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**Effect of vestibular stimulation on memory in postmenopausal Women with Osteoporosis****Danasegaran M<sup>1</sup>, Prabha V,<sup>2</sup> Komala Rao,<sup>3</sup> V Ramesh<sup>4</sup>, Purna Singh<sup>5\*</sup>**<sup>1</sup>*Department of Physiology, JIPMER, Pondicherry, India*<sup>2</sup>*Department of Physiology, Chamarajanagar Institute of Medical sciences, Chamarajanagar, Karnataka, India.*<sup>3</sup>*Dept. of Orthopaedics, GEMS, Srikakulam, Andhra Pradesh, India*<sup>4</sup>*Dept. of Orthopaedics. GEMS, Srikakulam, Andhra Pradesh, India*<sup>5</sup>*Department of Biomedical Sciences, King Faisal University, Saudi Arabia.*

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**ABSTRACT**

The current study was aimed to assess effect of vestibular stimulation on memory in postmenopausal Women with Osteoporosis. 30 post menopausal women with diagnosed Osteoporosis for past 5 years were recruited for the study after written informed consent by convenient sampling. Permission obtained from the Institutional Ethics Committee of GEMS Hospital, Srikakulam. After selection they were randomly grouped into control and intervention groups. Vestibular stimulation was achieved by swinging on a swing, according to their comfort. (Back to front direction) as previously described. Standardized spatial and verbal memory test was used to assess the spatial and verbal memory. Vestibular stimulation is found to be an effective method to improve cognition. Hence we recommend further detailed studies to support implementation of vestibular stimulation in clinical practice.

**Key words:** Vestibular stimulation, Cognition, Memory, Post-menopausal women

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**Introduction**

Production of Ovarian estrogen production begins to decrease 1 or 2 years before menopause. It was reported that brain was the important target for the estrogen and estrogen can influence brain activity by direct and indirect ways. [1] Estrogen will enhance synaptic plasticity, neurite growth, hippocampal neurogenesis, and long-term potentiation and helps in the formation of memories. It was reported that estrogen prevents Alzheimer's by inhibiting formation of beta amyloid plaques in the brain. Moreover, estrogen can influence several major neuro-transmitters responsible for cognition. Cholinergic neurons are reported to possess estrogen receptors. Hence estrogen can modulate cognition. [2] In contrast it was also reported that Serum estrogen levels at midlife are unrelated to episodic memory. [3, 4] Interestingly, it was reported that the decline in cognition was not

progressive in post menopausal women. [5] Earlier studies reported that Vestibular stimulation is known to modulate cognitive processing, enhance learning and spatial memory long term vestibular stimulation may be effective in enhancing cognition by reducing the cognitive, neurodegenerative, neuro-inflammatory changes and behavioral deficits.[6,7,8] The current study was aimed to assess effect of vestibular stimulation on memory in postmenopausal Women with Osteoporosis.

**Materials and methods**

**Study design:** This was a longitudinal follow-up study in which participants were assessed for memory for 2 times. Before the intervention and after 6 months of the intervention.

**Participants:** 30 post menopausal women with diagnosed Osteoporosis for past 5 years were recruited for the study after written informed consent by convenient sampling. Permission obtained from the Institutional Ethics Committee of GEMS Hospital,

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Srikakulam. After selection they were randomly grouped into two groups.

Group A: (n=15) Control group: Only routine treatment and no vestibular stimulation for 6 months

Group B: (n=15) Routine treatment+ Vestibular stimulation for 6 months

Pain scores was recorded before and after intervention and compared.

**Vestibular stimulation:** Vestibular stimulation was achieved by swinging on a swing, according to their comfort. (Back to front direction) as previously described. [6, 7, 8]

**Spatial and verbal memory:** Standardized spatial and verbal memory test was used to assess the spatial and verbal memory.[9,10]

**Statistical analysis**

Data was analyzed by SPSS 20.0. Data

## Results

Results are presented in table no 1 and 2. Highly significant improvement was observed in spatial memory followed by vestibular stimulation ( $P < 0.001$ ). Significant improvement was observed in verbal memory ( $P < 0.05$ ).

**Table 1: Memory in control and intervention groups before intervention**

Parameter	Control	Intervention group	P value
Spatial memory	4.2±2.3	4.6±1.82	0.20449
Verbal Memory	3.45±1.92	3.37±2.24	0.55402

Data was presented as mean±SD (\* $P < 0.05$ , \*\* $P < 0.01$ , \*\*\* $P < 0.001$ )

**Table 2: Memory scores in control and intervention groups after intervention**

Parameter	Control	Intervention group	P value
Spatial memory	4±2.7	5.7±1.66	0.0007***
Verbal Memory	3.48±0.88	4.34±1.47	0.01992*

Data was presented as mean±SD (\* $P < 0.05$ , \*\* $P < 0.01$ , \*\*\* $P < 0.001$ )

## Discussion

It was reported that vestibular stimulation has positive impact on both spatial and verbal memory. [11] Animal studies also reported improvement in memory followed by vestibular stimulation. [12] It was reported that especially otolithic and visual stimulation influence on cognitive processes. [13] Vestibular stimulation was found to modulate cognition through emotional circuits.[14] Vestibular stimulation is well connected with hippocampus.[6] In fact vestibular system is essential for maintenance of normal functioning of hippocampus, as vestibular lesion caused atrophy of hippocampus.[15] Vestibular stimulation can modulate memory through limbic system, neo-cortex and HPA axis.[6] Vestibular stimulation was found to increase acetylcholine release from rat hippocampus and enhances long term potentiation via activation of cholinergic septo-hippocampal cells.[16,17] Our study supports earlier studies as we have observed significant improvement in both spatial and verbal memory in intervention group followed by vestibular stimulation.

## Limitation

Major limitation was small sample size.

## Conclusion

Vestibular stimulation is found to be an effective method to improve cognition. Hence we recommend further detailed studies to support implementation of vestibular stimulation in clinical practice.

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