

Effect of mindfulness meditation on attention and working memory in elderly people

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Abstract

Introduction: Elderly age is associated with decline in cognitive functions. Attention and working memory are significantly affected during this phase of life.

Aim and Objective: To study the effect of mindfulness meditation (MM) on elderly age induced decline in attention and working memory.

Materials and Methods: 100 elderly participants were randomly divided in meditator group (n= 50) and control group (n = 50). Meditator group followed the MM schedule during 45 days study period. Digit Span test (DST) was used for pre- & post- study evaluation of attention & working memory.

Result: There was significant improvement ($p < .05$) in scores of DST for Meditator group participant. In control group, there were no significant changes in DST scores.

Conclusion: MM practice counters the elderly age induced decline in attention & working memory.

Keywords: Elderly, Mindfulness, Meditation, Attention, Working memory.

Introduction

World population is aging. In year 2017, the global population aged ≥ 60 years was 962 million and if ongoing trend continues, this number will double by year 2050.¹ Advancing age has many detrimental effects on the human brain which could manifest as compromised cognitive function.² But all parts of brain are not equally affected by aging induced degradation process. Prefrontal cortex & Parietal cortex are primarily affected. Because of involvement of these two areas, attention and working memory are significantly hampered in elderly people.³

During the long era of human development many attempts have been made to counter this age induced cognitive decline. In the same line, meditation has shown very promising effects on mental and physical aspect of meditators.⁴ Mindfulness meditation (MM) or Vipassana meditation is a kind of Buddhist meditation. Mindfulness is a way of living with present moment awareness. During practice of mindfulness, on one hand, importance is given to awareness to present moment sensation, thought and feelings, but on the other hand, further analysis or elaboration is avoided.⁵ Many studies have shown beneficial effect of MM on depression, stress, handling chronic pain. There is growing body of literature supporting to the beneficial effect of mindfulness meditation on cognitive functions.^{5,6} However, not much attention has been paid to "elderly age group" population.

As elderly age group is prone for cognitive decline, it would be of immense importance to study the impact of mindfulness meditation on cognitive attention and working memory of elderly people.

Materials and Methods

This study was undertaken by Department of Physiology, Kasturba Medical College, Mangalore, India.

Approval for conducting this study was obtained from institutional scientific and ethical committee of Kasturba Medical College, Manipal University. The present study was a randomized control trial. 100 elderly meditation naïve participants were recruited from general population in Mangalore. They had normal or corrected to normal hearing. Histories of alcohol or any substance abuse, ongoing or previous mental health problem or receiving psychopharmacological treatment were taken as exclusion criteria.

Written informed consent of the volunteers were obtained. As a part of pre study assessment all the subjects filled the questionnaires regarding their mental and physical health. Participants were randomly divided into meditator group (n=50; 34 male and 16 females, mean age = 63.86 years, SD \pm 3.01) and control group (n=50; 37 male and 13 female, mean age = 64.46 years, SD \pm 2.96). Lottery method was used for the randomization. Baseline assessment of attention & working memory was done by Digit span test. Meditator group subject did mindfulness meditation. Meditation was done for 30 min, 6 days per week for 45 days study duration. As per convenience of participant the meditation sessions were scheduled to be in the evening time. For proper monitoring a meditation instructor was appointed. Control group participants were not involved in meditation. They were suggested to read newspaper or books, have evening walk or watching television. But there was no supervision on control group participants. After 45 days study period, post study assessment was done by Digit span test.

Instructions for Mindfulness Meditation

Participants in the meditation group were introduced to a simple mindful breathing meditation by a meditation instructor. Participants were instructed to sit in relaxed

upright position with closed eyes. Meditator needed to pay attention to breathing. They were instructed to observe one full “in breathe” as it enters & one full “breathe out” as it goes out. It was just observation of breathing without any attempt of change the breathing pattern in any way. In case of any mental distraction, they had to redirect their attention to the perception of breathing. They were taught to attend all thoughts, sensations and feelings in non-judgmental attitude. For that they had to label any thought as “thought” and let it go, instead of identifying them as- sad, happy, anger, food and getting involved in further interpretation. It means, it is important to be aware of thoughts, but it is also important to avoid any kind of involvement or interpretation of thoughts.⁵

Digit Span Test: DST is a part of Wechsler Intelligence Scale. It has 2 parts – (a) Forward DST (b) Backward DST.⁷

(a) Forward DST: It assesses verbal attention & short term memory. In this test, examiner reads aloud a string of random number at a rate of one digit per second. Immediately after that, subject repeats that sequence of numbers. This pattern is repeated with 7 sequences of numbers. The length of these sequences extend from 3 to 9 digits (refer column 1). If the subject is unable to repeat or makes any mistake while repeating any sequence then examiner reads aloud an another random number sequence of same length from column 2. Forward DST completes in any of these 2 conditions- (i) When subject is able to repeat “9 digits sequence” correctly. (ii) When subject makes two consecutive mistakes in repeating any digit sequence.

(b) Backward DST: All the steps in this test are same as forward DST except that the subject repeats the sting of numbers in backward order. For example, if examiner speaks the number sequence as- 5,2,8,1 than subject is expected to repeat as 1,8,2,5. Backward DST completes

in any of these 2 conditions- (i) When subject is able to repeat “8 digits sequence” correctly. (ii) When subject makes two consecutive mistakes in repeating any digit sequence.

Forward DST score & Backward DST score represent maximum number of digits correctly repeated by subject in forward & backward order, respectively.⁷

The statistical analysis was done by using SPSS software 16.0 version. Data was reported as Mean ± Standard deviation (Mean ± SD). Comparison of the sex distribution was done by Chi-Square test. Statistical analyses were performed to investigate two main questions – first, whether there was any significant difference between the baseline DST scores of both groups. Second, comparing pre & post study score of both group & assess whether there was any significant change. To get the first answer pre-study inter group test scores were compared by unpaired student’s “t” test. For second answer pre- and post-study test results were compared by paired student’s “t” test. Probability level (p value) <0.05 was considered significant.

Result

The two groups did not differ significantly with respect to the age distribution (P= 0.31) & sex distribution (P = 0.66). Baseline scores of the DST (forward & backward) showed that there were no significant differences between two groups (Table 3). After completion of mindfulness schedule, the study group showed significant improvement in DST forward (P = 0.031) and backward scores (P = 0.026) (Table 4). On the other hand, after 45 days study period there were no significant changes (For Forward DST- P = 0.148 & for Backward DST- P= 0.420) in the meditator group scores of DST (Table 4).

Table 1: A sheet for forward digit span test

| Forward Digit Span Test | | | |
|-------------------------|-------------------|----------|-------------------|
| Column 1 | | Column 2 | |
| Digits | Example | Digits | Example |
| 3 | 3-4-9 | 3 | 5-1-8 |
| 4 | 7-1-5-2 | 4 | 3-8-1-4 |
| 5 | 9-3-8-5-1 | 5 | 2-7-4-1-9 |
| 6 | 7-2-8-3-9-5 | 6 | 3-8-5-1-9-2 |
| 7 | 5-8-3-9-2-6-1 | 7 | 6-1-3-8-5-2-9 |
| 8 | 3-7-2-6-1-9-4-8 | 8 | 2-5-1-8-3-7-4-6 |
| 9 | 8-5-2-9-1-4-7-3-6 | 9 | 8-5-6-3-9-4-7-1-2 |

Table 2: A sheet for backward digit span test

| Backward Digit Span Test | | | |
|--------------------------|-----------------|----------|-----------------|
| Column 1 | | Column 2 | |
| Digits | Example | Digits | Example |
| 3 | 5-8-2 | 3 | 3-5-1 |
| 4 | 7-2-8-5 | 4 | 3-8-2-9 |
| 5 | 1-8-5-7-9 | 5 | 2-7-1-9-3 |
| 6 | 2-6-1-9-5-8 | 6 | 5-3-8-2-9-4 |
| 7 | 7-3-5-1-8-9-6 | 7 | 3-8-5-2-6-1-9 |
| 8 | 2-8-6-9-7-3-8-1 | 8 | 2-5-8-1-4-9-8-6 |

Table 3: Comparison of pre-study digit span test scores between meditator and control groups: (mean± SD)

| DST type | Meditator Group (n= 50) | Control Group (n= 50) | P-Value | t value |
|--------------|----------------------------|--------------------------|---------|---------|
| Forward DST | 4.52± .61 | 4.46± .50 | 0.59 | 0.534 |
| Backward DST | 3.24± .62 | 3.10± .64 | 0.27 | 1.101 |

Table 4: Comparison between Pre- and Post- study Digit Span Test (DST) scores for meditator and control groups:- (Mean± SD)

| DST Parameters | | Meditator Group (n= 50) | Control Group (n= 50) |
|----------------|------------------|----------------------------|--------------------------|
| Forward DST | Pre-study score | 4.52 ± .61 | 4.46 ± .50 |
| | Post-study score | 4.68 ± .55 | 4.40 ± .49 |
| | P value | 0.031* | 0.182 |
| | t value | - 2.221 | 1.353 |
| Backward DST | Pre-study score | 3.24 ± .62* | 3.10 ± .64 |
| | Post-study score | 3.46 ± .50 | 3.06 ± .61 |
| | P value | 0.026* | 0.420 |
| | t value | - 2.292 | 0.814 |

Discussion

In the current study we investigated the impact of MM on attention and working memory in elderly people. The key question was – whether mindfulness meditation would be able to counter the age induced decline in cognitive functions? We used digit span test to assess the attention and working memory capacity. Pre & post study DST scores test assessment showed significant improvement in meditating group scores. On the other hand, in case of control group there was no significant finding. These observations are consistent with the view that mindfulness meditation has beneficial effect on attention and working memory.

This result is in line with previous studies. Jha et. al conducted a study to observe the protective effect of mindfulness training (MT) on the working memory capacity in military personals. In MT group there was improvement in test scores which showed the beneficial effect of MM on working memory. They also hypothesized that MM might improve the working memory “reserve”, which might play a significant protective role against age induced cognitive decline.⁸ The study done by Chamber et al showed improvement in attention blink & working memory capacity after 10-day intensive mindfulness meditation retreat.⁹

Aging is associated with many structural and neuro-physiological changes in the brain which manifest as compromised cognitive functions. But these changes don't affect equally to all parts of the brain. That is why aging has non-uniform impact on cognitive domain.¹⁰ Frontal & parietal cortexes are mainly affected by aging process. Faulty regulation of dopamine receptors of frontal lobe results in compromised working memory. “Working memory” may be defined as short term storage of task relevant information while it is being used for the performance of task. “Attention” is the key factor which determines the information to be stored in the working memory. According to “Inhibition Control theory”, proposed by Hasher & Zacks, inhibition control mechanism

does not allow irrelevant information to enter and eliminates information no longer useful from the domain of working memory. Aging associated decline in attention hampers the inhibition control mechanism of working memory. It results in impaired functioning of working memory.¹¹

MM develops attention & capacity to disengage attention from random thoughts, feelings and sensation. In this way, MM improves the attention network efficacy.¹² MM practice has shown to improvement in electrophysiological markers of attention mediator.¹³ Enhancement in attention might lead to beneficial effect on task relevant information allocation and irrelevant information deletion from working memory. Dopamine receptor binding in frontal and parietal region, which is associated with attention & working memory, might be improved by cognitive training.¹⁴ MM favours a balance between alert and relaxed mental state. It leads to proper management of attention resources which improves the cognitive functions.¹⁵ Mindfulness practice improves the thought monitoring and provides the capacity to emotionally disengage from the stress inducing thought or stimulus. This self-management of emotions could an important factor in cognitive functions improvement.¹⁶

We acknowledge some limitations in this study. Firstly, Because of resource constraints we were unable to provide the same environment to the subjects of both groups. The control group was not under any supervision during study period. Secondly, our study did not provide any direct causal inferences about the effect of MM on attention & working memory. Thirdly, as far as “attention assessment” is concern, Digit span test estimates only the “auditory” component of attention. So future studies could involve test for examining visual attention.

Conclusion

The current study supports the notion that mindfulness meditation improves the auditory attention and working memory in elderly age group people. Further studies are

warranted to identify and establish mechanism of effect of mindfulness meditation on cognitive functions. EEG study along with mediation might be helpful in this context.

Conflict of Interest: None.

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