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Effect of yoga practice on Cognition in Hypertensive Patients

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Abstract: ***Background:*** Yoga is one such alternative healthcare practice thought to improve blood pressure control. There is no single definition of the practice of yoga, that is universally accepted although it is generally described as an ancient tradition (originating 5,000 to 8,000 years ago) that incorporates postures, breath control, and meditation, as well as specific ethical practices. ***Materials and Methods****:* This is a prospective, descriptive and observational study. Department of Physiology, Index Medical College, Hospital and Research center Indore. Period of study is from January 2020 to December 2021. Seventy hypertensive subjects on yoga therapy and Seventy hypertensive subjects on without yoga therapy was enrolled in this study. Both groups were advised to continue their regular medicines. ***Result:*** A total of 70 patients who fulfilled the selection criteria during the study were enrolled. Pre-test Yoga Group Mean LNS increased from 8.04±0.74 (Mean±SD) to Post-test 10.14±0.66. In control group Mean LNS in pre-test 8.54±0.58 and post-test 8.67±0.36. However, the difference in Mean LNS in Yoga Group is statistically significant. (P value < 0.05). ***Conclusion:*** A Short Yoga program for patient to practice at home seems to have a positive effect on self-rated quality of life and reduction of stress. It also lowered the patient perception on stress and it enhanced the patient perception on health.

Keywords: Yoga, Cognition, Cerebral neurophysiology.

INTRODUCTION

The practice of yoga dates back over 2000 years to ancient India, with a focus on the unification of the mind, body, and spirit through the practice of physical movements, meditation and breathing exercises. [1] Over the course of its lengthy existence, many different schools of yoga have emerged, each placing a different emphasis on the practice. However, despite their different philosophies and combinations of exercises, they all are integrated in the common theme of uniting the mind and body. [2] Yoga's prominence in western civilization emerged in the late 20th century. While its origins root from religious principles, modern day culture is primarily drawn to it for its relaxation benefits (meditation and breathing exercises) and stretching and strengthening movements (physical poses). [3]

According to the National Center for Complementary and Integrative Health (NCCIH), yoga is the most popular form of complementary therapy practiced by more than 13 million adults, with 58% of adults citing maintenance of health and well-being as their reason for practice. [4] One of the reasons for yoga's increase in popularity is its versatility, in that it can be taught at a range of different intensities. Compared to traditional forms of aerobic and anaerobic exercise, the relatively low-impact, modifiable nature of yoga can offer a middle ground for individuals with movement limitations, clinical diagnoses, and is particularly suitable for aging populations. [5] Yoga's focus on improving the self through both physical *and* mental practices incorporates more mindful elements absent in traditional forms of exercise. [6]

Yoga's acute and intervention effects on cognition are evident in a recent study which reported moderate effect sizes for attention, processing speed and executive function measures for studies conducted with adult populations. [7] Yoga practice enables the practitioner to move in a controlled manner into modifiable physical postures concentrating initially on relaxing their body, breathing rhythmically, and developing awareness of the sensations in their body and thoughts in their mind. [8] In addition to the physical benefits from sequentially completing the postures, the breathing (*pranayama*) and meditation exercises included in yoga are practiced to calm and focus the mind and develop greater self-awareness. [9]

However, it is currently unknown if this relationship exists as a direct pathway, or if yoga indirectly influences cognitive functions through processes such as affective regulation. Negative affect including depression and stress are known to detrimentally impact both cognitive functioning and brain structure and systematic reviews discussed earlier have demonstrated the potential of yoga to improve anxiety, depression, stress and overall mental health. [10]

MATERIAL AND METHOD

This is a prospective, descriptive and observational study. Conducted at Department of Physiology, Index Medical College, Hospital and Research center Indore. Over a period of 1 year. Either gender with age group of 30-60 years of Seventy hypertensive subjects according to JNC VIII (Systolic BP >140mmHG and Diastolic BP >90 mmHg) was included. Patients with history of liver disease, kidney disease and Diabetes were excluded.

Baroreflex sensitivity: Baroreflex sensitivity was assessed using FinaPress NIBP system. Spontaneous baroreflex sensitivity was evaluated from systolic blood pressure and heart rate changes. Data was extracted using beat-scope software and exported into excel sheet.

Anxiety and Depression Scale (HADS): Raw score of anxiety and depression were calculated as per the instructions mentioned the manual of Hospital Anxiety Depression Scale (HADS) Hospital anxiety and depression (Snaith, 2003)

WAIS IV: Digit span. The Wechsler Adult Intelligence Scale, 4th edition (WAIS-IV) subtest Digit Span (DS) is a widely-used measure of Wechsler Memory scale (WMS). [11]. The DS test includes: Digit Span Forward (DSF), in which the participant is read a sequence of numbers and recalls the numbers back in the same order, assessing maintenance WM; Digit Span Backwards (DSB), in which the participant recalls the numbers in the reverse order, assessing a higher-load manipulation WM; and Digit Span Sequencing (DSS), a new subtest introduced in the WAIS-IV that is presumed to assess maintenance WM, in which the participant recalls the numbers in ascending order. However, while the first two subtests have been extensively investigated and have demonstrated very good psychometric properties, the latter subtest has received relatively little attention, and recent reports indicate some weaknesses in terms of Digit Span Sequencing test's psychometric properties. [12] Nevertheless, we chose to administer the third subtest in order to be able to extract an overall DS Total score (DST), which incorporates scores from all three subtests.

WAIS IV: Letter-number sequencing. The WAIS-IV subtest Letter-Number Sequencing (LNS) is a well-validated measure of manipulation WM. [13] The participant is read a series of numbers and letters and asked to recall the numbers in ascending order, followed by the letters in alphabetical order.

The Mindful Attention Awareness Scale (MAAS). The MAAS is a 15-item scale designed to assess dispositional mindfulness, which refers to a receptive awareness or attention to what is taking place in the present moment. [14] Items are scores on a 6-point Likert scale ranging from 1 = almost always to 6 = almost never. All items are first person statements such as "It seems I am 'running on automatic,' without much awareness of what I'm doing.", and "I could be experiencing some emotion and not be conscious of it until sometime later." Thus, higher scores reflect elevated mindful awareness. The MAAS demonstrated strong psychometric properties, with good ($\alpha = 0.84$) to very good ($\alpha = 0.91$) internal consistency found across different age groups and countries. [15] A number of studies have shown that the MAAS assesses a unique quality of consciousness that is associated with enhanced self-awareness as well as a variety of wellbeing constructs. [16] The MAAS's Cronbach alpha for the present study indicated good internal consistency (first administration $\alpha = 0.84$; second administration $\alpha = 0.81$).

Participants completed baseline assessment of maintenance and manipulation WM (DS and LNS) as well as mindfulness (MAAS) up to 1 week before participating in yoga sessions. Participants met with the experimenter (DB) individually in a research assessment room to complete a short demographic questionnaire, complete the MAAS questionnaire, and be administered the DS and the LNS at time 1, prior to attending yoga sessions, and time 2, at least 1 day after completing yoga sessions. Given scheduling constraints, assessment at time 2 took place within two weeks of the final yoga session.

Perceived Stress Scale:
The Perceived Stress Scale is a 10-item self-report questionnaire that measures persons‟ evaluation of the stressfulness of the situations in the past month of their lives. The citation for the 10-item scale is Cohen. S. & Williamson. G. (1988). [32] Scores can range from 0 to 40, with higher scores indicating greater stress.

Scoring criteria

- 0 -10 Minimal level of stress
- 11 -20 Mild levels of stress
- 21 -30 Moderate levels of stress
- 31 -40 Severe levels of stress

Statistical Analysis
The measurements data was statistically analyzed with the Statistical package for social sciences (SPSS)

version 25th software was used. Pre-post test data of all the variables were presented as mean and standard deviation. Data was subjected to normality test, data for all variables except baroreflex sensitivity was found to be normally distributed. Paired sample t test was used to assess within group changes for normal distributed data and independent sample t test was used for assessment of between group changes. At 95% interval, two-tailed $P \leq 0.05$ was considered statistically significant.

RESULT

A total of 70 patients who fulfilled the selection criteria during the study were enrolled. The data were analysed, and the final observations were tabulated as below.

Table 1: Distribution of Gender

Sex	Yoga Group n (%)	Control Group n (%)	p-value
Male	**39 (55.7%)**	**37 (52.8%)**	P>0.05
Female	**31 (44.2%)**	**33 (47.1%)**	
Total	**70 (100%)**	**70 (100%)**	

In table 1, of the 70 samples, 39 were males and 31 females, which correspond to 55.7% of male and the rest female in yoga Group and 37 were males and 33 females, which correspond to 52.8% of males in control group.

Table 2: Distribution of the number of subjects according to age group

Age group	Yoga Group n (%)	Control Group n (%)	p-value
30-40 years	**21 (30.0%)**	**19 (27.1%)**	P>0.05
41-50 years	**23 (32.8%)**	**26 (37.1%)**	
51-60 years	**26 (37.1%)**	**25 (35.7%)**	
Total	**70 (100%)**	**70 (100%)**	

In this study, the maximum number of patients were in the age group of 51-60 years which were 37.1% (n =26) of total followed by age group 41–50 years having 32.8% (n = 23) followed by age group 30-40 years with 30.0% (n=21) in yoga Group in table 2.

Table 3: Comparison of Mean Baroreflex sensitivity between Yoga Group versus Control Group

	Yoga Group Mean ±SD	Control Group Mean ±SD	p-value
Pre-test	6.54 ± 0.43	6.53 ± 0.53	**>0.05**
Post-test	9.13 ± 0.91	6.94 ± 0.73	**<0.05**

It is observed from **Table 3** that, pre-test Yoga Group Mean Baroreflex sensitivity increased from 6.54 ± 0.43 (Mean±SD) to Post-test 9.13 ± 0.91. In control group Mean Baroreflex sensitivity in pre-test 6.53 ± 0.53 and post-test 6.94 ± 0.73. However, the difference in Mean Baroreflex sensitivity in Yoga Group is statistically significant. (P value < 0.05).

Table 4: Comparison of Mean working memory function between Yoga Group versus Control Group

Working memory function		Yoga Group Mean ±SD	Control Group Mean ±SD	p-value
DS **Forward**	**Pre-test**	9.53 ± 1.43	9.63 ± 1.81	**>0.05**
	Post-test	11.64 ± 2.64	9.54 ± 1.89	**<0.05**
DS Backward	**Pre-test**	8.21±0.32	8.83±0.43	**>0.05**
	Post-test	10.23±0.65	8.41±0.54	**<0.05**
DS Sequencing	**Pre-test**	9.43±0.32	9.92±0.24	**>0.05**
	Post-test	9.54±0.43	9.54±0.63	**>0.05**
DS Total	**Pre-test**	8.94±0.85	8.72±0.83	**>0.05**
	Post-test	10.03±0.54	8.04±0.54	**<0.05**

DS, Digit Span.

It is observed from **Table 4** that, pre-test Yoga group Mean DS Total increased from 8.94±0.85 (Mean±SD) to Post-test 10.03±0.54. In control group Mean DS Total in pre-test 8.72±0.83 and post-test 8.04±0.54. However, the difference in Mean DS Total in Yoga Group is statistically significant. (P value < 0.05).

Table 5: Comparison of Mean working memory function between Yoga Group versus Control Group

Working memory function		Yoga Group Mean ±SD	Control Group Mean ±SD	p-value
LNS	**Pre-test**	8.04±0.74	8.54±0.58	**>0.05**
	Post-test	10.14±0.66	8.67±0.36	**<0.05**
MAAS	**Pre-test**	3.43±0.32	3.92±0.24	**>0.05**
	Post-test	5.54±0.43	3.54±0.63	**<0.05**

LNS: Letter-Number Sequencing; MAAS: Mindfulness Attention Awareness Scale

It is observed from **Table 5** that, pre-test Yoga Group Mean **LNS** increased from 8.04±0.74 (Mean±SD) to Post-test 10.14±0.66. In control group Mean **LNS** in pre-test 8.54±0.58 and post-test 8.67±0.36. However, this difference in Mean **LNS** in Yoga Group is statistically significant. (P value < 0.05).

Table 6: Comparison of Mean stress scores between Yoga Group versus Control Group

	Yoga Group Mean ±SD	**Control Group** Mean ±SD	**p-value**
Pre-test	36.53 ± 3.43	36.63 ± 3.81	**>0.05**
Post-test	11.64 ± 1.64	36.54 ± 3.89	**<0.05**

It is observed from **Table 6** that, pre-test Yoga group Mean stress scores decreased from 36.53±3.43 (Mean±SD) to Post-test 11.64±1.64. In control group Mean stress scores in pre-test 36.63±3.81 and post-test 36.54±3.89. However, this difference in Mean stress scores in Yoga Group is statistically significant. (P value < 0.05).

DISCUSSION

In this study, pre-test Yoga Group Mean Baroreflex sensitivity increased from 6.54 ± 0.43 (Mean±SD) to Post-test 9.13 ± 0.91. We assessed baroreflex sensitivity which is directly involved in blood pressure control. After Yoga intervention, we observed significant increase in baroreflex sensitivity. Our findings are consistent with the previous findings by Bowmen A, 1997; in this study 6 weeks of yoga intervention improved baroreflex sensitivity in elderly persons, whereas practice of aerobic exercises for same duration in similar population did not improve baroreflex sensitivity (Bowman, 2017). [17]

We examined whether sessions of yoga training, which included mindfulness meditation practice, improved WM functions and mindfulness or not. In accordance with our primary hypothesis, completion of this program was associated with overall significant improvement in measures of WM. Specifically, participants significantly improved performance on a maintenance WM task (DSF) over and above previous yoga experience. Participants also improved on two manipulation WM tasks (i.e., DSB, and LNS).

It is observed that, pre-test Yoga Group Mean LNS increased from 8.04±0.74 (Mean±SD) to Post-test 10.14±0.66. However, this difference in Mean LNS in Yoga Group is statistically significant. (P value < 0.05). Another study by O Parshad, 2011, sixty-four healthy students of average age 21.3 years underwent six weeks of yoga practice (one session/week) post intervention a significant increase in LNS and MAAS. [18] The physical and cognitive benefits associated with yoga and mindfulness may be due to mechanisms including pranayama and activation of the parasympathetic nervous system [19]; meditative or contemplative practices; increased body perception; stronger functional connectivity within the basal ganglia; or increased activation of grey matter volume and amygdala with regional enlargement [20].

Subramanya and Telles utilized the Wechsler Memory Scale (WMS): Digit Span Forward and Backward to assess WM (N = 57) in healthy adults pre- and post-yoga based relaxation techniques (cyclic meditation and supine rest). The meditative aspect of yoga practice may contribute to the enhancement or improvement of WM, although the mechanism is yet to be clarified. [21]

Yoga practice appears to be linked to anatomical changes in the frontal cortex, hippocampus, anterior cingulate cortex and insula. Yoga practice showed a consistent positive relationship with measures of brain structure (i.e. GM volume, GM density, cortical thickness). Differences in brain function between yoga-practitioners and non-practitioners have been observed in the dorsolateral prefrontal cortex, with yoga-practitioners showing less activation during both working memory and affective Stroop tasks. [22] Additionally, yoga-practitioners differed from non-practitioners within the ventrolateral prefrontal cortex, superior frontal gyrus, and amygdala during other aspects of the affective Stroop task. [23] Studies investigating changes in the functional connectivity of the brain following yoga practice have primarily identified increases in the default mode network, one of which found that those changes were related to memory performance. [24]

In our study, observed that; pre-test Yoga Group Mean stress scores decreased from 36.53±3.43 (Mean±SD) to Post-test 11.64±1.64. The ability of yoga-based practices to decrease stress, as indicated by down-regulation of the sympathetic nervous system and the hypothalamic-pituitary-adrenal (HPA) axis is well-supported in the literature. [25]

Practice yoga enjoys better health, temperament, discipline, behaviour, concentration, memory and stamina. The results of the study showed better performance with practice of yoga and meditation in enhancing cognitive performance pertaining to higher level cognitive skills of: sustained and divided attention and concentration, short term memory, visual information processing and working memory, and complex cognitive speed and flexibility over that of non-practicing students.

Our study had some limitations included a relatively small sample size and the use of a cognitive paradigm with sufficient task difficulty to subjects which may have attenuated the ability to detect behavioural Stroop effects. The small sample may have limited the reliability of study findings on the observed impact of limbic responses on subsequent affect, and thus this analysis should be replicated in studies with larger sample sizes.

CONCLUSION

A short Yoga program for patient to practice at home seems to have a positive effect on self-rated quality of

life and reduction of stress. It also lowered the patient perception on stress and it enhanced the patient perception on health. Regular yoga practise decreases basal cortisol, catecholamine, sympathetic activity and increases parasympathetic activity that shows beneficial effect on cognitive functions and cerebral neurophysiology.

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