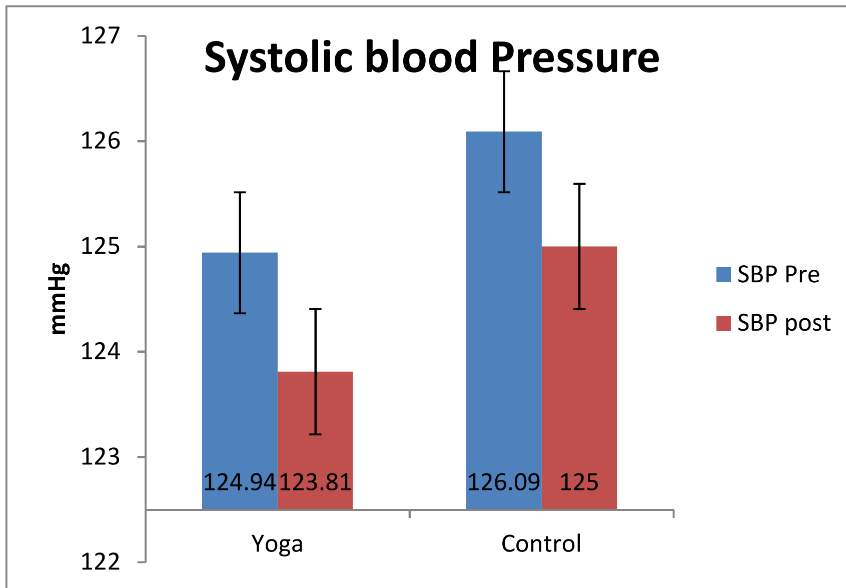


Figure3 Pre-post changes in Diastolic Blood Pressure (DBP) in the yoga and control group following one week intervention

Values are group Mean±SD

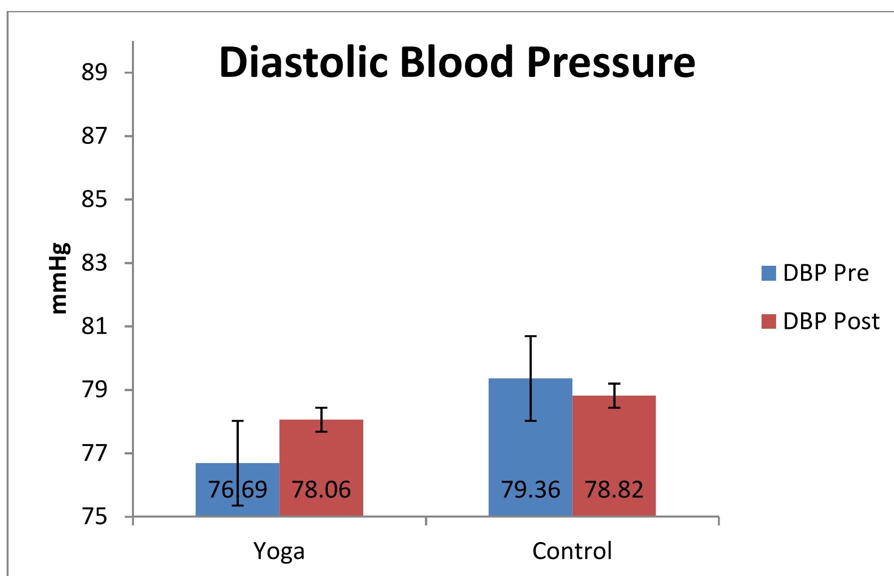


Figure 4 Pre-post changes in Pulse Rate (PR) in the yoga and control group following one-week intervention

Values are group Mean±SD

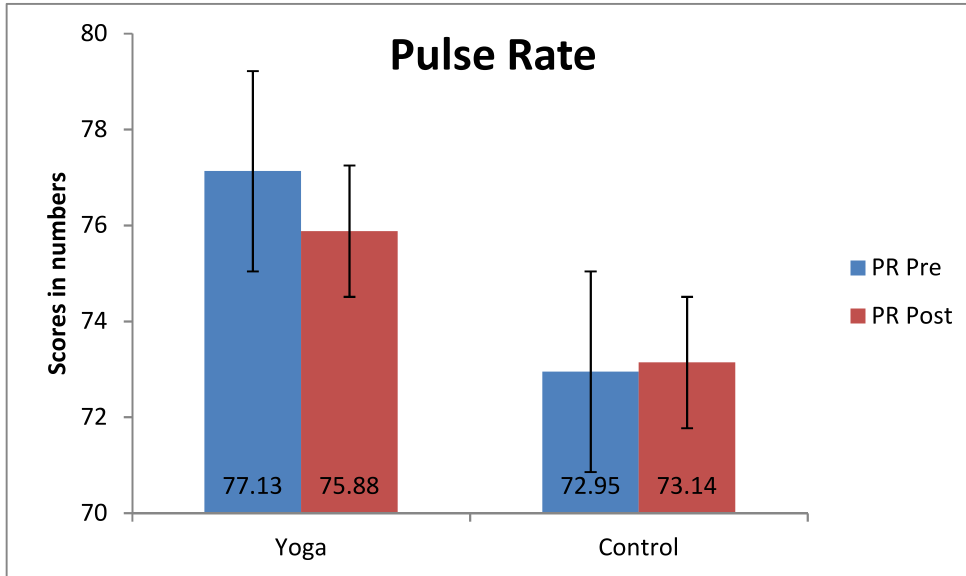


Figure 5 Pre-post changes in Dass21 Stress (Dass 21 S) in the yoga and control group following one week intervention

Values are group Mean±SD

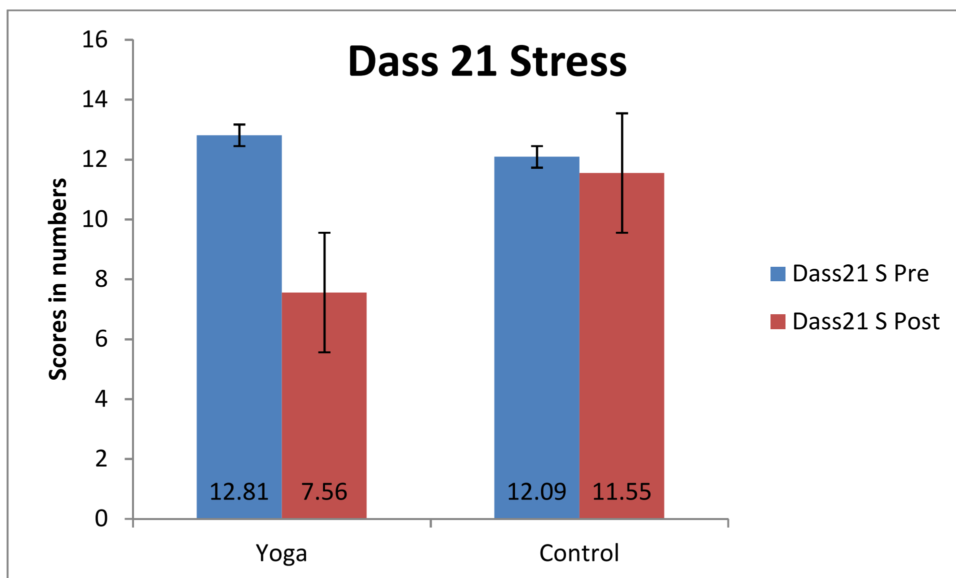


Figure 6 Pre-post changes in Dass 21 Anxiety (Dass21 A) in the yoga and control group following one-week intervention

Values are group Mean±SD

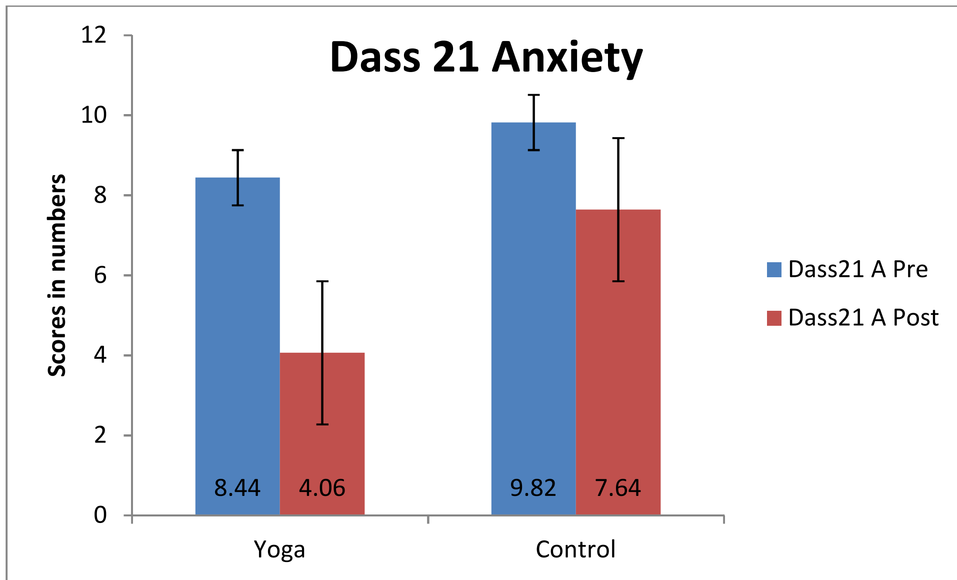


Figure 7 Pre-post changes Figure Changes in Dass 21 Depression (Dass21 D) in the yoga and control group following one-week intervention

Values are group Mean± SD

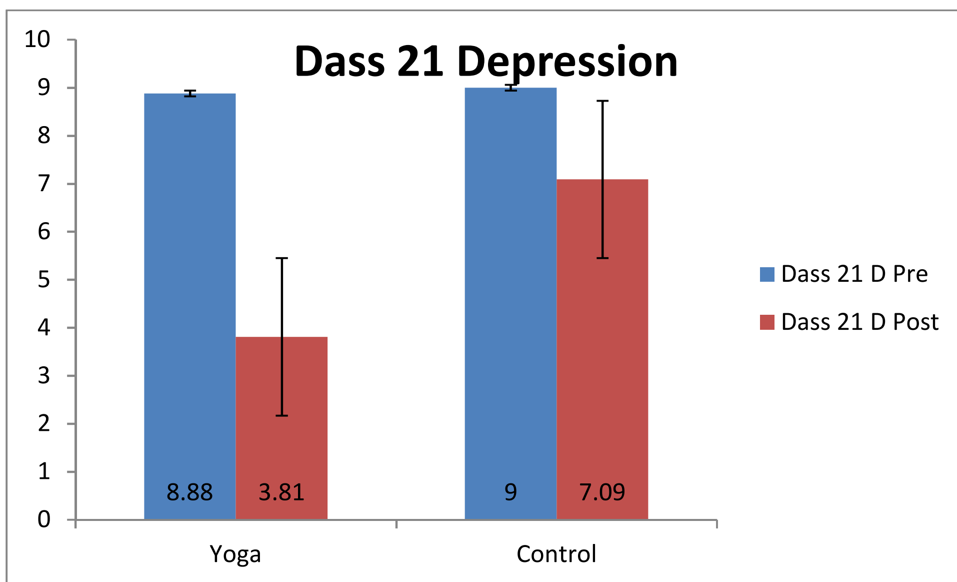


Figure 8 Pre-post changes in Digit span forward (DS_F) in the yoga and control group following one-week intervention

Values are group Mean±SD

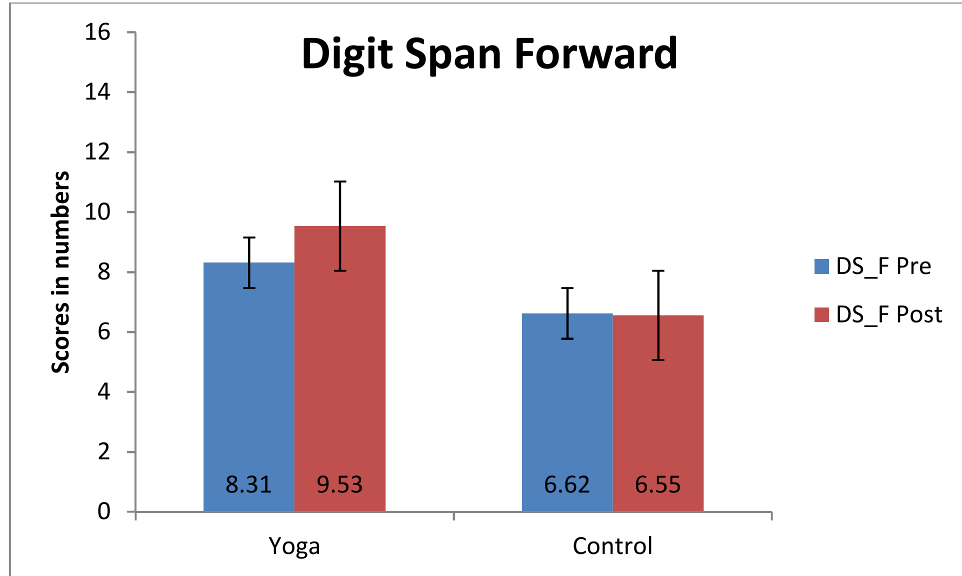


Figure 9 Pre- post changes in Digit Span Backward (DS_B) in the yoga and control group following one-week intervention

Values are group Mean± SD

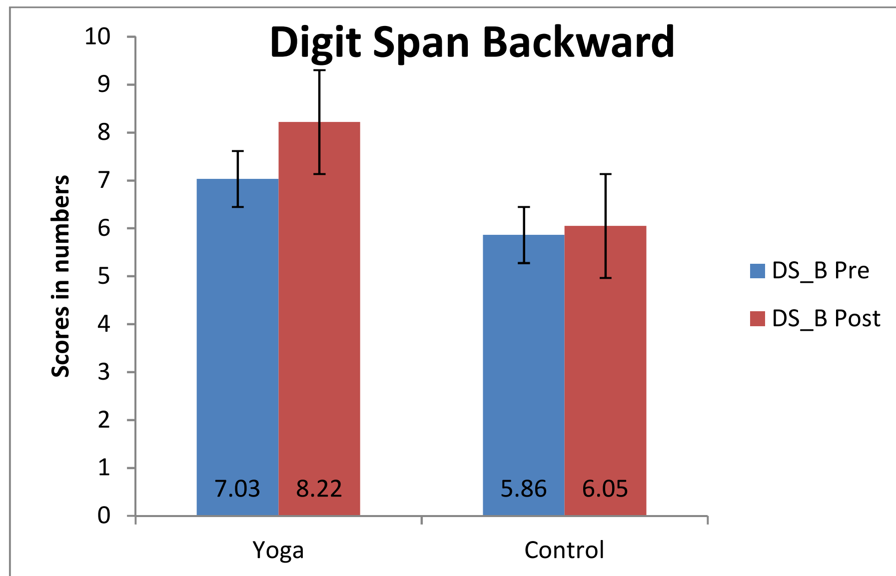


Figure 10 Pre- post changes in Total Number processed (TN) in the yoga and control group following one-week intervention

Values are group Mean± SD

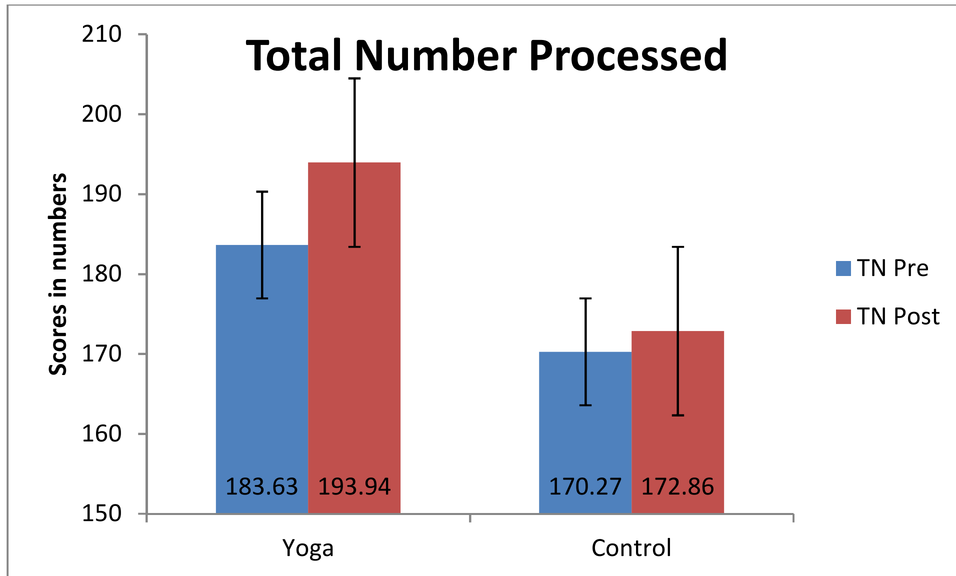


Figure 11 Pre- post changes in Error (E) in the yoga and control group following one-week intervention

Values are group Mean± SD

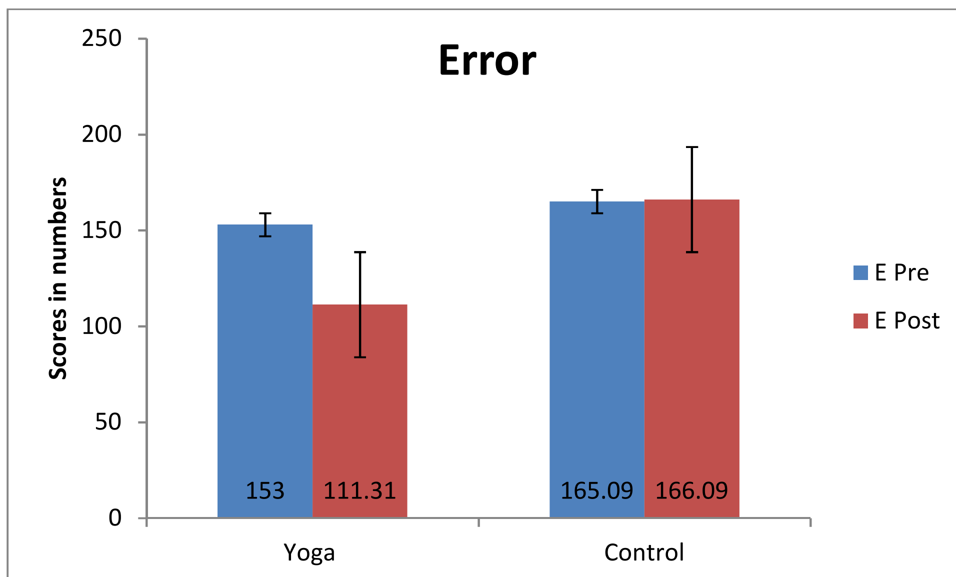
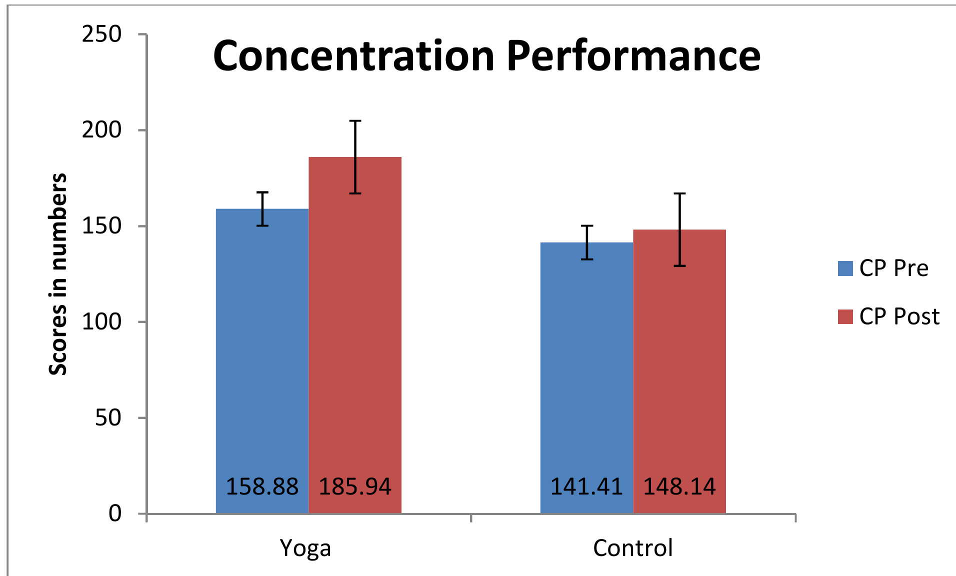


Figure 12 Pre-post changes in Concentration Performance (CP) in the yoga and control group following one-week intervention

Values are group Mean± SD



8. DISCUSSION

8.1 SUMMARY OF THE RESULTS

In present study, we found that one week of residential IAYT intervention have beneficial effect on mental health and cognition among elderly people with mild cognitive impairment. Control group showed no improvement.

Residential IAYT intervention is considered to be a comprehensive yoga intervention which encompasses many lifestyle components such as diet, physical activity, stress etc. it includes different counselling, relaxation techniques and laughter therapy as well. Findings of previous studies on IAYT are in support with the present findings.

Cognitive impairment is a most common condition reported by elderly person and is one of the important risk factors for severe form of neurodegenerative problems such as dementia and Alzheimer's disease (Morris et al., 2001). In the present study IAYT intervention found to be effective in improving cognitive facets such as memory, attention and concentration. It also found to improve mental health by reducing anxiety depression and stress.

8.2. COMPARISON WITH PREVIOUS STUDY

To the best of our knowledge, this is the first study to assess the effect of integrated approach of yoga therapy on cognition and psychopathologies among elderly persons with mild cognitive impairment.

Previous study has shown that decline in vascular reserve capacity was associated with decline in cognition (Novak & Hajjar, 2010), one week IAYT intervention was useful to

improve baroreflex sensitivity, systolic blood pressure and total peripheral resistance in hypertensive patients (K.G. et al., 2017),.Kirtan Kriya Meditation program (KKM) and Kundalini Yoga (KY), given to 15 adults diagnosed with mild cognitive impairment for 8 weeks and was found to improve depression and anxiety scores and memory scores suggestive of enhancement in cognitive and psychological wellbeing (Borras-Boneu et al., 2016). In another study Kundalini yoga training was given to 81 older people with mild cognitive impairment and assessed after 12 weeks and 24 weeks and showed short term and long term improvements in executive functions (Eyre et al., 2017). Previous study yoga was given to 7 healthy elderly and magnetic resonance images were obtained after 6months, showed improvement in volume of hippocampus, suggestive to reduce age related cognitive decline (Gangadhar et al., 2013). In another study 7 week yoga was found to useful to improve mental and emotional well- being as well as reduce stress levels in elderly (Lindahl et al., 2016).

Our study also showed similar results in improving working memory and decreasing stress, anxiety and depression among elderly people. Compared to other studies where only yoga practices were given, IAYT group in our study also underwent spiritual lectures, counseling. Yogic kriyas and satsang, which further helped to motivate elderly people.

8.3. POSSIBLE MECHANISM

The exact mechanism how the IAYT intervention leads to improvement in cognition and mental health is not known. However, decrease in anxiety following IAYT intervention may be attributed decreased activation of HPA axis which is associated with reduced anxiety response (Dieleman et al., 2015). Yoga also plays role in autonomic nervous

system. It helps to maintain homeostasis and decrease shift from sympathetic to parasympathetic dominanace (Murugesan et al. 2000; Selvamurthy et al. 1998), which is associated to reduction in stress.

Enhanced physical activity is also known to improve depression and cognition (Ströhle, 2009), Yoga is also known to increase various good hormones such as serotonin which is associated to reduction in the depression (Rocha et al., 2012). Different Asanas and Pranayama needs the focused attention in the body part during the practice, this might have helped in improving the attention and concentration following IAYT (Ashraf Khazaei, Yousefi, & Kahrizi, 2014). Decreased stress and anxiety is associated with enhanced memory (Luethi, 2008). Also the GABA levels have been associated with higher urgency (impulsivity) and lower automatic motor control and poor decision making ability. Yoga is known as a natural means to improve GABA levels, this might have helped to improve cognitive abilities (Streeter et al., 2010).

9. APPRAISALS

9.1. CONCLUSION

One week of IAYT intervention showed improvement in mental health and cognitive function among elderly with mild cognitive impairment. However, further studies need to be encouraged with larger sample size and robust research design.

9.2. STRENGTH OF THE STUDY

Screening test was done to assess mild cognitive impairment in elderly. Control group was included to measure difference with intervention group. Along with yoga practices participants also received spiritual discourse, counseling, yogic kriyas and satsang. This study highlights stress reduction in intervention group which benefits in age related cognitive decline.

9.3. LIMITATIONS OF THE STUDY

The study has several limitations. The sample size was small. For better understanding yoga effects of yoga in elderly with mild cognitive impairment people larger sample has to be taken. Also, there was short duration of intervention. Effects of yoga is limited with a week duration; thus, a longer duration of yoga intervention should be preferred. There was no use of objective methods to evaluate variables.

9.4. SUGGESTIONS FOR FUTURE STUDY

Larger sample with longer duration of intervention should be used to specify usefulness of IAYT in elderly. In future, randomized controlled design should be done.

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APPENDIX 1

ETHICAL CLEARANCE CERTIFICATE

स्वामी विवेकानन्द योग अनुसंधान संस्थान

Swami Vivekananda Yoga Anusandhāna Samsthāna

(Declared as Deemed-to-be University under Section 3 of the UGC Act, 1956)

Eknath Bhavan, # 19, Gavipuram Circle, Kempegowda Nagar, Bangalore - 560 019

Ph: 080 - 2661 2669, Telefax: 080 - 2660 8645

E-mail: svyasa@svyasa.org Website: www.svyasa.org

RES/IEC-SVYASA/112/2017 **17 October 2018**

To,
Dr. Pukar Lohani,
MD Scholar,
S-VYASA University,
Bengaluru.

Reference:

"Effect of Integrated Approch of Yoga Therapy on cognitive functions in elderly people with mild cognitive impairment", - Committee Approval of the above mentioned study.

Dear Dr. Pukar Lohani,

We have received from you the following study related documents vide your letter dated 13 September 2018.

1	Project Proposal
2	Informed consent form

Ethics committee meeting was held on **02 December 2017** between 2:00 PM and 5:00 PM at Eknath Bhavan, Bengaluru. Above documents were examined and discussed in the meeting. After due consideration, the committee has decided to approve conducting the aforementioned study.

APPROVED

INSTITUTIONAL ETHICS COMMITTEE
SVYASA, BANGALORE

स्वामी विवेकानन्द योग अनुसंधान संस्थान
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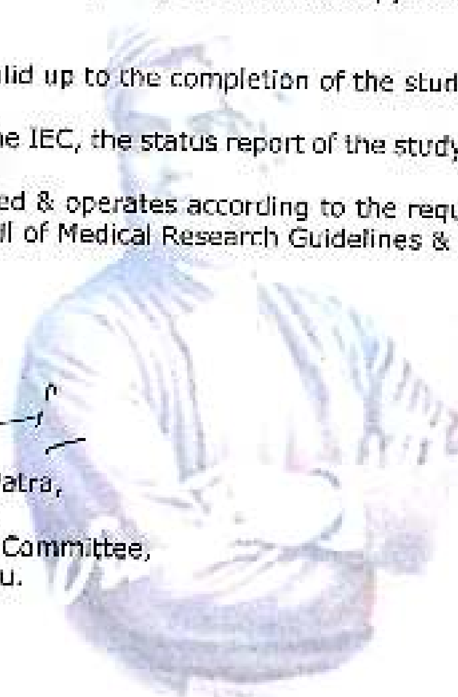
Ph: 080 - 2661 2669, Telefax: 080 - 2660 8645
E-mail: svyasa@svyasa.org Website: www.svyasa.org

This is to confirm that neither Dr. Pukar Lohani nor any staff participating in this study were involved in the voting procedures and decision making.

The Institutional Review Board / Institutional Ethics Committee (IEC) are expected to be informed about the progress of the study / any changes in the protocol and patient information / informed consent. The investigators are also expected to submit a copy of the final report to IEC for records.



This approval is valid up to the completion of the study at the site.

Please submit to the IEC, the status report of the study as per the SOPs.

The IEC is organized & operates according to the requirements of ICH-GCP, Indian Council of Medical Research Guidelines & Schedule Y.

Best Wishes,

Dr. Sanjib Kumar Patra,
Member Secretary,
Institutional Ethics Committee,
S-VYASA, Bengaluru.

APPENDIX 2

INFORMED CONSENT FORM

Swami Vivekananda Yoga Anusandhana Samsthana

#19, EkanathBhavan, K.G. Nagar, Bangalore -560019

This informed consent form is for the men and women whom we are inviting to participate in the study titled "**EFFICACY OF INTEGRATED APPROACH OF YOGA THERAPY ON COGNITIVE MEASURES AND PSYCHOPATHOLOGIES AMONG ELDERLY PERSONS WITH MILD COGNITIVE IMPAIRMENT**".

Name of the principal investigator: Dr. Pukar Lohani

Name of the organization: S-VYASA, Bengaluru

PART I

Introduction

I, Dr Pukar Lohani, would like to provide you information and invite you to be part of a research study on efficacy of integrated approach of yoga therapy on cognitive measures and psychopathologies among elderly persons with mild cognitive impairment. Before you make a decision about the participation in the study, feel free to talk to anyone you feel comfortable to make an appropriate choice. The data will be collected on the day of admission and discharge and will not be providing any extra treatments.

There may be some words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain. If you have questions later, you can ask them of me.

Purpose of the study

Cognitive impairment is common among elderly. The purpose of this study is to find out whether integrated approach of yoga has effect in elderly people with mild cognitive impairment.

Type of Research Intervention

This research will involve you being included in yoga group after your selection in consultation with our consultants at Arogyadhama Holistic Health Centre, Bangalore.

Voluntary Participation

Your participation in this study is entirely voluntary. It is your choice whether to participate or not. Whether you choose to participate or not, all the services you receive at this centre will continue and nothing will change. If you choose not to participate in the study, you will be offered the treatment that is routinely offered in this centre for osteoarthritis. You can discontinue your participation from the study an any point of time, even after you initially have agreed to participate.

Procedures and Protocol

Yoga Group: The standardized Integrated Approach of Yoga Therapy (IAYT) protocol for mild cognitive impairment will be provided inclusive of SukshamaVyayama, ShithilikaranaVyayama, Asana, Pranayama, Kriya and Meditation practices.

Control Group: Normal daily routine

Potential Health benefits to you or to others

This research study will help decreasing your pain and disability. It helps in improving the quality of life and enhances the functional status.

Compensation for research related injury:

In the unlikely event of your sustaining a physical injury arising out of this study, primary care will be provided at Swami Vivekananda Yoga Research Foundation without any extra charges. However, the investigators will not be able to provide any monitory compensation in any such event for any treatments suggested other than the primary care. In case of any adverse events due to therapy while intervention participant will be provided primary care first at SVYASA if required participant will be referred to nearby higher health care center.

Alternatives to participating in this research study

Since, participation in this study is purely voluntary and if you choose to participate, you are free to withdraw your consent and discontinue participation in this research study at any time by giving it in writing without this decision affecting your medical care provided to you during the study. If you have any question regarding your rights as a subject, you may phone the Institutional Ethics Committee office at (080) 22639906.

Withdrawal from this research study

You do not have to take part in this research if you do not wish to do so and refusing to participate will not affect your treatment at this center in any way. You will still have all the benefits that you would otherwise have at this center. You may stop participating in

the research at any time that you wish without losing any of your rights as a patient here. Your treatment at this Centre will not be affected in any way.

Confidentiality

The information that we collect from this research project will be kept confidential. Information about you that will be collected during the research will be put away and no-one but the researchers will be able to see it. Any information about you will have a number on it instead of your name. Only the researchers will know what your number is and we will lock that information up with a lock and key. It will not be shared with or given to anyone except Dr Kashinath Metri and Dr Apar Saoji who will be guiding me in my research.

Whom to Contact

If you have any questions you may ask them now or later, even after the study has started. If you wish to ask questions later, you may contact any of the following:

Dr Pukar Lohani: 8050468079 , pukarlohani@gmail.com

Dr Kashinath Metri ,9035257626 , kgmhetre@gmail.com

DrAparSaoji: 8970345905, aparsaoji@gmail.com

PART II: Certificate of Consent

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily to participate as a participant in this research.

Name of Participant__________________

Signature of Participant ___________________

Date ___________________________

Day/month/year

Statement by the researcher/person taking consent

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands that the following will be done:

1.

2.

3.

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this ICF has been provided to the participant.

Name of Researcher/person taking the consent________________________

Signature of Researcher /person taking the consent__________________________

Date ___________________________

Day/month/year

APPENDIX 3

SCREENING TOOL

Six Item Cognitive Impairment Test (6CIT)

(6CIT - Kingshill Version 2000, Dementia screening tool)

Patient's Details:	Date: Name of Assessor:

Question	Score Range	Score
1. What year is it?	0 – 4 Correct - 0 points Incorrect – 4 points	
2. What month is it?	0 – 3 Correct – 0 points Incorrect – 3 points	
3. Give the patient an address phrase to remember with 5 components, eg **John, Smith, 42, High St, Bedford**		
4. About what time is it (within 1 hour)	0 – 3 Correct – 0 points Incorrect – 3 points	
5. Count backwards from 20-1	0- 4 Correct - 0 points 1 error – 2 points More than 1 error – 4 points	
6. Say the months of the year in reverse	0- 4 Correct - 0 points 1 error – 2 points More than 1 error – 4 points	
7. Repeat address phrase **John, Smith, 42, High St, Bedford**	0 – 10 Correct - 0 points 1 error – 2 points 2 errors – 4 points 3 errors – 6 points 4 errors – 8 points All wrong – 10 points	
TOTAL SCORE	0 – 28	/28

Outcome from Score

0-7 = normal	Referral not necessary at present
8- 9 = mild cognitive impairment	Probably refer
10-28 = significant cognitive impairment	Refer

APPENDIX 4

ASSESSMENT TOOLS

Name: ____________________

Age: ______ Sex: ☐ male ☐ female

Handedness: ☐ L ☐ R

Years of education: ____________________

Occupation: ____________________

d2 Test of Attention

Rolf Brickenkamp & Eric A. Zillmer

Examiner: ______________ Date: ________

Example: d d d

Practice line: d p d d d d p d d p d d d d p p d d d p d d

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

	Raw Score	Percentage	Percentile Rank	Standard Score
TN (total number)				
Omissions: E1				
Commissions: E2				
E (errors)				
TN-E (total-errors)				
CP(concentration performance)				
FR (fluctuation rate)				

S-Syndrome: ☐

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Order number #01 013 22

		TN	E_1	E_2	CP
1	d d p d d d p p d p d d d d d p d p d d d p p d d d d d d p d p d d p p d d d d p p d p d d p				
2	p d p p d d d d p d p d d d p d d p d p d p d d p d p d d d d p d p d p d p d d d d p d p d d				
3	d d d d p p d p d p p p d d p d p d p d d p d p d d p d p p d d d d p d d p d p d d d d d p d				
4	d d p d d d p p d p d d d d d p d p d d d p p d d d d d d p d p d d p p d d d d p p d p d d p				
5	p d p p d d d d p d p d d d p d d p d p d p d d p d p d d d d p d p d p d p d d d d p d p d d				
6	d d d d p p d p d p p p d d p d p d p d d p d p d d p d p p d d d d p d d p d p d d d d d p d				
7	d d p d d d p p d p d d d d d p d p d d d p p d d d d d d p d p d d p p d d d d p p d p d d p				
8	p d p p d d d d p d p d d d p d d p d p d p d d p d p d d d d p d p d p d p d d d d p d p d d				
9	d d d d p p d p d p p p d d p d p d p d d p d p d d p d p p d d d d p d d p d p d d d d d p d				
10	d d p d d d p p d p d d d d d p d p d d d p p d d d d d d p d p d d p p d d d d p p d p d d p				
11	p d p p d d d d p d p d d d p d d p d p d p d d p d p d d d d p d p d p d p d d d d p d p d d				
12	d d d d p p d p d p p p d d p d p d p d d p d p d d p d p p d d d d p d d p d p d d d d d p d				
13	d d p d d d p p d p d d d d d p d p d d d p p d d d d d d p d p d d p p d d d d p p d p d d p				
14	p d p p d d d d p d p d d d p d d p d p d p d d p d p d d d d p d p d p d p d d d d p d p d d				

DASS21

Name: *Date:*

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you *over the past week*. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

0 Did not apply to me at all
1 Applied to me to some degree, or some of the time
2 Applied to me to a considerable degree, or a good part of time
3 Applied to me very much, or most of the time

1	I found it hard to wind down	0	1	2	3
2	I was aware of dryness of my mouth	0	1	2	3
3	I couldn't seem to experience any positive feeling at all	0	1	2	3
4	I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion)	0	1	2	3
5	I found it difficult to work up the initiative to do things	0	1	2	3
6	I tended to over-react to situations	0	1	2	3
7	I experienced trembling (eg, in the hands)	0	1	2	3
8	I felt that I was using a lot of nervous energy	0	1	2	3
9	I was worried about situations in which I might panic and make a fool of myself	0	1	2	3
10	I felt that I had nothing to look forward to	0	1	2	3
11	I found myself getting agitated	0	1	2	3
12	I found it difficult to relax	0	1	2	3
13	I felt down-hearted and blue	0	1	2	3
14	I was intolerant of anything that kept me from getting on with what I was doing	0	1	2	3
15	I felt I was close to panic	0	1	2	3
16	I was unable to become enthusiastic about anything	0	1	2	3
17	I felt I wasn't worth much as a person	0	1	2	3
18	I felt that I was rather touchy	0	1	2	3
19	I was aware of the action of my heart in the absence of physical exertion (eg, sense of heart rate increase, heart missing a beat)	0	1	2	3
20	I felt scared without any good reason	0	1	2	3
21	I felt that life was meaningless	0	1	2	3

3. Digit Span

Start
Ages 16–90
Forwards: Item 1
Backwards: Sample Item, then Item 1
Sequencing: Sample Item, then Item 1

Discontinue
Forwards: After scores of 0 on both trials of an item
Backwards: After scores of 0 on both trials of an item
Sequencing: After scores of 0 on both trials of an item

Score
Score 0 or 1 point for each trial
DSF, DSB, and DSS
Total raw score for Forwards, Backwards, and Sequencing, respectively
LDSF, LDSB, and LDSS
Number of digits recalled on last trial scored 1 point on Forwards, Backwards, and Sequencing, respectively

Forwards

	Item	Trial	Response	Trial Score	Item Score
16–90 ➔	1.	9 – 7		0 1	0 1 2
		6 – 3		0 1	
	2.	5 – 8 – 2		0 1	0 1 2
		6 – 9 – 4		0 1	
	3.	7 – 2 – 8 – 6		0 1	0 1 2
		6 – 4 – 3 – 9		0 1	
	4.	4 – 2 – 7 – 3 – 1		0 1	0 1 2
		7 – 5 – 8 – 3 – 6		0 1	
	5.	3 – 9 – 2 – 4 – 8 – 7		0 1	0 1 2
		6 – 1 – 9 – 4 – 7 – 3		0 1	
	6.	4 – 1 – 7 – 9 – 3 – 8 – 6		0 1	0 1 2
		6 – 9 – 1 – 7 – 4 – 2 – 8		0 1	
	7.	3 – 8 – 2 – 9 – 6 – 1 – 7 – 4		0 1	0 1 2
		5 – 8 – 1 – 3 – 2 – 6 – 4 – 7		0 1	
	8.	2 – 7 – 5 – 8 – 6 – 3 – 1 – 9 – 4		0 1	0 1 2
		7 – 1 – 3 – 9 – 4 – 2 – 5 – 6 – 8		0 1	

LDSF (Max = 9)

Digit Span Forwards (DSF) Total Raw Score (Maximum = 16)

Backwards

	Item	Trial	Correct Response	Response	Trial Score	Item Score
16–90 ➔	S.	7 – 1	1 – 7			
		3 – 4	4 – 3			
16–90 ➔	1.	3 – 1	1 – 3		0 1	0 1 2
		2 – 4	4 – 2		0 1	
	2.	4 – 6	6 – 4		0 1	0 1 2
		5 – 7	7 – 5		0 1	
	3.	6 – 2 – 9	9 – 2 – 6		0 1	0 1 2
		4 – 7 – 5	5 – 7 – 4		0 1	
	4.	8 – 2 – 7 – 9	9 – 7 – 2 – 8		0 1	0 1 2
		4 – 9 – 6 – 8	8 – 6 – 9 – 4		0 1	
	5.	6 – 5 – 8 – 4 – 3	3 – 4 – 8 – 5 – 6		0 1	0 1 2
		1 – 5 – 4 – 8 – 6	6 – 8 – 4 – 5 – 1		0 1	
	6.	5 – 3 – 7 – 4 – 1 – 8	8 – 1 – 4 – 7 – 3 – 5		0 1	0 1 2
		7 – 2 – 4 – 8 – 5 – 6	6 – 5 – 8 – 4 – 2 – 7		0 1	
	7.	8 – 1 – 4 – 9 – 3 – 6 – 2	2 – 6 – 3 – 9 – 4 – 1 – 8		0 1	0 1 2
		4 – 7 – 3 – 9 – 6 – 2 – 8	8 – 2 – 6 – 9 – 3 – 7 – 4		0 1	
	8.	9 – 4 – 3 – 7 – 6 – 2 – 1 – 8	8 – 1 – 2 – 6 – 7 – 3 – 4 – 9		0 1	0 1 2
		7 – 2 – 8 – 1 – 5 – 6 – 4 – 3	3 – 4 – 6 – 5 – 1 – 8 – 2 – 7		0 1	

LDSB (Max = 8)

Digit Span Backwards (DSB) Total Raw Score (Maximum = 16)

APPENDIX 5

RAW DATA YOGA GROUP

SN	Gender	Age	DSF		DSB		Dass_S		Dass_A		Dass_D		TN		E		TN-E		Cp	
			Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	post
1	M	68	7	9	7	8	10	6	4	2	16	6	206	233	127	69	42	15	169	84
2	F	60	9	9	6	8	6	10	4	2	4	8	163	195	146	114	20	24	166	138
3	M	60	9	12	9	11	10	8	8	2	18	12	113	113	209	209	23	1	232	210
4	M	72	8	8	7	6	10	4	4	2	2	0	220	189	97	135	31	10	128	145
5	M	75	9	6	9	6	4	4	4	4	4	0	303	213	117	85	123	7	240	92
6	F	65	6	6	4	4	28	10	26	4	26	10	188	218	114	86	27	8	141	94
7	M	61	7	9	7	7	22	16	16	12	20	14	184	175	119	124	8	6	127	130
8	F	60	9	11	7	9	12	0	8	4	8	0	219	195	156	103	59	11	215	114
9	M	71	7	9	6	8	16	14	8	6	10	4	154	193	140	88	3	2	143	90
10	M	67	9	10	10	10	6	4	2	2	4	2	165	149	131	139	13	4	144	143
11	M	75	8	10	7	8	18	16	8	2	10	8	170	233	131	69	13	15	144	84
12	F	60	7	9	5	7	2	0	2	0	4	0	159	184	137	113	19	7	156	120
13	M	75	8	12	8	7	4	2	4	2	2	2	180	185	121	110	12	2	133	112
14	M	70	10	12	8	10	4	2	6	2	4	0	185	222	100	65	7	2	107	67
15	M	75	7	6	6	6	30	16	16	14	4	0	196	199	137	116	38	14	175	130
16	M	65	9	11	7	8	18	12	18	6	6	6	189	196	128	103	24	7	152	110
17	F	75	8	6	7	7	6	4	8	0	16	0	187	158	126	130	19	6	145	136
18	M	66	8	10	6	8	8	4	8	4	4	4	181	183	120	112	11	5	131	117
19	M	65	10	14	8	10	6	0	4	2	6	0	157	190	137	99	7	3	144	102
20	M	63	7	6	6	6	30	16	16	14	4	0	196	199	137	116	38	14	175	130
21	F	60	7	6	6	6	6	2	2	2	4	0	159	171	196	128	56	13	252	141
22	F	70	8	8	5	8	12	8	4	2	6	0	196	210	120	103	32	19	152	122
23	F	60	6	9	6	8	14	8	8	8	12	4	237	286	109	38	66	34	175	72
24	M	64	8	9	6	9	20	10	24	12	24	0	190	188	136	95	45	3	181	98
25	M	60	9	11	7	11	14	16	8	6	4	0	159	199	123	84	5	3	127	87
26	M	69	6	6	5	6	30	18	16	16	22	32	175	177	121	103	5	0	126	103
27	M	68	5	8	7	7	18	10	2	0	4	2	196	247	108	55	15	9	123	64

RAW DATA CONTROL GROUP

SN	Gender	Age	DSF		DSB		Dass_S		Dass_A		Dass_D		TN		E		TN-E		Cp	
			Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	post
1	M	69	6	6	5	6	6	6	6	4	8	4	195	163	126	166	29	41	155	207
2	F	68	5	5	4	4	8	10	14	16	2	2	171	171	133	147	14	28	147	175
3	M	73	4	4	4	4	22	22	24	20	24	12	164	184	160	136	31	33	191	169
4	M	75	5	4	4	4	16	12	16	8	16	8	174	179	145	139	29	29	174	168
5	M	61	8	8	7	8	4	4	2	2	4	4	178	178	149	134	39	34	188	168
6	F	72	6	6	5	5	20	12	14	10	10	2	182	178	118	128	11	15	129	143
7	M	66	8	7	6	7	18	18	20	14	14	16	181	185	131	128	22	24	153	152
8	F	74	7	6	6	6	14	14	6	4	10	8	170	171	138	142	17	24	155	166
9	M	69	6	6	5	5	16	16	10	10	12	12	165	165	150	148	25	25	175	173
10	M	65	8	8	8	7	4	2	2	2	8	8	169	172	138	137	17	20	155	157
11	M	69	8	7	6	6	6	6	4	2	4	2	182	184	138	132	21	24	159	156
12	F	74	4	4	4	4	12	20	12	4	8	6	137	141	174	179	21	29	195	208
13	M	67	8	8	6	6	10	12	2	2	10	10	163	181	138	116	11	8	149	124
14	M	75	7	7	8	9	20	12	20	12	22	14	179	212	152	121	41	46	193	167
15	M	72	8	8	8	8	8	8	10	8	4	4	173	177	131	125	14	12	145	137
16	M	71	8	8	6	7	8	8	10	8	4	4	177	187	142	141	27	29	169	170
17	F	75	8	8	7	8	6	6	6	4	4	4	188	190	131	136	32	36	163	172
18	M	75	8	8	6	6	14	12	2	2	8	8	178	181	124	115	12	6	136	121
19	M	72	6	6	7	6	12	12	14	14	8	8	92	93	202	199	4	2	206	201
20	M	71	8	6	6	6	20	20	10	10	4	8	189	195	129	123	27	27	156	150
21	F	65	8	8	5	5	8	8	4	2	4	2	185	166	137	164	32	40	169	204
22	F	72	6	6	6	6	14	14	8	10	10	10	154	146	153	155	17	11	170	166