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Effect of auditory cueing, foam hurdle crossing with eyes closed on balance and quality of life in geriatric population- An experimental study

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Abstract
Background: Aging in elderly people often develops fear of fall, risk of fall, impaired balance, poor eyesight, leading to limitation in functional activities/impairments, poor quality of life. Screening and treating fear of fall and balance impairments will lead to betterment in quality of life (QoL).
Purpose: The effect of auditory cueing and eyes closed foam hurdle crossing on balance and quality of life in geriatric population.
Design: A single group pre post experimental design.
Setting: The study was conducted at old age homes and tertiary care hospital.
Patients: 30 elderly subjects above 60 years were recruited using Berg balance score (BBS) of >21.
Intervention: Intervention given is eyes closed foam hurdle crossing exercises on auditory cueing for 20 minutes a day, five times a week over three weeks.
Measurements: Patients were assessed at baseline for balance using Balance Evaluation System Test (BEST) and for QoL using Old People Quality of Life scale (OPQoL). All subjects were re-assessed after 15 sessions.
Results: Mean, standard deviation, paired t Test were used. There was a statistically significant change in the BEST and OPQoL scores post intervention with p value <0.05.
Conclusion: Auditory cueing followed eyes closed foam hurdle crossing exercises were effective in improving balance and QoL in geriatric population.

Keywords: Geriatric, auditory cueing, foam hurdle-crossing, balance

Introduction
Human Ageing refers to multidimensional process of physical, psychological and social changes [1], which occurs with time along with gradual decline in body's functional capacity [2]. Globally India stands at second position with 1.2 billion geriatric population. It is expected that geriatric population will be crossing 177 million (10.8%) by 2025 and 324 million by 2050 of total world population.
Annually one third of the geriatric population experience accidental falls. Among these, 10% land-up into serious injuries like fractures [3].
Consequences of limitation in physical inactivity may be due to systemic changes [4]. This leads to the development of fear of fall, balance problems and frank falls leading to functional disability [5].
Balance is also a commonly faced problem which affects performance of activities of daily living. This may be a result of decrease in balance controlling mechanism and maintaining static balance, which leads to abnormal postural sway [6, 7], inability to react quickly to known or unknown perturbations [8].
After extensive literature search numerous studies and protocols for balance training were found, using cueing (Metronome or RAS) and obstacle crossing in freezing and non-freezing gait in Parkinson's, Alzheimer's disease, and stroke. Few studies in healthy geriatric population with the similar intervention mentioned above showed improvements in gait parameters. However there is paucity of literature on interventions such as hurdle crossing with eyes closed on auditory cueing. So correction of balance problems to prevent falls and to improve attention levels, complex balance training should be incorporated which is posited to have a positive impact on quality of life in geriatric population. Hence the objective of the study is to evaluate the effectiveness of auditory cueing, Foam Hurdle

crossing with eyes closed on balance and QoL in geriatric population using BEST and OPQoL Scale respectively.

Methods

Ethical approval was obtained from Institutional review board. Informed consent was obtained from all the subjects who were willing to participate in the study. Thirty elderly subjects were included in study. Subjects were >60years of age of both genders, able to perform activities of daily living on their own, ambulate without any support or walking aids with berg balance scale score more than 20. Exclusion criteria was hearing loss or hearing disorders, amputation or deformities of lower limb, history of any musculoskeletal injuries, neurological problems (like stroke, multiple sclerosis and Parkinson's disease) which can affect balance.

Experimental Design

Balance and quality of life were assessed using BEST and OPQoL scale respectively, after which eyes closed foam hurdle crossing on auditory cueing was given for 20 minutes, 5days a week, for 3 weeks. In 1st week small Size Foam Hurdle of 4inches, in the 2nd week medium Size Foam of 6inches and in the 3rd week different size foam hurdles were used for hurdle crossing with eyes closed on auditory cueing.

Data Collection

Pre-post assessment for balance was done using BEST under six different sub-components. This include base of support, ankle strength, functional reach forward and lateral, sit to stand, stand on one leg, standing eyes open and closed on firm and foam surface and timed up and go test. Quality of life was assessed using OPQoL questionnaire. It has 8 sub-components which include life overall, health, social relationship independence/control over life home and neighborhood, psychological/emotional well-being, financial circumstances and leisure/activities which was read and explained in there understandable language.

Statistical Analysis

Statistical analysis were done manually as well as using SPSS version 21. Mean, standard deviation, and paired t Test, were used. Probability values <0.005 were considered statistically significant.

Results

The total number of male participants was 17 and female were 13. Age of the participants in the study was >60 years with mean age of 69.2±7.65 years. Other demographic data is shown in Table1.

Balance and QoL was measured by BEST and OPQoL which showed statistically significant results with p value <0.005. (Table 3)

Domains of BEST and QoL were also found to be statistically significant with p value <0.005. (Table 4 & Table 5 respectively)

Table 1: Demographic Data

Variables	Age	Height	Weight	BMI
Mean ± SD	69.2±7.65	158.93±9.57	58.74±8.46	23.13±1.60

Table 2: Distribution of male and females

Gender	N	%
Male	17	56.66
Female	13	43.33
Total	30	100.00

Table 3: Pre-Post intervention values of BEST and OPQOL

Variables	Pre-test	Post-test	P value	t value
BEST	82.13±10.70	92.03±8.81	<0.000**	-12.55
OPQOL	101.9±13.38	95.83±12.61	<0.000**	7.45

*p<0.05; **p<0.001

Table 4: Pre-Post Values of Domains of BEST Scale.

Balance Evaluation System Testing			
Domains / Pre-Post Values	Pre-test Values	Post-test values	p value
Bio-Mechanical Constraints	12.47±2.16	12.50±2.15	0.162
Stability Limits/Verticality	16.17±2.82	16.57±2.65	0.031*
Transitions/Anticipatory	13.53±2.21	16.53±2.53	0.000**
Reactive	13.43±2.43	14.33±2.51	0.000**
Sensory Orientation	10.37±2.17	13.73±1.20	0.000**
Stability in Gait	15.40±3.27	17.27±2.12	0.021*

*p<0.05; **p<0.001

Table 5: Pre-Post Values of Inter-Domains of OPQoL Scale.

Old People's Quality Of Life Scale			
Domains/Pre-Post Values	Pre-test Values	Post-test values	p value
Life Overall	13.80±2.23	13.63±2.14	0.028*
Health	12.63±1.59	12.43±1.68	0.041*
Social Relationship	13.73±2.48	10.13±2.60	<0.000**
Independence/Freedom/Control Over Life	11.37±2.67	11.17±2.79	0.041*
Home and Neighbourhood	10.17±1.86	9.57±1.48	0.000**
Psychological/Emotional Well-Being	10.63±1.48	9.73±2.55	0.010*
Financial Circumstances	12.90±2.59	12.73±2.56	0.011*
Leisure and Activities	17.73±4.53	17.47±4.58	0.021*

*p<0.05; p<0.001

Discussion

The purpose of this study was to investigate, the effect of auditory cueing, foam hurdle crossing with eyes closed on balance and QoL in geriatric population. The participants were asked to cross foam hurdle on auditory cueing for 20 minutes a day, 5 days a week for 3 weeks.

The changes that occur in geriatric population due to ageing can be categorized as sensory, motor and somatosensory, with somatosensory being affected more as compared to sensory and motor. Aging always shows deterioration in balance, mobility and development of fear of falls. Characteristic symptoms shown by elderly are excessive swaying, reduction in cadence, stride length, step length, increased base of support. A compromised visual, auditory and vestibular system also plays a prime role in deterioration of balance. The main concern in this study is fear of fall, fall and balance. This can lead to limitation in functional and social activities [9]. The intervention had comprised of, eyes closed foam hurdle crossing with auditory cueing, which targeted the postural stability, orientation in space, joint proprioception and spatio-temporal parameters of gait.

The mean age of the subjects was 69 years. This co-related with a study with mean age of 70 years which showed decline in ability to maintain stance, sensory function, and decline in muscle mass, volume, strength, Loss of type II fibers, decreased visual, vestibular and auditory inputs, which are all inter-dependent to maintain balance [10].

Many of the subjects were diabetic however it was not screened in the present study. Long term diabetes will lead to neuropathy. There may be a loss of type II motor units distally resulting in decreased joint proprioception [7, 8]. With addition to reduced strength in geriatric subjects, impaired proprioception due to diabetes may have resulted in balance problem in this age group.

The BMI in our study was 23.13±1.6. This co-relates with a study with the mean BMI of 24.5. Increased in BMI will lead to reduction in physical activity, reduce balance ability, reduced, grip, sensory deficits, vision impairments and decreased sensory motor abilities [11].

According to BEST scale the over-all post-intervention score improved. However out of 6 domains of BEST score of only one domain did not change that is bio-mechanical constraint. The sub-component i.e. base of support (BoS), center of mass (CoM), ankle strength, hip/ trunk lateral strength and sit to stand from floor have no statistically significant results. The subjects in the study were using large base of support in initial phase of intervention but as the sessions progressed the subjects reduced their base of support. Initially, because of occlusion in vision, the subjects used large base of support. During the course of intervention the subjects started using other systems of balance by compensating for the lack of vision [12]. These finding were significant clinically but not statistically.

In this study abnormal antero-posterior CoM alignment was seen. This may be a compensatory mechanism to accommodate the line of gravity within the BoS. This helps in improving the limits of stability thus reducing the occurrence of falls.

As stated the ankle strength was priory reduced due to multiple factors. In the present intervention none of the activities targeted the ankle activity, targeted activity of gastrocnemius and the tibialis anterior was not concentrated. These are the two major muscles that are required for producing torque around the ankle joint[13]. In addition to the reduced strength and other pre-morbid factors, no change has been seen the ankle strength and range.

Similarly the intervention did not target any proximal hip musculature which are required for activities such as hip/trunk lateral strength and sit to stand from floor. Even though the participants used hip strategy for maintaining balance, no changes were noted in the above factors.

The components of balance evaluation system test are based on postural control. The two main functional goals of postural control are postural orientation and postural equilibrium [14].

Biomechanical constraints

Lower scores were obtained for this component as well as no significant differences were obtained post intervention.

A study suggested that, intrinsic risk factors responsible for falls in the elderly population involve sex, race, and age related decline in strength, balance, vision, cognition and chronic diseases. These factors are major components for maintaining postural control [15].

Vision was occluded as a part of the intervention protocol which may have affected the subject's ability to maintain postural alignment with respect to the BoS. Age related decline in strength and mobility may be another factor for reduced postural control during hurdle crossing.

Stability Limits/ Verticality

Many factors have an impact on stability limits of body, including both velocity and position of CoM [16]. At the beginning of intervention, obstruction of vision had a negative impact on velocity. However with practice there were able to control the velocity thus helping them to maintain the CoM within the BoS.

In addition, stability limits are affected by many other factors such as fear of falling and perception of safety [15]. The perception of safety was kept in mind while crossing the hurdle and confidence was given to subjects by giving one on one intervention which also had a positive effect on reduction in fear of fall. Feedback from the external environment which also includes auditory cueing provides a sense of safety to any individual which have resulted in improvement.

Transitions-Anticipatory Postural Adjustment

Intervention had no activities of this domain, improvement was seen in the scores post treatment which may be due to the following reasons.

Visual inputs can influence postural control both reactively and in an anticipatory manner. Visual cues about the configuration of the environment can determine the strategies that are used to respond to a slip or trip. To determine the proactive contributions of vision to balance recovery, experiments were performed in which young adults walked into a room and then were instructed to use a handrail to recover balance in response to a platform translation. Liquid crystal goggles were used to occlude vision during response initiation. Results showed that the initial grasping trajectory was not affected by visual occlusion indicating that, information about the location of the railing was obtained prior to the perturbation onset, probably through the creation of an egocentric spatial map created upon entering the room. This thus ensures very rapid and accurate response onsets to unexpected balance threats [17].

As vision was occluded in our intervention as well, it can be said that the subjects may have created an image of the obstacles which were shown prior to initiation of the hurdle crossing activity. This may be one of the reasons for improved anticipatory postural control. Additionally, the

auditory cues provided during the intervention helped in anticipating the stimulus for postural disturbance.

Degree of practice has also shown to influence the timing of anticipatory postural adjustments. Dancers have been shown to activate anticipatory postural adjustments in a leg lifting task significantly earlier than non-dancers. This suggests the possibility that practicing tasks that require anticipatory postural activity may increase the efficiency of this component of postural control over time [17].

Reactive postural response

Age related decline in reactive postural control has been shown in many studies. Foam hurdles was the stimulus for reactive postural response. Subjects at first faced difficulty while crossing but with continual practice subjects were able to identify and judge the placement of the foot over the hurdle, accordingly making a stepping response.

Motor learning acquired through practice of the task is another important reason for improved postural control post intervention.

Stages of motor learning consist of the cognitive, associative and autonomous stage[18]. The task of hurdle crossing was first explained and demonstrated to the patient. This was practiced several times, followed which an automatic response was attained. This can be associated to the stages of motor learning. Auditory cueing facilitated this motor learning of the task and also provided a feedback to the subject.

Study done on Motor learning in Parkinson's disease has suggested that cueing is an important tool for Motor Learning. Not only did the cues improve dual-task performance, but also carry-over effects were even more pronounced during dual than single task conditions [19].

Sensory Integration for Balance

When the reliable Proprioceptive information from feet and ankles is altered (stance on the foam surface), subjects are compelled to rely more on other sensory (visual and vestibular) and motor systems to maintain stability [10].

These components require integration of all the sensory systems. But when vision is occluded the subject has to rely on the somatosensory and the vestibular systems to maintain balance. This increases the efficiency of the subject to use the other sensory systems as every individual is heavily dependent on his vision to maintain balance.

Our intervention challenged the subject to use their somatosensory and vestibular system. This was observed as increased vertical and horizontal head and neck movements indicating the use of vestibular system and as well as the somatosensory system seen as change in gait parameters. This reduces the heavy reliance of the individuals on the visual system. This could have helped in providing better scores on the components of sensory integration as subject was now able to interpret the type of response required.

Stability in Gait Section

Gait parameters as well as the ability to walk with heads turns and stepping over obstacles and reaction time using Timed Up and Go test were tested in this domain.

Analysis post intervention showed significant improvement for these components. The auditory cueing provided, served to improve the phases of gait as it reduced the cadence and gait speed.

However in our study the deficit of vision being occluded was compensated by the auditory cueing provided to the subjects during intervention [12].

Study done was done to assess the role of vision for control of balance during walking. They showed that integrative visual feedback information is primarily used during walking to control balance in the medio-lateral direction while in the antero-posterior direction stability is passively obtained through the dynamics of walking. Typical adaptations are a smaller stride length and a more plantar foot contact. They hypothesized that subjects develop a strategy to overcome the problems faced by sensory deprivation in order to maintain stability [20]. Similar results was also obtained in our study.

Quality of Life

Significant changes were seen in the scores of this questionnaire. Reduced physical activity as a result of fear of falls has a significant impact on the quality of life of an elderly individual. Participation in daily activities, socializing and financial circumstances is equally important for elderly subjects as it is for younger and middle aged adults. Dependence on others also negatively affects psychological and social wellbeing. Fear of factor is one reason for poor quality of life.

Research demonstrated that elderly people can develop fear of falling even when they have not fallen [21, 22]. Therefore overcoming the fear of falls in these individuals is the greatest challenge that a physical therapist faces. Therefore our intervention aimed that reducing this fear of fall through the task of hurdle crossing with eyes closed which had a positive impact on the domains of quality of life questionnaire. This shows the efficacy of the intervention as proven by the results.

References

1. Mane MB, Sanjana T, Patil PR, Srinivas T. Prevalence and Correlation of Fear of Fall among Elderly Population in urban area of Karnataka, India. Journal of Mid-life Health. 2014; 5:150-155.
2. Timiras PS. Physiological Basis of Aging and Geriatrics. 4th ed. New York. Library of Congress publications, 2007.
3. Selmanowitz WS, Rizer RL, Orentreich N. Aging of the skin and its appendages, In Finch C, Hayflick L: Handbook of the Biology of Aging. New York. Van Nostrand Reinhold Co. 1977, 496-509.
4. Brandfonbrener M, Landowne M, Shock NW. Changes in cardiac function with age. Circulation. 1955; 12:567-576.
5. Bader H. Dependence on wall stress in the human thoracic aorta of age and pressure. Circ Res. 1967; 20:354-361.
6. Wilson JD. The pathogenesis of prostatic hyperplasia. American Journal of Medicine. 1980; 68:745-756.
7. Rebeiz JJ, Moore MJ, Holden EM. Variations in muscle status with age and systemic diseases. Acta Neuropathol. 1972; 22:127-144.
8. Recker RR, Saville PD, Heavey RP. Effect of estrogens and calcium carbonate and bone loss in postmenopausal women. Ann Intern Med. 1977; 87:649-655.
9. Jung D. Fear of fall in Older Adults: Comprehensive Review. Asian Nursing Research. 2008; 2(4):214-222.

10. Abrahamova D, Hlavacka F. Age-related changes of human balance during quiet stance. Physiological Research. 2008; 57(6):957.
11. Jeon B J. The effect of obesity on fall in elderly people. Journal of physical therapy science. 2013; 25(11):1485-1489.
12. Iosa M, Fusco A, Morone G, Paolucci S. Effect of visual deprivation on gait dynamic stability. The scientific world journal. 2012, 1-7.
13. Devita P, Hortobagyi. Age causes a redistribution of joint torques and powers during gait. Journal of applied physiology. 2000; 88:1804-1811.
14. Horak FB. Postural orientation and equilibrium: what do we need to know about neural control of balance to prevent falls. Age and Aging. 2006; 35(2):ii7-ii11.
15. Dsouza SA, Rajashekar B, Dsouza HS, Kumar KB. Falls in Indian older adults: A barrier to active ageing. Asian Journal of Gerontology & Geriatrics. 2014; 9(1):33-40.
16. Shumway-Cook A, Woollacott MH. Motor Control: Translating Research into Clinical Practice. 4th edition. China: Lippincott Williams and Wilkins. 2010, 166-289.
17. Nieuwboera A, Rochesterb L, Liesbeth M, Swinnen SP. Motor learning in Parkinson's disease: limitations and potential for rehabilitation. Parkinsonism and Related Disorders 15S3. 2009, S53-S58.
18. O'Sullivan SB, Schmitz TZ. Physical Rehabilitation. 5th ed. Philadelphia: F A Davis Company. 2013, 227-271.
19. Abrahamova D, Hlavacka F. Age-related changes of human balance during quiet stance. Physiological Research. 2008; 57(6):957.
20. O'Connor SM, Kuo AD. Direction-dependent control of balance during walking and standing. J Neurophysiol. 2009; 102:1411-1419.
21. Murphy J, Isaacs B. The post-fall syndrome: A study of 36 elderly patients. Gerontology. 1982; 28:65-70.
22. Lau PY. To improve the quality of life in elderly people with fragility fractures. Hong kong Med J. 2016; 22:4-5.