

The Effectiveness of Vestibular Stimulation by Rocking and Vestibular Exercises on Auditory and Visual Reaction Time and Quality of Life in Elderly

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Abstract

The present study was undertaken to observe the effectiveness of vestibular stimulation by rocking on auditory and visual reaction time and quality of life in the elderly. A total of 150 elderly male and females were part of the study after obtaining the written informed consent. After recruiting the participants, they were randomly grouped into three groups with 50 participants in each group. Neither exercise nor rocking was administered to the control group. Rocking was administered using a rocking chair once a day for 5 days in a week for 6 months for a rocking group. Rocking was administered using a rocking chair once a day for 5 days in a week + vestibular exercises were practiced two sessions per week for 6 months for rocking and vestibular exercise group. There was a significant decrease in the visual reaction time in the rocking only and rocking+ vestibular exercise groups ($P<0.05$). There was a decrease in the auditory reaction time in rocking only group. However the decrease is not statistically significant. There was a significant decrease in the auditory reaction time in the rocking+ vestibular exercise group ($P<0.05$). There was a significant increase in the physical health domain of quality of life in the rocking only and rocking+ vestibular exercise groups ($P<0.05$). There was a slight increase in the psychological domain of quality of life in the rocking only and rocking+ vestibular exercise groups. However the increase is not statistically significant. There was a significant increase in the social relationships domain of quality of life in the rocking only and rocking+ vestibular exercise groups ($P<0.05$). There was a slight increase in the environmental domain of quality of life in the rocking only and rocking+ vestibular exercise groups. However the increase is not statistically significant. The present study results support the beneficial effects of vestibular exercises and rocking on reaction time and quality of life in elderly. The study also recommends further detailed studies in this area to recommend application of vestibular exercises and rocking in elderly population.

Keywords: Vestibular stimulation, Elderly, Quality of life, Rocking.

Introduction

The vestibular system is considered the gateway to the brain and is said to have the most important influence on everyday functioning. Several recent

studies associate the function of vestibular system beyond maintaining balance, equilibrium and/or reflexes with advanced functions such as improving cognition, improving general health and reducing stress. As the vestibular system remains enigmatic among the human senses, it is fast becoming one of the most thoroughly and broadly investigated topic of this era.¹ Vestibular stimulation is the Input that the body receives when it experiences movement or change in direction. It can be mild such as nodding head or climbing stair, or intense such as skydiving or going on a roller coaster.

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Vestibular sensation provides information to the CNS about movement and position of the head in space in order to have conscious perception of head movement and position and reflexive control of posture and balance, head position and eye-head coordination. Stimulating vestibular system in a controlled way has shown many benefits such as decreased self-stimulation and hypersensitivity, increased postural security, concentration, attentiveness, balance and body awareness, calming effects and reduction of abnormal muscle tone.² The role of vestibular stimulation in improving initiation of movement, a better posture, increase in step length and stabilize small sway is reported in Parkinson's disease.³ Rotatory vestibular stimulation is reported to be effective in improving motor skills in children's with autism.⁴ Vestibular stimulation is reported to have stimulatory effect on GABA transmission in the ipsilateral substantia nigra and has an enhancing effect on locomotion in hemiparkinson lesions.⁵ Vestibular stimulation being a safe, inexpensive and non-time consuming technique to stimulate vestibular system offers ease of incorporation into our daily life to improve motor functions. The present study was undertaken to observe the effectiveness of vestibular stimulation by rocking and vestibular exercises on auditory and visual reaction time and quality of life in elderly.

Materials and Method

Study Design: Experimental study with pre and post control.

Study Setting: The present study was conducted at St. Mary's school of nursing, Podanur, Tamil Nadu, India.

Participants: A total of 178 elderly male and female participants were screened to recruit in the study. Twenty-eight individuals were not met with the inclusion-exclusion criteria. The participants were recruited from different old age homes of Coimbatore. The study protocol was duly approved by the institutional ethics committee. Written in-formed consent was obtained from all the participants. The following inclusion and exclusion criteria were followed while recruiting the participants:

Inclusion Criteria:

1. Age group 60 years to 75 years.
2. Willing participants.

Exclusion Criteria:

1. Patients with Inner ear disease, Migraine, cerebrovascular disease and any serious systemic illness.
2. Patients undergoing therapy or treatment for postural stability
3. Unwilling participants.

After recruiting the participants, they were randomly grouped into three groups with 50 participants in each group.

The control group (n=50): Neither exercise nor rocking was administered.

Rocking group (n=50): Rocking was administered using a rocking chair once a day for 5 days in a week for 6 months.

Rocking and vestibular exercise group (n=50): Rocking was administered using a rocking chair once a day for 5 days in a week + vestibular exercises were practiced two sessions per week for 6 months.

Rocking Chair: Rocking chair was specially designed for the study. Details of the rocking chair was mentioned in our previous article.¹¹

Vestibular exercises: Each session of exercises comprises of 45 minutes. Two sessions per week were administered to the participants.^{6,7}

Outcome Measures:

Assessment of Reaction Time: RT apparatus for research, manufactured by Anand Agencies, Pune, was used to record auditory and visual RT. Anand Agencies (<http://www.anandagenciespune.in>).^{8,9}

Assessment of quality of life: Quality of life was assessed using WHOQOL-BREF questionnaire.¹⁰

Ethical Considerations: The present study was approved by the institutional human ethical committee of Saveetha Institute of Medical and Technical Sciences.

Data Analysis: Data was analyzed using SPSS version 20.0. One way ANOVA was used to observe significance of difference. Probability value less than 0.05 was considered as significant.

Results

There was a significant decrease in the visual reaction time in the rocking only and rocking+ vestibular exercise groups (P<0.05). There was a decrease in the auditory reaction time in rocking only group. However the decrease is not statistically significant. There was a significant decrease in the auditory reaction time in the rocking+ vestibular exercise group (P<0.05). There was a significant increase in the physical health domain of quality of life in the rocking only and rocking+ vestibular

exercise groups (P<0.05). There was a slight increase in the psychological domain of quality of life in the rocking only and rocking+ vestibular exercise groups. However the increase is not statistically significant. There was a significant increase in the social relationships domain of quality of life in the rocking only and rocking+ vestibular exercise groups (P<0.05). There was a slight increase in the environmental domain of quality of life in the rocking only and rocking+ vestibular exercise groups. However the increase is not statistically significant.

Table 1: Visual reaction time (ms) of the participants before and after vestibular stimulation

	Control	ROC	R+V
Baseline	0.781±0.5185	1.0582± 0.3978	0.8118± 0.3531
After 3 months	1.0646±0.576	0.5588± 0.5164	0.6298± 0.5921
After 6 months	0.9603±0.4938	0.382± 0.1708	0.4052± 0.2043
F value	3.72722	41.44296	12.27881
significant	P<0.05	P<0.05	P<0.05

(*P<0.05 is significant)

Table 2: Auditory reaction time (ms) of the participants before and after vestibular stimulation.

	Control	ROC	R+V
Baseline	0.6263±0.4174	0.635±0.4126	0.9208±0.5791
After 3 months	0.9771±0.4365	0.593±0.3917	0.5166±0.3847
After 6 months	0.9772±0.5405	0.5084±0.3296	0.4052±0.2043
F value	9.55409	1.47115	21.44575
significant	P<0.05	no	P<0.05

(*P<0.05 is significant)

Table 3: QOL-Physical health of the participants before and after vestibular stimulation.

	Control	ROC	R+V
Baseline	44.04±12.1133	44.84±13.9713	44.54±13.1587
After 3 months	43.56±12.0647	64.7±14.9178	72.94±10.3123
After 6 months	43.92±12.2705	69.38±15.8911	68.22±14.0354
F value	0.02114	37.98994	72.90773
significant	no	P<0.05	P<0.05

(*P<0.05 is significant)

Table 4: QOL-psychological of the participants before and after vestibular stimulation.

	Control	ROC	R+V
Baseline	60.8±14.1465	62±12.8269	61.56±14.1308
After 3 months	60.08±13.1146	69.82±19.2351	68.42±18.0703
After 6 months	61.04±14.327	67.44±19.9378	67.06±17.9312
F value	0.06485	2.58602	2.33442
significant	no	no	no

(*P<0.05 is significant)

Table 5: QOL-social relationships of the participants before and after vestibular stimulation

	Control	ROC	R+V
Baseline	51.66±17.0349	51.36±17.0471	50.86±16.9489
After 3 months	50.72±9.9899	61.66±18.1688	72.7±12.8782
After 6 months	52.12±16.5562	56.46±15.1256	68.56±15.3492
F value	0.11501	4.68338	29.30893
significant	no	P<0.05	P<0.05

(*P<0.05 is significant)

Table 6: QOL-environmental of the participants before and after vestibular stimulation

	Control	ROC	R+V
Baseline	73.3±12.6495	74.12±11.5009	73.04±13.9532
After 3 months	66±13.4012	73.94±12.2481	74.18±12.7962
After 6 months	73.3±12.6495	76.92±13.7527	74.62±14.8858
F value	5.33314	0.88842	0.17196
significant	P<0.05	no	no

(*P<0.05 is significant)

Discussion

The present study was undertaken to observe the effectiveness of vestibular stimulation by rocking and vestibular exercises on auditory and visual reaction time and quality of life in elderly. There was a significant decrease in the visual reaction time in the rocking only and rocking+ vestibular exercise groups (P<0.05). There was a decrease in the auditory reaction time in rocking only group. However the decrease is not statistically significant. There was a significant decrease in the auditory reaction time in the rocking+ vestibular exercise group (P<0.05). There was a significant increase in the physical health domain of quality of life in the rocking only and rocking+ vestibular exercise groups (P<0.05). There was a slight increase in the psychological domain

of quality of life in the rocking only and rocking+ vestibular exercise groups. However the increase is not statistically significant. There was a significant increase in the social relationships domain of quality of life in the rocking only and rocking+ vestibular exercise groups (P<0.05). There was a slight increase in the environmental domain of quality of life in the rocking only and rocking+ vestibular exercise groups. However the increase is not statistically significant. Vestibular system is extensively connected to the cognitive areas of the brain especially hippocampus, basal ganglia, parieto-frontal cortices, cerebellum which is collectively called vestibular cortices.¹² The hippocampus is the fundamental integrative center for spatial processing and regulating the exploratory activities. Vestibular system is extensively connected to the hippocampus through

four main pathways. Connections among vestibular nuclei, hippocampus prefrontal & parietal cortices, limbic system, thalamus are vital for cognitive functions such as spatial functions, navigation and various types memory. As we can see through examples, bilateral vestibular lesions had consequence like spatial memory deficits, bilateral hippocampal atrophy and reduced fractional anisotropy in white matter tracts within the limbic system and the thalamus.¹³ Vestibular input is crucial in generating theta rhythm by place cells and head direction cells in hippocampus, Para hippocampal area and thalamus Which in turn important for spatial orientation or spatial memory. It has been proven that loss of vestibular function abolishes the theta rhythm generation and could lead to bilateral hippocampal atrophy.¹⁴ Vestibular stimulation is known to stimulate septohippocampal cells in CA1 area of hippocampus there by Long Term Potentiation (LTP).¹⁵ The increment of dendritic arborization and synapses in the hippocampal pyramidal neurons by vestibular stimulation improves the performance in the spatial learning tasks.¹⁶ Controlled vestibular stimulation inhibits both stress axis (Hypothalamic-pituitary-adrenocortical (HPA) axis & sympathetic adrenomedullary (SAM) axis) and this leads to decrement of glucocorticoids and cortisol levels which indirectly modulates learning and memory.¹⁷ The major mechanism behind it is vestibular system is extensively connected to brain structures involved in emotions, behaviour and cognition.¹⁸ The study results are in accordance with earlier studies.

Conclusion

The present study results support the beneficial effects of vestibular exercises and rocking on reaction time and quality of life in elderly. The study also recommends further detailed studies in this area to recommend application of vestibular exercises and rocking in elderly population.

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Conflicts of Interest: None declared

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