

## ORIGINAL ARTICLE

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## COMPARISON OF MULTISENSORY VERSUS STRENGTHENING EXERCISES ON FUNCTIONAL MOBILITY AND BALANCE IN ELDERS

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## ABSTRACT

**Background:** Individuals with the age of 60 years and above may present with the symptoms of imbalance and body instability. Therefore, balance related activities such as standing, getting up from chair; walking becomes difficult which leads to fall. Also, old people are more prone to frequent diseases, sickness and also have limited regenerative capabilities when compared to other adults. So, the purpose of this study was to find out the comparison of multisensory versus strengthening exercises on functional mobility and balance in elders.

**Methods:** 45 subjects with good comprehension were selected for the study based on inclusion and exclusion criteria and were randomized into three groups Group A(15), Group B(15), Group C (15) by simple random sampling technique. The subjects in Group A received Multisensory exercises whereas Group B received strengthening exercises and Group C underwent Walking. The subjects were made to do these exercises for five days a week for a total duration of 6 weeks. The baseline values and post –test values were assessed with Timed ‘up and go’ test (TUG) and Guralnik test battery.

**Results:** The mean difference between subjects trained with Multisensory exercises (Group- A) and Walking (Group-C) is greater than Multisensory exercise (Group-A) and Strengthening exercise (Group B), Walking (Group C)and Strengthening(Group B)for both Timed up and go test ( $P<0.0001$ ) and Guralnik test battery( $P=0.05$ ) (Graph 1, 2). This shows that multisensory exercises are effective compared to strengthening exercises and walking.

**Conclusion:** In this study, multisensory exercises showed more improvement in mobility and balance. So, multisensory exercise can be considered as an adjunct with other exercises in rehabilitation of the elderly subjects with balance impairment.

**Keywords:** Multisensory Exercises, Strengthening, balance impairment, Elderly.

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## INTRODUCTION

Impairment of vision, vestibular and somato sensory information occurs in ageing process that results in problems of environmental perception and precision of movements there by leading to deficits of balance and gait [1].

The elderly population aged 60 years and above represents 7.4% of total population. About 65% of aged depends on others for day to day activities. The incidence of aged population with disability accounts 64 in rural areas and 55 in urban areas per thousand populations. Overall, 3% of people presents with locomotor disability which is the commonest disability among the aged persons [2]. A national survey have revealed that 5% of elderly presents with difficulty in physical mobility with women (7%) experiencing more difficulty than men (4%) [3].

Postural control plays a role in execution of activities such as sitting, standing and walking. This complex function requires input from vestibular, visual, proprioception and general exterosensibility which results in generation of motor response allowing the transition between dynamic and static activities [4]. The ability to maintain balance depends on the integrative functioning of many factors. Sensory information is received from visual, vestibular, proprioceptive, exteroceptive and tactile sources and provides that this information can be decoded and used by the intact nervous system. Balance becomes a function which is assumed and taken for granted. It is only when the balance mechanism fails that its importance is realized.

The most common intervention to prevent complications of decreased balance is physical exercise. The exercises that are designed to improve balance mainly concentrated on maintaining body Centre of mass with in base of support and the exercises includes participants exercise their muscles against an external force, as a consequence of voluntary movement or in response to an unexpected perturbation of stimulus [5].

Literature have put forward various exercises such as strengthening exercises, stretching, functional task, balance, Co-ordination, gait and 3D exercises (tai chi, yoga, dance), multisensory exercises to improve muscle strength, mobility, balance and to prevent risk of falls [6,7]. Multisensory teaching combines three learning senses, auditory (hearing and speaking), visual (seeing and perceiving), and kinesthetic (touch and movement). Exercises are taught using two or more of these modalities simultaneously to receive or express information.

Strength is the ability of a muscle or group of muscles to produce tension and a resulting force in one maximal effort, which dynamically is in relation to the demands placed upon it. Muscle strength can be determined by so many factors that include type of contraction, frequency of firing of motor units, psychological factors, angle of pull, length of muscle at time of contraction, neural factors, and length of lever arm, speed of contraction, genetic factors, number of motor units activated and cross-sectional area of the muscle. The general principles of strength training in

the early stages involves reducing pain and improving circulation, maintaining range of movement and circulation using passive movements, progressing to auto-assisted and manually assisted movement, ensuring correct postural alignment and support to maximize proprioceptive input and to prevent further damage.

Most of the elderly subjects presents with the impairment of functional mobility and balance which leads to fall. In literature various geriatric rehabilitation techniques have been implemented to improve balance. But selection of dominant technique is still controversial. So the purpose of the study is to find out the effect of techniques i.e., multisensory and strengthening exercises in elderly subjects with regards to functional mobility and balance.

## METHODOLOGY

All subjects of both male and female with age group between 60-70 years and who are independent to participate in physical activities were screened for inclusion. Subjects who were under any Physical therapy training in the last three months, Presence of any severe clinical and systemic illness or severe musculoskeletal impairments, cardio respiratory problems, presence of visual impairment, dizziness or falls were excluded for the study. The nature and purpose of the study was explained to the subjects before recruiting them in the study. Informed consent was taken from every subject.

All the 45 subjects with good comprehension were selected for the study based on inclusion and exclusion criteria and were randomized into three groups: Group A(15), Group B(15), Group C(15) by simple random sampling technique. The subjects in Group A received multisensory exercises, group B received strengthening exercises and group C underwent Walking. A pre-test score was taken before the commencement of exercises. The functional activity was measured using Timed 'up and go' test (TUG) and Guralnik test battery. This technique was given for five days a week for a total duration of 6weeks.

### GROUP A: MSE (MULTI SENSORY EXERCISES)

A warm up period with short walks followed by stretching exercises for Hip, Knee, Ankle and Para spinal muscles which was performed in Supine lying, sitting and Standing position. Following warm up period the subjects were made to do the following set of exercises that includes resisted exercises using theraband for flexors and extensors of lower limb and trunk against gravity with each exercise performed with three series of repetitions; the subject were asked to remain standing on uni or bipedal support with open or closed eyes; walking forward, backward, and sideways, both with open and closed eyes, at different speeds, even with varied distances and ground surfaces including mattresses and different densities of rubber foams challenged with obstacles likeropes, cones, and sticks (FIG:1). These sensorial challenges lasted 20 to 30 minutes. Finally, training of motor coordination was performed with alternate movements of upper and lower limbs with different positions of head and neck, and with and without visual

stimuli.



Figure 1: WALKING FORWARD

**GROUP B (STRENGTHENING EXERCISES):** The muscle strengthening program was performed using four different resistance devices such as chest press (FIG: 2), rowing (FIG: 3), leg press (FIG: 4) and calf (FIG: 5) with varying resistance. At each device the subjects were oriented to perform three series of exercises with varying load: the first (12 repetitions) with a load corresponding to 50% of the maximum, second (10 repetitions) with 75% of maximum, and last(8 repetitions) with maximum tolerable load based on De Lorme & Watkins.

**GROUP C:** Subjects were asked to walk for 30 minutes. The post test score of all the subjects were measured with Timed 'up and go' test (TUG), Guralnik test battery at the end of 6<sup>th</sup> week. The pre-test & post test scores were compared and analyzed statistically.



Figure 2: CHEST PRESS



Figure 3: ROWING



Figure 4: LEG PRESS



FIGURE-5: CALFS

#### DATA ANALYSIS AND RESULTS

The collected data were tabulated and analyzed using descriptive and inferential statistics. The data was analyzed using statistical package for social science (SPSS 17) to present the finding of the study. ANNOVA was used for this study.

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	1263.504	2	631.752	29.183	.000
Within Groups	909.220	42	21.648		
Total	2172.725	44			

**Table 1:** Comparison of multisensory exercises, strengthening exercises and walking training in terms of timed up and go test in elderly.

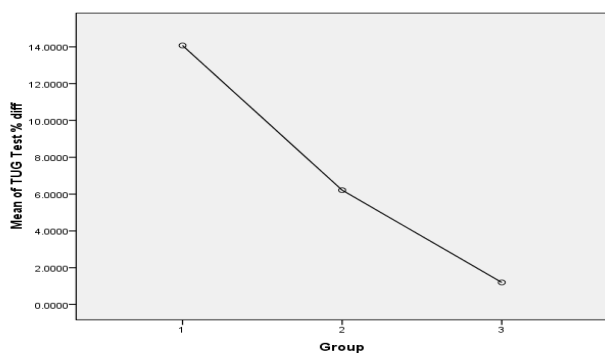
In this table the P value is less than 0.0001 which is highly statistically significant and indicates an improvement of mobility and balance in elderly after giving the exercises.



(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	7.8619519 <sup>*</sup>	1.6989448	.000	3.734376	11.989528
	3	12.8748413 <sup>*</sup>	1.6989448	.000	8.747265	17.002417
2	1	-7.8619519 <sup>*</sup>	1.6989448	.000	-11.98 9528	-3.734376
	3	5.0128894 <sup>*</sup>	1.6989448	.014	.885313	9.140465
3	1	-12.8748413 <sup>*</sup>	1.6989448	.000	-17.002417	-8.747265
	2	-5.0128894 <sup>*</sup>	1.6989448	.014	-9.140465	-.885313

**Table 2:** Comparison of multisensory exercises, strengthening exercises and walking training in terms of timed up and go test in elderly.

The mean difference is significant at the 0.05 level. The mean difference between group 1 and 3 is greatest when compared to group 1 and 2 and group 2 and 3. Therefore, there is a difference between the three interventions in terms of timed up and go test.



**Graph 1:** Comparison of mean difference of multisensory exercises, strengthening exercises and walking training in terms of timed up and go test in elderly.

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	5621.945	2	2810.973	68.932	.000
Within Groups	1712.706	42	40.779		
Total	7334.651	44			

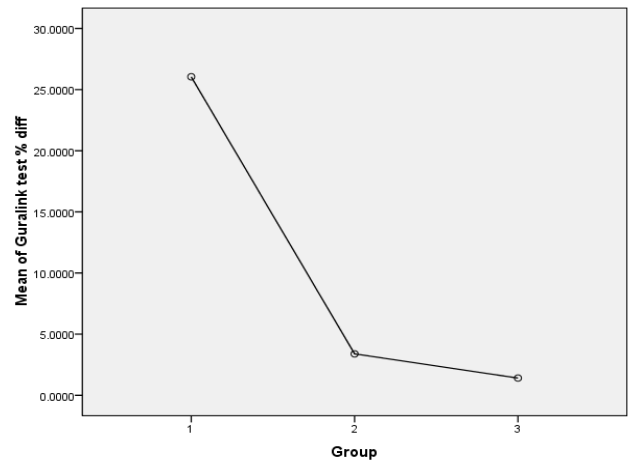
**Table 3:** Comparison of multisensory exercises, strengthening exercises and walking training in terms of Guralnik test battery in elderly

In this table the P value is less than 0.0001 which is highly statistically significant and indicates an improvement of mobility and balance in elderly after giving the exercises.

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	22.6592112 <sup>*</sup>	2.3317722	.000	16.994185	28.324237
	3	24.6380471 <sup>*</sup>	2.3317722	.000	18.973021	30.303073
2	1	-22.6592112 <sup>*</sup>	2.3317722	.000	-28.324237	-16.994185
	3	1.9788360	2.3317722	.675	-28.324237	7.643862
3	1	-24.6380471 <sup>*</sup>	2.3317722	.000	-28.324237	-18.973021
	2	-24.6380471 <sup>*</sup>	2.3317722	.675	-7.643862	3.686190

**Table 4:** Comparison of Guralnik test battery score in multisensory exercises, strengthening exercises and walking training in elderly.

The mean difference is significant at the 0.05 level. The mean difference between group 1 and 3 is greatest when compared to group 1 and 2 and group 2 and 3. So, there is a difference between the three interventions in terms of Guralnik test battery.



**Graph 2:** comparison of mean difference of multisensory exercises, strengthening exercises and walking training in terms of Guralnik test battery in elderly.

## DISCUSSION

This study was done to find out the effectiveness of multisensory exercises over strengthening exercises and walking. The results of this study have revealed that strength exercises and walking showed little influence on functional activities that was assessed by timed up and go test (TUG) and Guralnik tests. The mean difference between subjects trained with multisensory exercises (Group- A) and Walking (Group-C) is greater than multisensory exercise (Group-A) and Strengthening exercise (Group B); Walking (Group C) and Strengthening (Group B) for both Timed up and go test ( $P < 0.0001$ ) and Guralnik test battery ( $P = 0.05$ ) (Graph 1, 2). This shows that multisensory exercises are effective compared to strengthening exercises and walking.

Fabio Marcon Alfieri et al (2010) revealed the benefits of two exercise regimens on postural control of healthy elderly subjects and have concluded that both intervention groups showed statistically significant improvements in many parameters, and showed better improvement in the multisensory approach and the differences between the groups were statistically significant. The results obtained by the GM (multisensory) group A are clinically important because the subjects in this group have achieved better postural control. This is due to reduced oscillation of the body center of pressure, whereas a wide area of oscillation might reflect the deterioration of postural control.

Improvement of muscle action is the first to be used for maintaining balance and can be a contributing factor in the prevention of falls among the elderly. Although the results for the two groups were statistically different, study shows that only the multisensory group significantly improved the work of the muscles, which are important for the maintenance of static posture. This result showed that the intensity, duration, and frequency of the strengthening

exercises performed by the subjects in this study were not adequate to promote changes in the muscular action of the body.

Multi-sensory exercises usually performed on different surfaces and the training stimulates visual, vestibular, and somato-sensory systems which may be the cause for reduced body sway in participants [8]. The agility and changing positions in multi-sensory training are very frequent when compared to strength training, thus helps in the improvement of functional mobility.

Anne Shumway Cook et al (2000) concluded that, in assessing the chance of fall in community dwelling older adults the timed up and go test is a sensitive and specific indicator. Thus, the timed up and go test is a relatively simple screening test which takes less time to perform and having good content validity, can make screening successful in both level of functional mobility and risk of falls in community-dwelling elderly people [9].

Micheal I. Puthoff (2008) concluded that the physical performance tests in ELSA i.e. English longitudinal study of ageing were designed to provide an objective measure of lower limb function and upper limb muscle strength. The results show that the physical performance declines with age and the frequency is more in women when compared to men. There is a great diversity noted in the function, where some older people will show high levels of ability when compared to middle-aged respondents [10].

Thus statistical analysis shows that Group A individuals who were given Multisensory exercises showed more improvement in mobility and balance compared to Group B who were trained with Strengthening exercises and Group C who were trained with walking activity. These results show that, the balance and functional mobility in community dwelling elder people are majorly depending on regular physical exercises.

## CONCLUSION

In this study, multisensory exercises showed more improvement in mobility and balance. So, multisensory exercise can be considered as an adjunct with other exercises in rehabilitation of the elderly subjects with balance impairment.

### Citation

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