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Effect of Single Session of Motor Imagery on Motor Learning of Locomotion in Male and Female Older Adults: A Comparative Study

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ABSTRACT

Introduction: Motor imagery elicits activity in brain regions that are normally activated during actual task performance. The motor imagery, also known as "Mental practice" is the imagining of an action without it's physical execution. Purpose of the study was to investigate the influence of a single session of locomotor based motor imagery training on physical performances and motor learning of locomotion among male and female older adults aged > 64 years.
Methodology: Sixty older adults aged > 64 years were included in this study. Both male and female were equally distributed in two groups on the basis of inclusion criteria. The participants were randomly assigned to both the group following base line locomotor testing which determined their activity for motor imagery training session. The participants in both groups completed 20 imagined repetitions of locomotor task. Imagined performances times were measured for each training repetition. Timed up–and–go and the time to complete obstacle course was measured before and after the single training session.
Results: The mean average age in male is greater than female. There was no significant difference (P > 0.05) between male and female groups at base line in any outcome measure. After motor imagery training of locomotor task there was a significant difference between both groups. Male older adults in comparison to female older adults had a better learning of locomotor skill through Motor Imagery Technique.
Conclusion: During a single session of Motor Imagery Technique, the effect of motor Imagery has a better learning of locomotor skill in males in comparison to females.

Keywords: Locomotor skill, Mental Practice, Older Adults, Motor Imagery.

INTRODUCTION

The Motor Imagery (MI) is also known as mental practice or kinaesthetic imagery. [1-2,5] Age-related disintegration in balance and mobility contribute to disability, falls and mortality and reduce independence. [1] Additionally, impairments in mobility predict future disability and reduced independence in older adults. [2] MI is the mental stimulation of an action without its physical execution. [1-2,6,8] The potential benefits of MI as a rehabilitation tool for older adults relies on the ability of MI training to promote motor learning and enhance cortical excitability. MI give rise to activity in brain regions that are normally activated during actual task performance. [2] Motor learning is used to describe relatively permanent changes in the capability for motor skills but related to training and aimed interventions rather than development due to maturation or aging. The motor learning is defined as the acquisition of new unknown skills as well as relearning and improvement of motor skills acquired in the past. When considering a life-span

approach, it is difficult to clearly distinguish motor development from motor learning. Motor development across the life span encompasses learning and development as well as capacities and constraints. [3] In old age, locomotor function is required for the safe completion of everyday tasks, such as the ability to use level crossings within the allocated time. The integrity of the biological systems important in locomotor function, are modifiable by increasing levels of physical activity. In particular, strong evidence exists that neuromuscular function and cardio respiratory function are improved following physical training in old age, whilst emerging evidence indicates that balance control and cognitive function can be improved following physical training interventions in old age. [4]

MI is used as a technique to enhance motor learning and to improve rehabilitation in patients with neurological condition like stroke and Parkinson's. More recently, the mental chronometry approach of MI has been used to assess gait impairment in older adults. Thus, two main MI related strategies compete to imagine the body's displacement in the space, which are based on allocentric and egocentric spatial encoding. [7]

The previous study showed that author Vaughan P Nicholson et al in 2018 did a study to investigate the influence of a single session of locomotor based MI training on motor learning and physical performances. Thirty independent older adults aged > 65 years were included in the study. They were divided into three groups following baseline testing the motor imagery training, physical training, and control groups. The motor imagery training group completed 20 imagined repetitions of a locomotor task, the physical training group completed 20 physical repetitions of a locomotor task, and the control group spent 25 minutes playing mentally stimulating games on an iPad. The result showed that motor imagery training of specific locomotor task also had a positive transfer effect on related physical locomotor performance outcome. [2]

Author Vaughan Nicholson et al in 2019 studied "effect of motor imagery training on balance and mobility outcomes in older adults". The question of this study – does motor imagery training improve measure of balance, mobility and falls in older adults without a neurological condition ? – the older adults with a mean age of at least 64 years and without neurological condition were included in this study. Twelve trail including 356 older adults were included in the systematic review and 10 trials 316 older adults were included in the meta- analysis. The result showed that motor imagery training can significantly improve balance, gait, and speed and timed up and go in older adults. [1]

Purpose of the study

Purpose of the study was to investigate the influence of a single session of locomotor based motor imagery training on physical performances and motor learning of locomotion among male and female older adults aged >64 years.

Aim and objective

The aim of study was to compare be effect of MI technique on the motor learning of locomotion between male and female older adults.

Assess whether single session of MI can enhance task specific locomotor performances outcomes.

Significance of the study

MI is used as technique to enhance motor learning and to improve activity of daily living (ADL) or rehabilitation in neurological patient like Parkinsons, stroke and ataxia. The MI has been used to assess gait, mobility impairment in older adults.

METHODOLOGY

Sixty older adults aged greater than 64 years were included in this study. The sample was recruited by convenience sampling method from Delhi and Uttar Pradesh. Participants were divided in two

groups on the basis of Gender ie. male and female. The included participants, needed to be community dwelling, independently mobile, and be able to commit to the study time frame. Exclusion criteria were any falls in the past twelve months, use of a walking aid for mobility, cardiovascular disorder, respiratory disorder, neurological deficit and any physical disability.

The participants were told the objective of performing the test. A consent form was taken which included volunteer's declaration, right to withdrawal and confidentially of their details. After that participants completed questionnaires relating to demographics, cognition [mini – mental state examination (MMSE)] and imagery ability [kinaesthetic and visual imagery questionnaire (KVIQ)]. Then, they underwent a series of base line locomotion task, completed training session, then concluded with reassessment of locomotion task. The participants were randomly assigned to both groups following baseline locomotor testing which determined their activity for the motor imagery training session. The participants completed 20 imagined repetition of obstacle course within single session. Participants were seated in a chair at the start of the course and were instructed to imagine your-self completing the obstacle course as quickly and accurately as possible from a first person perspective. The time taken (in second) to complete each repetition was measured to determine trial by trial changes. Timing started on the command of "go" and ceased when the participant said "stop" to correspond with their imagined self placing their back against the back rest of the chair. Participants had a 30- second rest between each trial, then a larger 5- minutes rest after 10 repetitions to minimize mental fatigue. [2]

The intervention of this study is TUG test (timed - up - and - go) and iTUG - test (imagined timed - up - and - go) the participants were tested in home and ground.

TUG-Test the participants were instructed to seated position in a chair on the command of "go" participants were required to stand up, walk 3 m. as quickly and safely as possible past a line on the floor, turn around, walk back to the chair, and sit down with their back against the chair. Time started on "go" and stopped when the participants had their back against the back rest of the chair. The mean of trial was used for analysis. [2]

iTUG-Test the participants were instructed to seated in a chair and were instructed to imagine doing the timed-up-and-go (TUG) and to say "stop" out loud when they were finished with their back on the back rest of the chair. Time started on the command "ready-set-go" and stopped when the participant said "stop". The mean of trial was used for analysis. [2]

Obstacle course – this test was included primarily to be used for task-specific. The participants were instructed seated in a chair, on the command of "go" participants stood up and walked 10 meter as quickly as well as safely possible, stepped over a 15 cm. hurdle, slalomed through a series of 5 markers spaced 50 cm. apart, return over the hurdle then walked back along the 10 meter walkway to return to sitting. Time started and go and stopped when the participant had their back against the back rest of the chair. Participants completed a practice trial. The mean of two trials was used for analysis. [2]

DATA ANALYSIS

To analyze all the data, the level of significant were defined as $p < 0.05$. The T-test was used to identify any changes within group from base line to final training in locomotion measure. Analysis of variance (ANOVA) was used to identify any base line difference between group. ANOVA was used to determine whether scores from initial to final testing differed between groups for locomotion measure. The data was recorded using the statistical software, Statistical Package for Social Sciences, SPSS version 14.0 for Windows 10 Ultimate edition (IBM SPSS V-20 for Windows).

RESULTS

From screening of 70 older adults, 60 older adults (male/female) aged > 64 years were included in the study. 10 participants were excluded on the basis of exclusion criteria. The mean average age of male is greater than female. There were no significant differences (p> 0.05) between male and female groups at baseline in any outcome measure shows in (Table -1). One way ANOVA test is used for the data analysis of the male and female. The comparative average mean of age within group after motor imagery training of loco motor task there was a significant difference (p=0.0184) between both groups shows in (Table -2).

Table 1- Comparative average mean of age between Male and Female

Average mean Age of Male group (N=30)	Average mean Age of Female group (N=30)	T Value	Level of significance p-value
71.03	68.77	1.307	0,981 non-significant

The p-value at 0.05 > 0.981 which is non-significant.

Table 2- Comparative average mean of age within group

Male /female	1st I (TUG)	Difference of two value	Significance P value	F (TUG)	Difference of two value	Significance P value	Difference in second male /female	Difference of two value in seconds	Significance level P value
Male	20.03 + 4.064	2.8	0.005	18.33 + 4.099	2.06	0.026	1.9 + 0.607	0.53	0.0184
Female	22.83 ± 3.44			20.4 ± 3.59			2.43 ± 1.04		

1 .The difference of initial I (TUG) is 2.8. The P value is 0.005*.The result is significant as P value < 0.5. The standard deviation difference is about 0.6624.
2. Difference of male /female Final F (TUG) is 2.06. The P value is 0.026. The result is significant as P Value < 0.5. The standard deviation is about 0.509.
3. Difference in seconds value between Male / Female is 0.53 Seconds, the P value is 0.0184.The standard deviation is -0.433.

Male older adults in comparison to female older adults had a better learning of locomotor skill through Motor Imagery technique. The effect of motor imagery promoted improvement in some locomotion outcomes. The I(TUG) in male was 20.03 second and female was 22.83 second shows in (Figure – 1). The F (TUG) in male was18.13 second and female was 20.40 second shows in (Figure - 2). Then, the difference in second male is 2.43,so there was very less change in TUG delta scores for both groups shows in (figure-3).

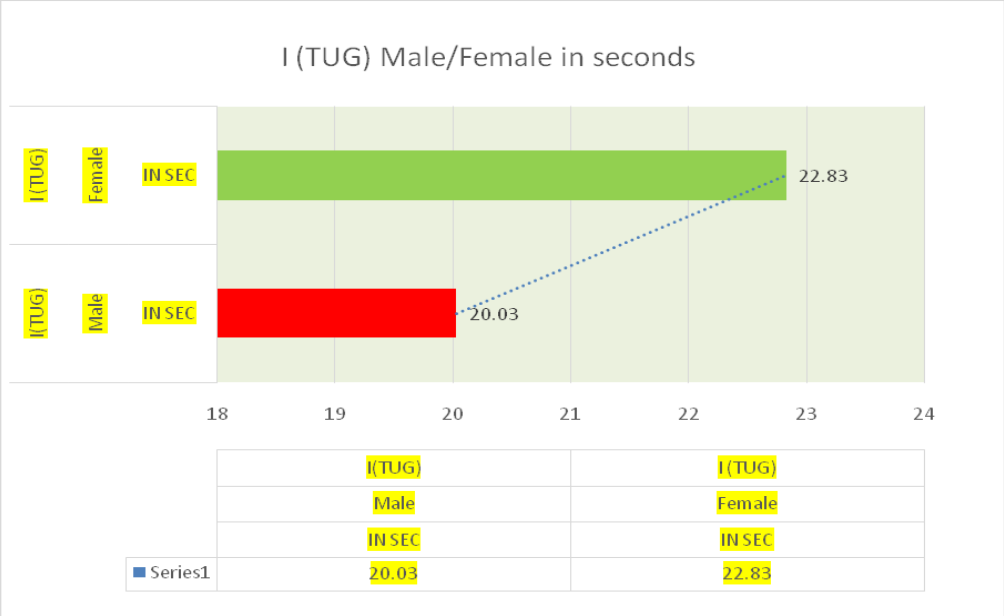

Figure: 1 I (TUG) between male and female

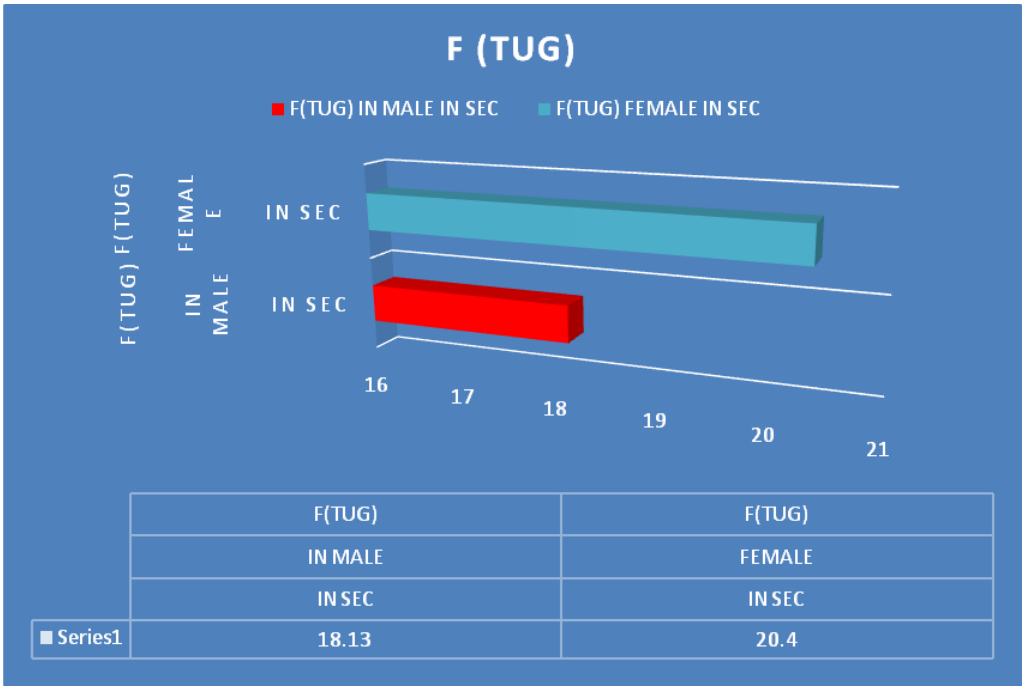

Figure:2 F(TUG) between male and female

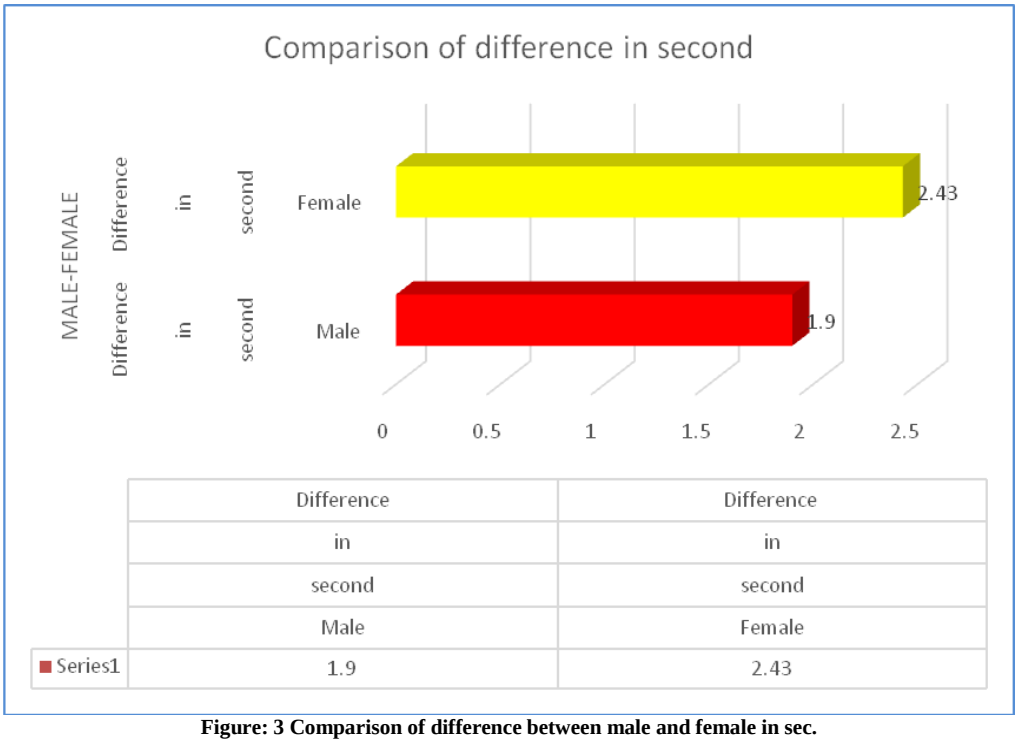

Figure: 3 Comparison of difference between male and female in sec.

DISCUSSION

The present study was aim to compare effect of motor imagery technique on the motor learning of locomotion between older adults. This systemic review provides evidence that motor imagery can improve measures of locomotion, such as gait speed, in neurological independent older adults. The improvements in locomotion associated with motor imagery training identified in this systemic review are thought to be largely explained by improvements in motor planning that promote motor learning. Changes associated with motor imagery training have long been established in sports, in rehabilitation setting, and more recently in older adults. [1] The main finding of this study is that within

single session changes occurred during motor imagery training of an obstacle course locomotor task in independent older adults. The trail-by-trial changes within a single training session is different between the two groups as an overall increase in imagined time occurred during motor imagery training. [2]

Author Vaughan P Nicholson et al studied during a single session of motor imagery training, the training of an imagined locomotor task was refined to better match that of the physical performed locomotor task. There were significant group differences between physical and motor imagery training for training variability as measured by the CoV. The aim of previous study was to determine whether a single session of motor imagery training could produce improvement in older adults' physical performances.

Motor imagery training in previous study, did not lead to significant between group changes in the time to complete the obstacle course or other locomotor task, and there were no significant effects on gait variability measures. The motor imagery training may have been more effective if performed in standing as it has been found that adopting a more similar position to the imagined task is beneficial. [2]

The motor imagery training may have been more effective in older adults. Motor imagery training in this study did not lead to significant between group changes in the time to complete the locomotor task, there were no significant effect between male and female groups. After motor imagery training of locomotor task there was a significant present in between both groups.

Based on the previous observation it was decided to have participants complete the motor imagery training in sitting as the obstacle course started with a sit to stand, but an upright posture may have been more reflective of the entire task considering the obstacle course included straight-line walking, hurdle stepping and direction changes. The clinical significance of determining this isolated effect is related to the Potential application of motor imagery in male and female older adults. The beneficial effect of motor imagery (MI) if combined with physical practice, but detailed description of MI training session elements and temporal parameters are lacking. [9]

CONCLUSION

During a single session of motor imagery training, the effect of motor Imagery has a better learning of locomotor skill in males in comparison to females.

Strength of the study

Based on the previous research, sample size of the study was small. Participants were randomly assigned to one of three groups motor imagery, physical group and control group. But in this study, sample size was large and participants were randomly assigned to both groups, male and female.

Weakness of the study

Sample size of study was small. Study was confined to age group more than 64 years.

Clinical significance of the study

The present study is useful for clinical assessment and rehabilitation of neurological condition like stroke and Parkinson's disease.

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