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Original Research Article

Assessment of Elderly Slips and Falls Utilising Induced Slip Training or An Obstacle Course

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ABSTRACT

Background: Falls are a frequent reason for injury-related hospitalisation or mortality in older people. This research discusses a unique conceptual framework on dynamic stability and weight support in reducing the chance of falls and slips, based on induced slip training or an obstacle course principle.

Objective: To find either an obstacle course or induced slip training for slips and falls in elderly people.

Design: Berg Balance Scale and a modified timed up and go test study.

Study setting: Community centres and communities in Agra and Mathura.

Participants: A total of 30 subjects were selected based on the inclusion and exclusion criteria.

Outcome measure: Obstacle course training and timed up & go test were used as for assessing older people with balance and mobility issues.

Results: In elderly people, the low friction surface trained group maintained their balance while walking at their usual speed in timed up and go.

Conclusion: Based on findings of the study, the low friction surface group showed a faster time to walk over the same surface without losing balance. They were able to adjust their posture in response to the stresses by applying tactics learnt via repetition, resulting in more stable and safe movement.

KEY WORD: Geriatric slips and falls, Induced slip, Obstacle course, Up and go test,

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INTRODUCTION

Given that older people are more likely to fall, there is a serious health risk for them [1]. For Americans 65 and over, accidental falls ranked as the sixth leading cause of death in 1999. Falls are associated with an increased risk of mortality, morbidity, functional impairment, and nursing care admissions [2]. Elderly people who live in the community face a fall risk of 31%. It is anticipated that one in three seniors over 65 would experience at least one annual fall. The old have a higher injury rate, especially for catastrophic injuries, even though young children may fall more frequently than the elderly.

Fall-related injuries may induce restricted mobility or activity levels due to a fear of falling. Falls are frequently linked to severe morbidity, and they might be signs of ill health and declining function. A decrease in living activity results in either circumstance. The basic objective of the central nervous system (CNS) must be to prevent falls since human upright position is inherently unstable, which starts with preventing unintended loss of balance. Loss of balance occurs when the motion state—that is, the instantaneous location and velocity of the body's centre of mass (COM) in respect to its base of support (BOS) exceeds certain stability restrictions. It may be important to adaptively enhance the internal representation of postural stability to consider for actual or future disruption in order to strengthen the CNS's ability to avoid balance loss. The CNS can choose and carry out a suitable action in a feed-forward control manner in order to offset the disturbance and prevent any unintended balance loss. A range of intervention strategies are used to safeguard elderly persons against slipping and falling. Two of these are training for induced slips and training for obstacles. [3-6].

Low-friction surface training is an intervention strategy that helps older people prevent falls by bolstering their neuromuscular defence system. It focuses on developing motor skills in situations that are representative of everyday life. It focuses on reducing slip- related falls since people frequently experience unexpected slips while carrying out regular actions including rising from a sitting position and walking. The greatest way to develop the motor skills necessary to overcome barriers in real life, such slip accidents, is in situations that mimic real-world occurrences [7-8]. In order to maintain balance and delay the body's degeneration following a slip, the CNS can be trained simultaneously. In order to strengthen feed forward control while lowering reliance on input, the CNS most likely develops new internal representations or modifies existing ones when a person is frequently exposed to slips [9].

Modified obstacle courses have developed into a safer and more established training method than obstacle courses, giving patients precise and quick feedback [10]. Now, the only approach to teach stepping over reactions is to expose participants to actual dangers, including walking over objects of different sizes that are in different places and different shapes, colours, and forms [11]. There will not be any need for parallel bars or an additional person to switch obstacles because certain obstacles will be placed close to walls. The two methods are successful in keeping elderly persons from slipping and falling.

METHOD

For the experimental investigation, 30 individuals were randomly selected from community centres and neighbourhoods in Agra and Mathura.

Study Population: The elderly above the age of 65, the capacity to walk unassisted, both genders, and the sample was chosen according to the following criteria: In the past two years, there have been many falls.

The exclusion of any previously known neurological diseases was done throughout the sample selection procedure using the following criteria: A cardiopulmonary impairment limits both the ability to take part in the study and the ability to treat any recognised musculoskeletal condition. a lens cannot compensate for a person's vision problems Previously experienced cognitive impairments and officially confirmed osteoporosis.

Study Protocol: The sample size was small, with 30 people being selected. Because they were unable to find adequate time to attend the daily intervention sessions, two individuals withdrew from the study. Following informed consent and compliance with the inclusion criteria, participants were at random assigned to one of two groups: group I, which comprised students in the first, third, fifth, and seventh grades; or group II, which included students in the second, fourth, sixth, and eighth grades. All the participants had a single intervention session each day with three repetitions for a total of three weeks.

Measurement tools: For the observations and outcomes, the following tools were used:

· saw dust,
· stop watch,
· chair (46.5cm seat height),

· Artificial grass, jute carpet,

· Height (95cm W22cm H) and low (4" high 30" W) stairs

· Sand,

· Marble chips in a small pan (61 cm 2.4m 5.1 cm), Ramps that go up and down (30" W x 6" D x 12" H).

Procedure: Following the execution of an informed permission form, participants who met the inclusion criteria were selected from the pool of eligible subjects. Prior to the intervention, participants had a Berg Balance Scale examination and a modified timed up and go test. Demographic information and a brief fall history were also gathered. Both sets of subjects were separated. The method was thoroughly explained to the participants before to the intervention, and the researcher remained by the patient's side during the surgery to prevent him from passing out. The Berg Balance Scale and a modified Timed up and Go were used to reassess participants from each group after they had finished their individual intervention plans. Before and after the intervention, data from both groups will be compared.

Berg balance scale: The Berg balance scale was developed to measure balance in older people with balance impairments by looking at how well they performed functional tasks [12]. The 14-item scale requires about 15-20 minutes to finish. With no outside help, participants were instructed to do the task at their own leisure.

Timed 'Up and Go': A quick mobility test called "Timed Up and Go" was created for senior adults with weaker bodies. The instructions included asking the subjects to stand up from a chair with a straight back, walk three metres away from the chair's front legs, then come back and sit down. There is a 1–3-minute administration period. The result of these actions is the amount of time required to perform them.

Low friction surface training: Slips occurred when standing up from a sitting position and moving over the surface. The person is positioned in a chair with their heels touching, their knees bent at a 100-degree angle from their anatomical position, and their ankles dorsiflexed by 10 degrees. The participants were instructed to stroll on a smooth surface at their normal and comfortable pace while donning no shoes. On a low-friction foundation made of sawdust, slips were first developed. Before beginning the slip trials, the individuals were informed that they would complete the non-slip trials first. Three regular walking trials on a regular surface were followed by a block of five consecutive slip trials on a low friction surface. Following the first slip experiment, participants were informed that a slide "may or might not" occur in following trials. The same procedure was used to the final two sessions. The researcher stood by their side to prevent the patient from falling. All participants were intended to travel at a comfortable pace as they finished the trip.

Obstacle course training: The course was created so that players might finish it without wearing shoes. Everyone was instructed to follow the researcher's instructions. The researcher went on a trial walk through the challenge course. Each obstacle course was then completed by each participant.

Twelve simulations of situations or activities that are common at home for people with functional mobility make up the Functional Obstacle course. Each station comes with a choice of four different floor textures. In two of the stations, surfaces with various levels of gradation are visible (up & down ramps). Two stations include several staircase kinds (exercise stairs commonly used in rehabilitation settings). There are four places to find functional tasks. In order for the patient to easily utilize the ramp, it was positioned such that it faced the wall.

Statistical Analysis: These techniques were used to the analysis of statistical data. Version 11.5 of SPSS was used for data analysis. Significant ness was determined by the 0.05 p value. The Wilcoxon signed rank test was used to analyze the data for the two groups. The U test was used to analyze the data between the two groups.

RESULTS AND DISCUSSION

28 individuals, 17 men and 11 women, whose

data were analysed had all fallen during the preceding year. There were 14 individuals in each group. Participants in groups A and B were, on average, 68 years old and 66.12 years old, respectively, with standard deviations of 2.5 and 2.4.

Table 1: Berg Balance Scale (BBS) Mean and SD at Pre, Post, and Mean Diff. (Pre-Post) for Group A and Group B participants.

Berg Balance Scale	Group A		Group B	
	Mean	SD	Mean	SD
Pre – Intervention	39.28	1.85	38	3.41
Post – Intervention	44.78	2.66	43.07	2.81
MD (Pre – Post)	5.5	1.65	5.07	1.97

Table 2: Mean and SD of TUG at Pre, Post and Mean Diff. (Pre-Post) for the subjects of Group A and Group B.

TUG	Group A		Group B	
	Mean	SD	Mean	SD
Pre – Intervention	19.92	1.73	20.14	2.03
Post – Intervention	16	1.46	17.71	1.77
MD (Pre – Post)	3.92	1.32	2.42	1.08

Table 3: Comparison of mean value for Berg Balance Scale (BBS) between Pre and Post Interval within Group A and Group B.

Berg Balance Scale	Group A		Group B	
	z value	p value	z value	p value
Pre – Interval Vs Post – Interval	-3.311	0.001	-3.321	0.001

Table 4: Comparison of mean value for Berg Balance Scale (BBS) at Pre, Post Interval and Mean Diff. (Pre – Post) between Group A and Group B.

Berg Balance Scale	Group A Vs Group B	
	U value	p value
Pre – Interval	-1.367	0.171
Post – Interval	-1.623	0.105
MD (Pre – Post)	-0.748	0.454

Table 5: Comparison of mean value for TUG at Pre, Post Interval and Mean Diff. (Pre – Post) between Group A and Group B.

TUG	Group A Vs Group B	
	U value	p value
Pre – Intervention	-0.164	0.87
Post – Intervention	-2.481	0.013
MD (Pre – Post)	-2.82	0.005

Comparative Analysis Within the Group:

Table 1 - Berg Balance Scale (BBS) Mean and SD at Pre, Post, and Mean Diff. (Pre-Post) for Group A and Group B participants

Table 2 - Mean and SD of TUG at Pre, Post and Mean Diff. (Pre-Post) for the subjects of Group A and Group B.

Table 3 - Comparison of mean value for Berg Balance Scale (BBS) between Pre and Post Interval within Group A and Group B

Table 4 - Comparison of mean value for Berg Balance Scale (BBS) at Pre, Post Interval and Mean Diff. (Pre – Post) between Group A and Group B

Table 5 - Comparison of mean value for TUG at Pre, Post Interval and Mean Diff. (Pre – Post) between Group A and Group B

Low Friction Surface Training Compared Within the Group: Repeated exposure causes subjects to get habituated to slipping on a slippery surface. The majority of slips occur when rising from a seated position [12]. Low friction surfaces encourage users to stand up and walk over them, instructing them to adopt a posture that lessens the risk of falling. Adaptive changes in stability control are shown in proactive adjustments, which take place prior to or in advance of the onset of a disturbance and primarily rely on feed forward control. They may also take place in the reflexive response, which is reliant on feedback mechanisms. The subject modified his posture when rising up and walking after each exposure to sliding following non-slipping trials as the intervention continued because he could remember past fall avoidance techniques.

Individuals may differentiate between the two types of surfaces utilizing sensory information during trials on slick and non-slick surfaces, enabling the best postural adjustments [13]. Stability control is to regulate the relative motion state (position and velocity) between the body's centre of mass (COM) and its base of support (BOS). The base of support also varies as the body's centre of mass does. Recent studies using the sit-to-stand task to induce slips have shown that repeated exposure to a low-friction surface may be used to adaptively boost one's COM state stability and reduce the danger of falling. The subject's reaction to a slip caused by decreased surface friction in the walkover pattern resembled a regular gait with barely detectable forward BOS displacement [12]. After being exposed to slips repeatedly, a person learns how to stand so that their centre of mass is inside their base of support. This posture reduces their risk of falling and, in low-friction situations, replaces their protective stepping reflex with a walkover approach.

Older persons have a harder time forming a rapid reflexive postural adjustment when they fall because they are less mobile than young adults [14–15]. Slip-training appears to prepare for both the reflexive start of the recovery step and the cognitive control of step length. These people discovered how to alter their walking pace in response to the stability requirements of the surface, which also increased stability on low-friction surfaces.

Obstacle Course Training Compared Within the Group: The results suggest that using an obstacle course to test elderly individuals with balance and mobility difficulties might be useful [16]. When older people encounter obstacles such different flooring, carpets, and objects on the way, they are more likely to slide [17–18]. The obstacle course is made up of a range of materials and surfaces with different textures that might cause slippage. Because the responders often go over and pass obstacles, they are able to discern between various forms and textures, which lowers the risk of falling [19]. The subjects learned to maintain a certain stride length and velocity at each barrier, assisting them in maintaining balance, using sensory input gained from each surface [20].

The only sensory modality that appears to allow a person to recognise a surface before stepping on it is vision. There have been both avoidance and accommodation strategies for controlling movement. Avoidance strategies include shifting the foot's position, raising the ground clearance, changing the gait's direction, and modifying the swing foot's velocity. Accommodation techniques include longer-term adjustments such shortening step lengths on slippery surfaces [22]. By leveraging their visual awareness of obstructions, subjects also learnt how to alter their stepping and crossing over tempo to attain safe mobility [20].

An essential component of ambulation that enables a person to function safely in every-day circumstances is the ability to step over obstacles. When navigating an obstacle course, moving from one surface to the next immediately decreased the subject's reaction time for that particular surface each time they crossed it, which prevented them from slipping.

Group Comparisons of Berg Balance Scale: The berg balance scale is used to evaluate a person's performance on 14 items, including 1 sitting item and 13 standing items, that are connected to routine balance function activities. An instrument for evaluating balance in elderly persons is the Berg balance scale [21]. After going through an obstacle course and training on low friction surfaces, the participants' balance greatly improved. The subjects developed adaptation strategies for different surfaces, textures, and obstacles in the pathway leading to falls because dynamic components were more heavily involved in both training methods, but because the berg balance scale does not include a gait component [21], the subjects performed worse on the berg balance scale.

In contrast to anticipation, which is proactive and entails navigating through challenging and occasionally crowded conditions while utilising a variety of sensory inputs to help with stability management, adaptation is reactive in nature and involves the neuro-musculoskeletal system [23].

Both training methods included exercises that gave the necessary sensory input, which led to better balance. However, berg balance was limited to a few number of trials with minimal sensory input, yielding scores that were identical for both groups.

Group Comparisons of Timed Up & Go Test:

A balance exam for seniors called Timed up & Go concentrates on their functional skills and walking speed. Functional views are essential when it comes to questions of balance. Both training methods include all of the practical elements a person needs to do daily chores, which might cause a person to trip and fall while walking. A form of intervention called low-friction surface training employs feed - forward and feedback mechanisms to assist people in finding their balance. Both groups' balance was enhanced by proactive adaptation strategies created through sensory perception of numerous objects, textures, and surfaces in both training approaches [23].

Due to the inclusion of almost identical activities in TUG and repeated practise of the same components, the low friction surface group demonstrated a faster time to walk over the same surface without losing balance when both training groups were graded after training on a timed up and go task. Using techniques gained via repeated practise, they were able to adjust their posture in response to the stresses applied, leading to more stable and secure movement.

The obstacle course group took longer to complete the activities because they had more experience crossing over or stepping over obstacles, whereas the low friction surface trained group preserved their balance while walking at their typical speed.

CONCLUSION

Both training groups demonstrated an improvement in balance following training on timed up and go due to the inclusion of essentially similar tasks in TUG and repeated practise of the same components. The low friction surface group, however, demonstrated a quicker time to go across the same surface without tipping over. By using strategies, they had practised, they were able to modify their posture in response to the stressors, leading to more steady and secure movement.

The obstacle course group took longer to accomplish the activities because they were more accustomed to stepping over or crossing over obstacles, but the low friction surface trained group maintained their balance while walking at their usual speed in timed up and goes.

Conflicts of interest: **None**

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