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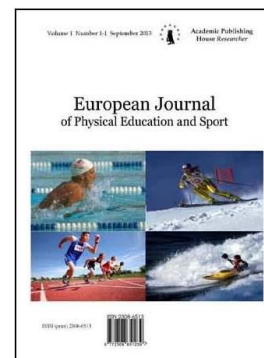
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Improvement of Brain Function through Combined Yogic Intervention, Meditation and Pranayama: A Critical Analysis

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Abstract

Background: The practice of yoga includes static and dynamic postures (asanas), breathing manipulations (pranayama) and meditation (dhyana). Yoga is a tool which works in the gross body level to the shuttle mind level. Yoga is a simple and inexpensive health regimen that can be incorporated as an effective adjuvant therapy for the improvement of brain and mental activity.

Aim: To review scientific literatures related to yoga practice and brain function.

Method: Researchers collected scientific evidences through electronic databases; Pubmed, Embase, Medline, Google Scholar, Google Advance Search, PsycINFO, ROAJ, DOAJR, Web of Science and critically analyzed the entire relevant article according to the nature of this study.

Findings: Combined yogic practices improve memory which can influence the academic performance of the students. Meditation practices improve higher level of concentration and consciousness which may reduce the psychic disorder. Pranayama practice may be applied as alternative therapy for reducing stress related diseases

Conclusions: Regular yogic practices may improve brain and others neuro cognitive functions.

Keywords: Yoga, Meditation, Pranayama, Brain function, Neuro psychology.

1. Introduction

Brain is the sites of mind and mental function. Brain has three specific areas, lower brain, mid brain and fore brain. This three parts control different types of mental function. Brain is a vast area and lakhs of specialized neurons engage themselves for different types of mental activities. Some area stores the memory where as the other control intelligence level. The development of brain function started from the early childhood and it continuous up to the starting point of ageing. Obviously there is an individual difference in brain function. The improvement of brain function is related with educational development, job performance, professional achievement and sports performance. Ageing and injury may decline the brain function. Scientist are trying to improve brain function by different modes and methods and to delay the declining of brain function.

For the improvement of brain function pharmacological drugs, natural products, different types of chemical has been used in different civilization from the ancient time. Indian is the only ancient civilization who identified vyamaya (physical exercise) and yoga (mental exercise) for the

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development of brain function and especially the mental function. By definition yoga is a practice to control and develop the mental function. In yoga techniques they used different types of asanas, pranayama and meditation as a whole or in a part. In this article, the present researcher reported improvement of brain function related literatures with the intervention of pranayama, meditation and combined yoga intervention. It is interesting to note that there is no such literature found till date on asanas effect on brain function.

2. Objective of the Study

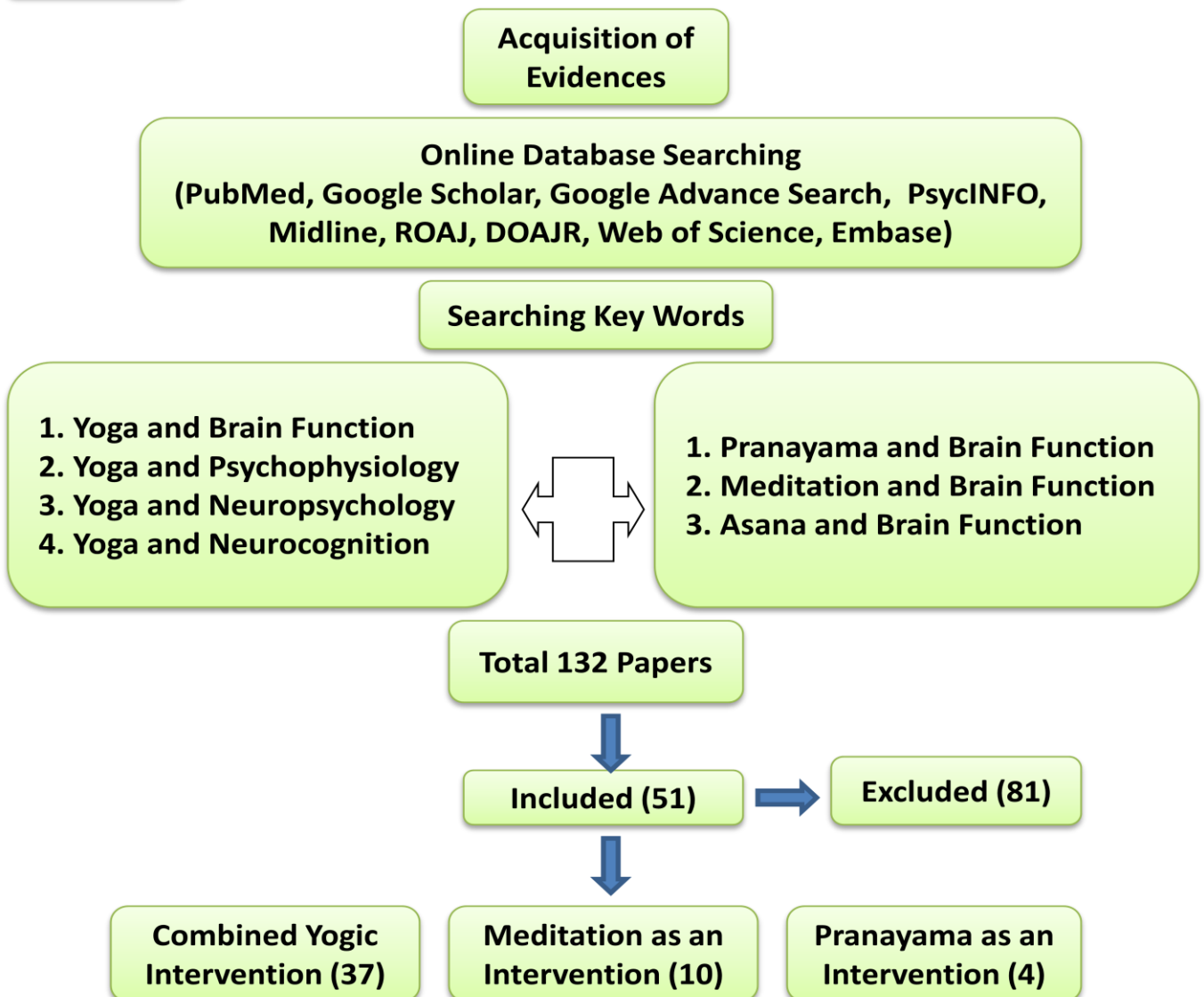
The specific objective of this systematic review study was to explore the improvement of brain function through meditation, pranayama and combined yogic intervention.

3. Methods

3.1 Acquisition of Evidence:

In this systematic review study a thorough online searching procedure was applied for acquisition of evidence. The electronic databases: PubMed, Embase, Medline, Google Scholar, Google Advance Search, PsycINFO, ROAJ, DOAJR and Web of Science were carefully searched for the purpose of reviewing the literatures.

Figure-1



3.2 Inclusion and Exclusion Criteria:

Studies related to the objective of this paper were included in this project whereas studies which were not directly matched with the concept of analysis were excluded from the process.

3.3 Selection Procedure of Review Articles:

In the first attempt, a total 132 article with full text were assessed on the basis of eligibility criteria. Out of which only 51 papers were fulfill the objective of this study. Detail selection procedure adopted for this study is presented in the [Figure-1](#).

A growing body of scientific evidence indicates that yoga has a positive influence on brain function. In this systematic review, the studies related with the yoga and brain function are summarized under the following heads.

4. Improvement of brain functions through combined yogic intervention:

Long term combined yoga practice improves primary cognitive processes such as attention, perception, reaction time, accuracy, and observation ([Verma, 2015](#); [Banerjee, 2014](#); [Gothe, 2013](#)). Short term yoga practice for 10 days in school children lead to significant improvement in cognitive function ([Reddy, 2015](#)). Short term integrated yoga practices can improve memory scores of diabetics and play a vital role in managing the mental health of diabetics patient ([Bhanu, 2015](#)). The effect of eight-week yoga exercise improve balance with intellectual disability ([Parisa, 2015](#)). Combination of regular yoga practice with oral hypoglycemic agents improve better cognitive abilities in type 2 diabetic population rather than administration of oral hypoglycemic agents alone ([Nagothu, 2015](#)). Yoga module can improve attention and remembrance which may positively affect on academic performance of students ([Ramkumar, 2014](#)). Yoga practices are correlated to neurophysiological system that increases in associative attention and positive affective valence ([Mackenzie, 2014](#)). Regular practiced of yoga module yielded higher concentration levels and exhibited better short term memory ([Kauts, 2012](#)). Yoga has a beneficial effect on P300 wave and thus can be incorporated along with the conventional medical therapy for improving cognitive brain functions in diabetes ([Kyizom, 2010](#)). 8 weeks sahaj yoga practice improve neurocognitive function and it can lead to additional improvement in executive functions like manipulation of information in the verbal working memory and added improvement in attention span and visuo-motor speed of the depressives ([Sharma, 2006](#)). Pranayama and yoga-asana practice on P300 wave latency and amplitude in type 2 Alzheimer patients have beneficial effect on reduction of Alzheimer and thus can be incorporated along with the conventional medical therapy for improving cognitive brain functions (Tripathi). Yoga practice supported by a common paralimbic brain network which linked to awareness, attention and emotion in order to support memory dependent self reference (Lou, 2011). Combined yoga practice reduces the comorbid anxiety and depression (Forbes, 2008). Yogic education system enhances visual and verbal memory scores ([Rangan, 2009](#)).

Yoga based stress management programme on brain wave coherence recorded with brain master EEG 2 channel and found that the delta, theta, alpha gamma wave coherence increases 19.31 %, 5.04 %, 15.40 %, 18.68 % respectively and 1.67 % decrease in beta wave coherence between pre and post intervention measurements ([Ganpat, 2011](#)). Yogic intervention improve alpha-EEG level of working women which causes brain come in relax and cool state ([Bharadwaj, 2013](#)). 40 days pranakarshan pranayama and yoga nidra practice improve the pranic energy level and change alpha dominance in the brain which influences the mental relaxation, reduce anxiety and stress ([Kumar, 2009](#)). Regular yogic intervention improves delta, theta, alpha and beta brain waves which improve overall brain function with emphasis on attention and concentration (Boonjaksilp). Combined yoga practice improve various cognitive behavior in terms of physiological parameters by using EEG and ECG analysis, where indicates improvement in parasympathetic activity and decrease in sympathetic activity. Yoga modifies the sympathovagal balance towards parasympathetic activation, improved the heart rate variability, and enhanced sense of wellbeing ([Nagendra, 2015](#)). Five weeks of brain waves vibration training, Iyengar yoga and mindfulness programme improve sleep latency, absorption, memory, salivary cortisol, mood, mindfulness and reduce overall stress ([Bowden, 2012](#)). Breathing, meditation, and posture-based yoga programme increased overall brain wave activity, increases gray matter along with amygdala and activate the frontal cortex ([Desai, 2015](#)).

MRI and voxel-based morphometry analysis observed three years combined yoga meditation practice improve gray matter volume in frontal, limbic, temporal, occipital, and cerebellar regions

of the brain of 18–55 years people (Froeliger, 2012). Combined yoga meditation practice may be associated with the promotion of neuroplastic changes in executive brain systems and using by fMRI, which may confer therapeutic benefits that accrue with repeated practice (Froeliger, 2012). Fluid intelligence declined with age as a natural process and it have a negative impact on brain function. Fluid intelligence declined slowly than the natural process with combination yoga and meditation practice (Gard, 2014). 12 weeks yogic intervention increase serum brain-derived neurotrophic factor (BDNF) and maintenance of serum serotonin level in premenopausal women (Lee, 2014). Yoga stimulate the parasympathetic nervous system and increase the inhibitory action of a hypoactive GABA system in brain pathways and structures that are critical for threat perception, emotion regulation, and stress reactivity (Streeter, 2012). 12 weeks yoga practices improve gamma-aminobutyric acid (GABA) which also helps to reduce the mood and anxiety disorder (Streeter, 2010). Regular 60 minutes yogasana and breathing exercise practices improve 27 % brain GABA level (Streeter, 2007).

Regular practices of yoga have beneficial effects on both phases of parasympatho-dominance and psychological well-being probably by balancing neuro-endocrinal axis (Kanojia, 2013). Yoga and meditation should be recommended as an adjuvant therapy along with medication to tilt the autonomic balance to parasympathetic dominance to get relieved from hypertensive symptoms (Sharma, 2013). Yoga practice decreases sympathetic activity and causes a shift in the autonomic balance towards parasympathetic dominance and indicates helps to reduce stress by optimizing the autonomic functions (Patil, 2012). 12 weeks yoga training program can changes in the brain's baseline and activated cerebral blood flow, dorsal medial cortex, and right sensorimotor area and greater impact found in right hemispheric function, particularly in the frontal lobes (Cohen, 2009). Yoga enhanced the vagal activity and reduced cortisol in turn may contribute to positive effects such as enhanced immune function and lower prematurity rate (Field, 2011).

5. Improvement of brain functions through meditation

Effect of yoga meditation practice and EEG wave was analyzed and it was observed that immediate yoga meditators have greater source of activity in low frequencies particularly theta and alpha wave during mental calculation. Advance yoga meditators showed greater activity in high frequencies (beta and gamma) in all conditions (Thomas, 2014). Other researcher reported that EEG based improvements in cognitive abilities like attention and working memory with meditation practice (Singh, 2014).

Two years meditation experience activates the bilateral hippocampi which are related to memory consolidation (Engstrom, 2009). Long term meditation practices positively improve in gray matter atrophy (Luders, 2014). Regular meditation practice positively affect on frontal region, anterior cingulate, limbic system and parietal lobes of the brain. Strong correlation was found between depth of meditation and neural activity in the left inferior forebrain areas including the insula, inferior frontal cortex and temporal lobe (Wang, 2011).

Long term meditation practice improves over all cognitive functions (memory, attention, perception, observation ability, processing speed, neural activity, intelligence executive function etc.) which energies brain to focus on its task (Singh, 2012; Khalsa, 2004; Prakash, 2011). Meditation technique may be able to offset age related cognitive decline and perhaps even increase cognitive capabilities (Gard, 2014). Meditative practices can be used as leveraged in the prevention and intervention of mental illness (Rubia, 2009).

6. Improvement of brain functions through Pranayama

Two months Sheetal and Sheethkari pranayama practice improve in the delta and alpha band power in the frontal and occipital regions and an increase in theta band power in the frontal region with a marked decrease in beta band power almost throughout the entire hemisphere which keeps brain calm and quiet with less anxiety (Thanalakshmi, (2014). Bhramari pranayama practice can generate controlled high-frequency gamma waves by using EEG signals which is contributed to improve the active thought (Vialatte, 2008). 20 minutes Nadi-Shodhana pranayama practice advocated improving cardio-respiratory efficiency as well as higher functions of brain in healthy individuals. Pranayama practice may be applied as alternative therapy or as adjunct to conventional therapy in stress related diseases (Gupta, 2014). If a person is breathing

predominately with the left nostril, that person's right hemisphere of the brain will be more active and putting out a greater electrical signal than the left hemisphere (Srinivasan, 1991).

7. Conclusion

Brain and neuro psychological profile decreases with age is a natural process and it have a negative impact on brain function. Yoga could be considered as a precious tool in the path of mind body medicine. Yoga have a potential benefits on brain health because this ancient Indian technique particularly trained the psycho-physical system. Combined yogic practices improve memory which can influence the academic performance of the students. Meditation practices improve higher level of concentration and consciousness which may reduce the psychic disorder. Pranayama practice may be applied as alternative therapy for reducing stress related diseases such as essential hypertension, neuro degenerative and Parkinson diseases. So the yogic practices improve brain function in multiple pathways.

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