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Frontiers

Role of Yoga and Meditation in Improving Brain Function in the Young and Reducing Age Linked Cognitive Decline

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A B S T R A C T

Introduction: Yoga can impede cognitive decline in the elderly and also delay the onset of degenerative diseases of ageing. Adolescence is a vulnerable time in the development of the brain. Recent brain scanning techniques have brought to light the beneficial effects of regular practice of yoga and meditation on the brain. Objectives: To review the beneficial effects of Yoga and meditation on the human brain and to identify perceptions of yoga teachers and practitioners regarding the effect of yoga practice on the brain. **Methods:** A review of existing information regarding the beneficial effects of Yoga and meditation on the human brain was done. A pre determined questionnaire was administered to yoga practitioners and teachers after informed consent and assuring confidentiality. This was followed by interviews with yoga teachers to identify perceived benefits of Yoga on mental abilities. Quantitative data is presented as tables and important findings were subjected to statistical tests like z test and chi square at 5% Level of Significance. **Results:** There were 37 yoga teachers and 71 yoga practitioners involved in this study. The effects of yoga on the brain were broadly categorised into 2 themes i.e. Self regulation and Intellectual pursuits. The most common yoga practiced are Hatha yoga, Ashtanga yoga, Power yoga and BKS Iyengar yoga. It is seen the yoga teachers were spending significantly more time in doing Pranayama and Dhyana. 73% of the teacher and 77.5% of the practitioners consider that all 3 aspects i.e. breathing, meditation and asanas are equally important for improving brain function. **Discussion:** This study looks at the changes in the structure and function of the brain in response to the practice of yoga. The role of meditation and breathing is of more importance in structural improvements in the brain and its better functioning. There is a move of the younger generation towards the western influence of yoga practice. **Conclusion:** Health care professionals can be persuaded by concrete evidence showing positive changes in the anatomical structure of the brain in yoga practitioners to seriously consider yoga as a better alternative. However care must be taken to ensure the practice of holistic yoga for complete well being.

Introduction:

Yoga helps people at all age groups. The young student can practice it for improvement in memory, attention, processing of information. The working person can benefit by yoga as it improves multi tasking which is a necessity for today's world. It also helps in focused work, better attention span and decision making.

It is expected that by 2050 there will be more than 2 billion people over the age of 60 the world over. Ageing is the main risk factor for most degenerative diseases like Alzheimer's disease and Parkinson's disease etc. Yoga also helps reduce the age related degenerative effects on the grey matter of the brain thereby decreasing cognitive decline in the elderly.

Every individual can recognize and optimize their cognitive, emotional, psychological and behavioural functioning to cope with life situations. Various social and biological determinants play a role in brain development like adaptation and response to stress and adversity throughout life allowing for strategies for both promotion of brain health and prevention of adverse outcomes.

Holistic Yoga consists of three main components; Asanas (poses), Pranayama (breathing effort) and Dhyana (meditation and contemplation). It is suggested that the combination of poses, breathing, and meditation produces structural changes in the brain.1

Types of popular yoga: The holistic practice of Hatha Yoga involves asanas that focus on slow, gentle movements, holding the asanas for a few breaths before transitioning to the next. This includes pranayama (breathing techniques), meditation, and even a recommended diet. Iyengar Yoga is a form of Hatha Yoga that focuses more on physical practices matched carefully with breathing techniques and is one of the most popular types of yoga in India. It also involves the use of props, like blocks and ropes. Ashtanga Vinyasa Yoga follows a series of set sequences of asanas. With its intense form of physical movement, it can be considered as power yoga. Though practiced widely, it is no longer considered a traditional form of yoga in India and westerners have since added to the practice

Western yoga versus Indian yoga: Yoga is a traditional art of acquiring the utmost state of body, mind, and soul. Though India is the birthplace of yoga, there are many people in the western world who are practicing and teaching yoga. While In the Indian context yoga is more a way of living life, in the West, yoga is considered to be an exercise for good health and physic. Yoga philosophy focuses on the calmness of mind and schools of yoga in India comprise of meditation, pranayama, and Savasana which helps in relaxation of body, mind and soul.2

Anatomy and function of the human brain: The brain is made up of many specialized areas. The outer cortex comprises brain cells which are involved in thought processes and the genesis of voluntary movements. The brain stem controls breathing and sleep. The basal ganglia synchronize messages between the various areas of the brain. The cerebellum is responsible for coordination and balance.

The frontal lobes of the brain are involved in problem solving, judgment and motor function. The parietal lobes manage sensation and body position while the temporal lobes are for memory and hearing and the occipital lobes deal with vision.3 Gray matter consists of brain cells or neurons and is responsible for many of the brain's functions, including learning skills

and memory. It is also responsible for the functionality of interpreting the senses of sight, hearing, smell, and touch muscle control and self-awareness. White matter consists of the connections that extend from the brain cells which connect different sections of the brain. Healthy white matter allows the brain to coordinate thoughts as well as movements. The Hippocampus plays an important role in learning, memory, spatial navigation and emotional behavior. 4 The advent of functional MRI scans and other brain scanning techniques has brought to light the beneficial effects of regular practice of yoga and meditation on the brain.5

Ageing and adolescence: As ageing occurs, due to decreased blood supply and other changes, the cerebral cortex of the brain shrinks in volume especially the frontal lobe. There is shrinking of the grey matter also due to neuronal cell death. The possibility of stroke and ischemia increases and the white matter develops lesions.6 It is important to investigate methods to impede or undo age-related neuronal deficits and their consequent behavioral outcomes.7 Adolescence is a vulnerable time in the development of the brain. Strengthening of the brain during this important phase of development may help protect against long-term mental disorders.8 Meditative, cognitive and empathic practices like concentration exercises, the practice of generosity, reflection on the momentary nature of the self, shifting perspectives from self-oriented to other-oriented and the visualization of the suffering of others have been developed in many traditions. These techniques and trainings counteract self-centered tendencies.9 There is some evidence that meditation alone provides neuroprotective effects by the way of increasing cortical thickness and that older people have advantage in getting this benefit of meditation.10

Role of meditation on brain anatomy and function: Meditation helps in stress reduction, improved attention, better memory, and even increased creativity and feelings of compassion. Meditation strengthens the connections between brain cells and enhances the “folding” of the cerebral cortex or gyrification as a result of growth in people who meditate. This allows the brain to process information faster making decisions, forming memories, and improving attention. Meditation has also been shown to diminish age-related effects on gray matter and reduce cognitive decline. Participants who meditated were seen to be better at multitasking which may be due to reduced levels of cortisol, a stress related hormone.11 There is also evidence of subtle changes in nerve cell function in regions of the white matter in meditators.12

Mindfulness meditation has therefore increasingly been incorporated into psychotherapeutic interventions as it exerts its effects on attention regulation, body awareness, emotion regulation and change in perspective on the self. Evidence suggests that meditation is associated with neuroplastic changes in various parts of the brain establishing mechanisms which enhance self regulation.13 Self regulation is an ability to effectively modulate one's behavior. The framework of Self-Awareness, -Regulation, and -Transcendence (S-ART) highlights relevant perceptual, cognitive, emotional and behavioral neuropsychological processes through meditation. This will pave the way for future research in the development of treatments for psychological disorders.14, 15

Balancing Asanas: The brain is the main overseer of balance in the body and balancing asanas can promote positive effects on the brain especially with regard to neuroplasticity which can enhance brain functions like reading, memory,

comprehension, and mathematics. There appears to be a link between poor balance, cognitive decline and small blood vessel disease in the brain.16 Not only is there an association between cognitive function, gait and falls, but a cause and effect relationship may also exist.17 The three essential elements of balance are alignment, strength, and attention. The focus required to perform balancing postures with steadiness develop concentration and balance at the emotional, mental and psychic levels, removing stress and anxiety. 18

Objectives:

1. To review existing information on the beneficial effect of Yoga and meditation on the human brain.
2. To conduct qualitative research involving yoga teachers and practitioners to identify perceptions of improved mental faculties.

Methods: A review of existing information on the internet, journals and articles regarding the beneficial effects of Yoga and meditation on the human brain and present relevant state of the art findings which will have a practical use for everyone. A pre determined and tested questionnaire was administered to yoga practitioners and teachers after informed consent and assuring confidentiality. This was followed by interviews with yoga teachers to identify perceived benefits of Yoga on mental abilities. Quantitative data is presented as tables and important findings were subjected to statistical tests like z test and chi square at 5% Level of Significance. Qualitative data obtained by diligent transcription and triangulation was analysed for emerging themes and presented.

Results: There were 37 (23 Male and 14 Female) yoga teachers involved in this study with an average teaching experience of 16.6 years (SD 10.8). 71 yoga practitioners (33 male and 38 female) with an average years of practice of 3.3 years (SD 1.8) were also involved.

Types of Yoga: The most common yoga practiced are Hatha yoga, Ashtanga yoga, Power yoga and BKS Iyengar yoga. (Table 1) Hatha yoga is practiced by most of the teachers and practitioners. In Table 2 it is seen that while both teachers and practitioners spent almost equal time each day in doing Asanas, the teachers were spending significantly more time in doing Pranayama and Dhyana. 73% of the teacher and 77.5% of the practitioners consider that all 3 aspects i.e. breathing, meditation and asanas are equally important for improving brain function (Table 3). Hatha yoga and Iyengar yoga is practiced more by those above 30 years while Ashtanga yoga and Power yoga is favored by the younger group. (Table 4)

All the participants unanimously agreed that with the practice of Yoga, there will be improvement in brain function in terms of better memory, concentration and attention, decreased depression, anxiety, stress, better multitasking, innovative thinking and emotional balance. Only 3 teachers suggested that there will be structural changes in the brain on practicing Yoga. One ascribed it to increased blood circulation to the brain.

Two themes emerged in the qualitative aspect of the study. Participants seemed to broadly categorise the effects of yoga on the brain into two: Self regulation and Intellectual pursuits. In the first group, 45.9% of the yoga teachers and 47.9% of the practitioners said that yoga would help in anxiety, stress, emotional balance, being at peace, lifestyle, confidence and positive thinking (self regulation). In the second group 54.1% of the teachers and 52.1% practitioners said that the effect of yoga practice would be more on memory, concentration, focus, decision making, judgement, multi tasking etc (intellectual pursuits).

"When I do yoga, I have self control. My mind is at peace, I can feel my stress decreasing."
33 year old male yoga teacher practicing hatha yoga for 4 years.

"There is decreased stress and anxiety. Blood pressure goes down. One can have a sound sleep".
50 year old male yoga teacher with 20 years of teaching experience in Ashtanga yoga.

"Previously I used to suffer with headache. But now I have totally recovered. My tension has decreased and I have positive feelings."
57 year old female yoga practitioner of hatha yoga practicing for 7 years.

"There is increased brain functioning in all aspects. One gets increased memory and concentration. Good focus and better thinking"
56 year old male practitioner of power Yoga practicing for 5 years.

49.1% of the participants said that the brain is definitely affected by yoga. However 18.5% said it is not affected and 32.4% were not sure. The top 6 asanas suggested by this group of teachers and practitioners are Sarvangasana, Shirshasana, Padahasthasana, Halasana, Forward bending and Balancing asanas. 58.3% said that yoga alone could cure brain diseases while 11.1% said no and 30.6% were not sure. Almost all the participants were if in favour of yoga practice for the elderly.

Discussion: This study looks at two issues in the practice and outcomes of yoga. The first one is about the changes in the structure and function of the brain in response to the practice of yoga. It also considers whether the changes in the brain are more in the practice of holistic yoga as seen in the eastern world compared to the more physical practice of yoga seen in the western world. The study also notes the move of the younger generation towards the western influence of yoga practice. The role of meditation and breathing is seen to be of more importance in structural improvements in the brain and its better functioning.

Various studies have shown that long term meditation can lead to important changes in the brain among others. This includes increased cortical thickness and increased gyrification (the pattern and degree of cortical folding) which is associated with increased size of the gray matter leading to improved memory, attention, information processing etc. 19

Increased gray matter in the brain stem leads to improved cognitive, emotional, and immune responses. It also has positive effects on breathing and heart rate. Larger hippocampal and frontal volumes of gray matter result in more positive emotions, emotional stability, more mindful behavior and better perception of daily activities.20 Brain metabolites like gamma-amino butyric acid (GABA), dopamine, oxytocin, serotonin, and endorphins have been linked to anxiety and depression. In experienced yoga practitioners, brain GABA levels increase after a session of yoga. This suggests that the practice of yoga should be explored as a treatment for disorders with low GABA levels such as depression and anxiety disorders.21

Better overall brain activity is a result of better connectivity between the areas of the brain and between the grey and white matters of the brain. Meditation leads to better performance in tasks requiring distributed attention and confirming the fact that the practice of meditation practice can have a significant impact on human cognition.22

Ivtzan I et al looking at the Yoga Boom in western society, suggest that there are

practitioners who have spiritual intentions and those who have spiritual intentions. In terms of psychological wellness, a significant difference was found between the two categories of yoga practitioners. Many individuals are more driven to practice yoga for its physical virtues than for the purpose of acquiring spiritual development. The study found that individuals who practice yoga with spiritual intentions have higher levels of self-reported psychological wellbeing. This finding emphasises the need for a holistic approach to yoga than a purely physical one. 23

Levy DM et al found that only those trained in meditation stayed on tasks longer, made fewer task switches, and had less negative emotions after task performance. Meditation is therefore a good tool for training people in concentration especially in computer based workers who multi task. 24

Many of the participants in the current study opined that yoga alone could correct illness of the mind and other diseases. Mind-body medicine is centered on the interactions between the brain, mind and body and harnesses the powerful ways in which emotional, mental, social, spiritual, and behavioral factors can correct health. 25 Yoga is a form of mind-body medicine that works particularly on stress related illnesses. Therapeutic yoga is defined as the application of yoga postures and practice to the treatment of health conditions and can reduce or alleviate structural, physiological, emotional and spiritual pain and suffering.26

Conclusion: In these days of overreliance on medications and surgical procedures for human ailments, concrete evidence showing positive changes in the anatomical structure of the brain in long term yoga practitioners will help many to seriously consider yoga as a better alternative. Health care professionals and health educators can be persuaded by these findings to become aware of yoga as having the potential to be an important part of healthy living. However instead of popularizing the purely physical side of yoga, care must be taken to ensure the practice of holistic yoga for complete well being.

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