



Association of fear of fall with functional strength, endurance and balance in patients with osteoarthritis of knee joint– A cross sectional study

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Abstract

Background and Purpose: Decreased muscle strength, proprioception, balance and mobility in patients with osteoarthritis (OA) give rise to loss of self-efficacy and self-confidence reducing the functional ability to perform activities of daily living thereby contributing to fear of fall. The purpose of the study was to find the association of fear of fall with functional strength, endurance and balance in patients with osteoarthritic knee.

Methodology: 50 patients with OA knee were included in present cross-sectional study. Participants were assessed for strength using Stair Climb Test (SCT), balance using 5 times sit-to-stand (5T-STs), endurance using 2 Minute Walk Test (2 MWT) and fear of fall using Fall Efficacy Scale-International (FES-I). Data analysis was done using SPSS software and correlations between fear of fall and functional strength, endurance and balance were obtained using Pearson's correlation coefficient.

Results: There was moderate positive correlation ($r = 0.41$) between SCT and FES-I, no correlation ($r = 0.005$) between 5 T-STs and FES-I and weak negative correlation ($r = -0.18$) between 2 MWT and FES-I in patients with osteoarthritic knee.

Conclusion: The study concluded that there were moderate positive, weak negative and no correlation exists of fear of fall with functional strength, endurance and balance respectively in patients with osteoarthritic knee.

Keywords: fear of fall, strength, endurance, osteoarthritis knee, association

Introduction

Osteoarthritis (OA) is a degenerative and progressive joint condition affecting about 250 million people worldwide.^[1] OA contributes to disability and functional limitations among older individuals above 40 years^[2]. The prevalence of OA in India was 22% to 39% in 2018^[3].

Fear of fall and avoidance of social activities due to fear of fall was found to reduce the well-being and quality of life in elderly^[4]. In OA knee patients, if modifiable risk factors such as Body Mass Index (Hereinafter will be mentioned as BMI) are not normalized, there can be increase in pain and further decrease in range of motion which can cause an increase in the risk of fall. Increased pain intensity leads to decrease in muscle strength, proprioception, balance and mobility. These factors give rise to loss of self-efficacy and self-confidence reducing the functional ability to perform activities of daily living thereby contributing to fear of fall.^[5, 6] Individuals having OA were found to have increased risk of falling by three folds leading to fractures^[6]. The subjective assessment of risk of falling using Fall Efficacy Scale -International (FES-I) helps in estimating the functional activity, body composition and health related characteristics in older adults^[7].

The determinants for assessment of functional ability in knee OA includes muscle strength and balance^[8]. Activities of daily living requires functional ability to perform functional movements like stair climbing, standing up and walking^[9]. Knee OA causes decreased ability to perform these functional movements which affects the quality of life^[10].

Patients with knee OA were found to have reduced functional ability due to joint pain, joint stiffness, and loss of muscle strength of the lower extremity^[11]. Studies have

found correlation between strength and fear of fall in OA knee patients^[12]. Patients with knee OA experience loss of proprioception, which may affect postural stability (dynamic and static balance). The decline in postural stability may cause falls and injuries, which leads to serious physical, psychological and social loss in the individual. Previous studies found that there was a deterioration in the balance with the increase in the severity of OA knee. Studies have found significant correlation between balance and fear of fall in OA knee patients^[13]. Studies found that quadriceps strength and endurance were reduced in OA due to functional impairment and increased pain^[14].

Objective and subjective assessment helps in diagnosis, prognosis and for planning a rehabilitation programme for OA knee patients^[15]. Previous studies have found that functional training can help in reducing pain, improving performance, functional ability and quality of life in OA knee patients^[16]. Studies have found significant correlation between strength, balance and fear of fall in OA knee patients^[12, 13]. However limited studies have been found studying correlation between strength, balance, endurance and fear of fall in OA knee patients. Hence, the need was identified to explore more about the correlation between strength, balance, endurance and fear of fall in OA knee patients.

Limited studies have been found studying association of fear of fall with functional strength, balance and endurance in Indian patients with OA knee. Limited literature has been found supporting the evidence that OA knee is associated with risk of fall. Hence the study intended to find association of fear of fall with functional ability in patients with OA knee.

Aims and objectives

Aim

To study the association of fear of fall with functional strength, endurance and balance in patients with osteoarthritis knee.

Objectives

- To assess fear of fall using subjective Fall Efficacy Scale -International (FES-I)
- To assess the functional ability using
 - Stair climb test (SCT) for the component of strength.
 - 5 times sit-to-stand test (5T-STTS) for the component of balance.
 - 2minute walk test (2MWT) for the component of endurance.
- To correlate fear of fall with functional strength, endurance and balance in patients with OA knee.

Methodology

- Study Design:** Cross sectional study
- Study Population:** Patients with Osteoarthritis of knee joint
- Sampling Method:** Convenient sampling
- Sample Size:** 50 patients with OA knee
- Duration of Study:** 6 months
- Selection Criteria**

Inclusion criteria

- Patients with unilateral or bilateral OA knee based on criteria of American College of Rheumatology.
- 45 - 65 years.
- Both genders.
- VAS score at rest 0 to 1 and on activity: less than 6
- Willing to participate in the study.

Exclusion criteria

- Participants having any lower extremity or spine pathology or surgeries.
- Any other surgical or medical condition.
- Rheumatoid arthritis/Systemic lupus erythematosus/inflammatory arthritis/ polyarthralgia.
- Patients with vestibular disorders.

Outcome measures

- Stair climbs test (SCT) measured in seconds ^[18].
- 5 times sit-to-stand test (5T-STTS) measured in seconds ^[19].
- 2minute walk test (2MWT) measured in meters ^[20].
- Fall Efficacy Scale-International (FES-I) score ^[21].

Study procedure

- Participants were chosen considering the inclusion and exclusion criteria and a written consent was taken.
- Demographic data were documented like name, age, gender, occupation, dominance etc.
- First the participant was asked to rate his/her pain during rest and activity such as raising from the chair activity, stair climbing up and down and walking activity using VAS.

Visual analogue scale

A visual analogue scale (VAS) was used in the study for measuring pain severity. It is a 10 cm long horizontal line

which ranges from 0 (no pain) to 10 (unbearable pain) grades of intensity of pain, The participants were asked to mark a point on the scale to grade their intensity of pain. In this 0 represents no pain, 1-4 represents mild pain, 5-6 represents moderate pain and 7-10 represents severe pain ^[17].

- Participants were assessed using following test for the components of strength, balance and endurance using Stair Climb Test (SCT), 5 times sit-to-stand (5T-STTS), 2 Minute Walk Test (2 MWT) and Fall Efficacy Scale-International (FES-I) respectively as described below.

1. Stair climb test (SCT)

Participants were instructed to ascend and descend 9 stairs (step height 20cm) in their usual manner. They were allowed to use assistive device and the hand rails. Time (seconds) taken to complete the task was recorded. ^[18]

2. 5 times sit-to-stand (5T-STTS) test

Participants were informed to stand erect from a chair with 43 cm height, both knees at 90degree, arm across the chest as quickly as possible. They were asked to rise fully between each repetition of the test from chair 5 times at self-selected pace & were informed not to use their arms. Time (seconds) taken to complete the task was recorded. ^[19]

3. 2 minute walk test (2MWT)

Participants were informed to walk as fast as they could over 50ft (15.2 m). Cones were kept at both the ends and was asked to walk around the cones until asked to stop. They were instructed not to worry if they had to slow down or rest, but if they stop, they will have to start walking again as soon as they feel ready to do so. The distance (meters) covered was documented ^[20].

4. Fall Efficacy Scale-International (FES-I)

were given to all patients to respond ^[21].

Statistical analysis

- Data were presented using MS-excel version 19. Statistical analysis was performed using SPSS version 15 software.
- Statistical analysis was performed to find the association of fear of fall with functional strength, endurance and balance in patients with osteoarthritis knee. Data were analysed for correlation of fear of fall with functional strength, endurance and balance using Pearson's correlation coefficient. Level of significance was set at α 0.005.

Results

- Demographic data of participants are presented as follows. Out of 50 participants which were included in the study there were 20 males (40%) and 30 females (60%). Mean age of participants was 55 years. Mean VAS was 4.7/10.
- There was moderate positive correlation ($r=0.41$) between SCT and FES-I in patients with osteoarthritis knee.
- There was no correlation ($r = 0.005$) between 5T-STTS and FES-I in patients with osteoarthritis knee.
- There was weak negative correlation ($r = -0.18$) between 2MWT and FES-I in patients with osteoarthritis knee which was not found significant.

Table 1: Mean and standard deviations of Fall efficacy Scale-I, Stair Climb test, 5 Times Sit to Stand Test, 2 Minute Walk Test.

Parameter	Mean	SD
FES-I (score)	29.26	11.40
SCT (seconds)	19.18	6.457
5T-STs (seconds)	21.41	6.100
2 MWT (meters)	112.3	24.40

Table 2: The statistical analysis of correlation of Fall efficacy Scale - I with Stair Climb test, 5 Times Sit to Stand Test, 2 Minute Walk Test.

Parameter	Correlation coefficient (r)	P value
Stair Climb Test and Fall Efficacy Scale International	0.4159	0.0027
5 Times Sit to Stand and Fall Efficacy Scale-International	0.005372	0.9705
2 Minute Walk Test and Fall Efficacy Scale International	-0.1884	0.1902

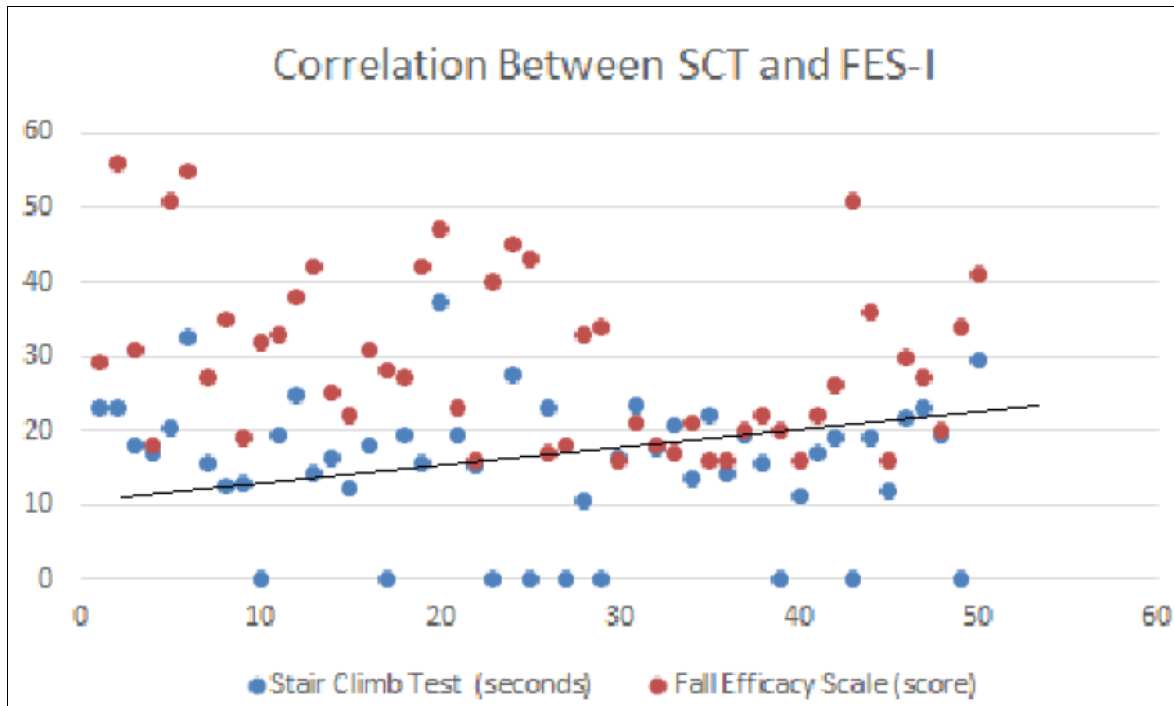


Fig 1: Correlation between SCT and FES-I in patients with Osteoarthritic Knee.

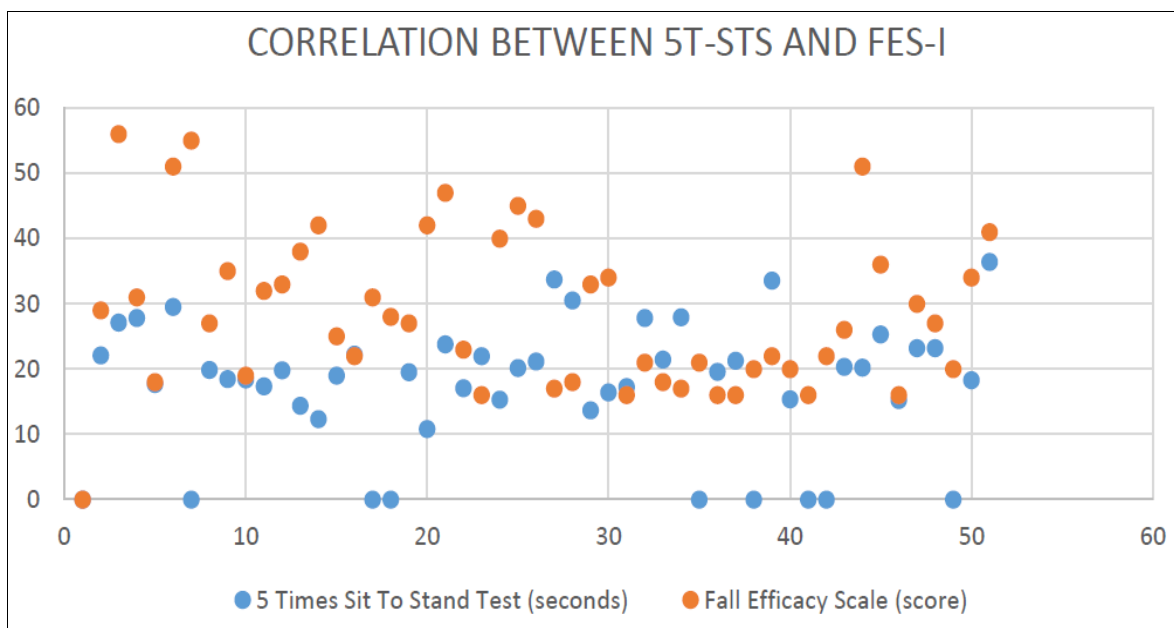


Fig 2: Correlation between 5T-STs and FES-I in patients with Osteoarthritic Knee.

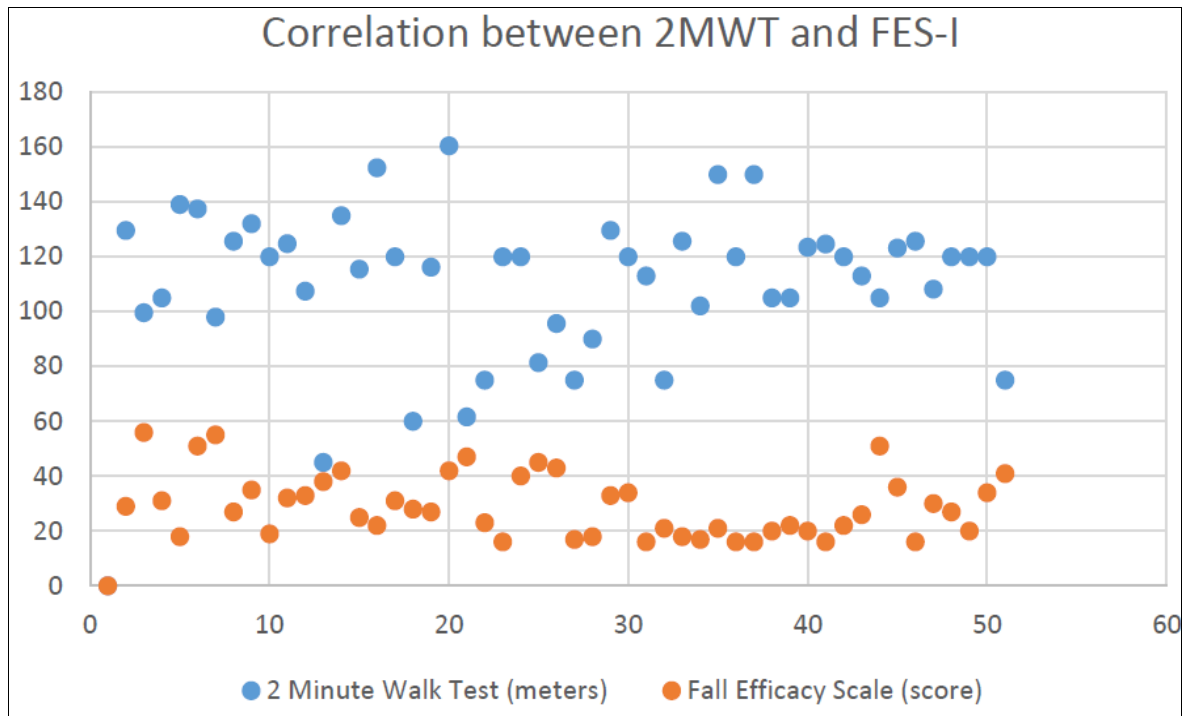


Fig 3: Correlation between 2MWT and FES-I in patients with Osteoarthritic Knee.

Discussion

The present study found moderate positive correlation ($r=0.41$) between SCT which was a measure for strength and FES-I for fear of fall. SCT was used as psychometric measure for lower extremity strength [22]. With increase in time to complete SCT there is increase in the fear of fall. SCT being the measure of lower limb strength that can be moderately correlated with subjective feeling or fear of fall. The findings are in line with the study conducted by Pauelsen M, *et al* (2017) on older adults and found significant correlation between lower extremity strength and FES I [23]. S Haripriya *et al.* (2021) conducted a study on postmenopausal women and found significantly high correlation between FES-I and ankle strength [24]. Ratsepsoo *et al.*(2013) also conducted a study on females with late-stage osteoarthritic knee and found that fear of falling was correlated to the leg extensor muscle strength.[25]. Borges V *et al* (2017) also conducted a study on elderly women and found similar findings [26]. Cho *et al* (2012) conducted a study on elderly. They found significant decrease in lower extremity strength in fallers group and found association with increased risk of fall [27].

Probable mechanism proposed by researchers for correlation between strength and fear of fall are that pain is considered to initiate Arthrogenic Muscle Inhibition (AMI) through activation of A-delta myelinated fibres and C unmyelinated fibres that causes damage to joint structures. AMI is an ongoing neural inhibition that prevents the quadriceps muscles from being fully activated causing quadriceps weakness leading to fall [28]. In the present study mean VAS was found to be 4.7/10, therefore pain might have played a role affecting strength. This could have contributed to moderate correlation between strength and fear of fall in OA knee patients [29].

Proprioception is an integral component of motor control. Impairment in afferent proprioceptive information to the supraspinal centers may result in slowing of quadriceps muscle activity. Quadriceps weakness may lead to fatigue of

the muscle thereby slowing and inhibition of motor control. Delayed onset of quadriceps activity may be associated with proprioceptive deficits, altered muscle function, pain or effusion during stair ascend and descend.[30] Also the decline in proprioception can change the joint biomechanics and neuromuscular control of limbs resulting in impaired balance and increase risk of fall [31].

SCT was used as psychometric measure for lower extremity strength. Studies found that entire lower limb musculature like hip extensor, abductor and ankle plantar flexor muscle strength may also contribute to gait changes and postural control during activities like stair climbing, walking etc. The weakness of these muscles reduces the ability to stabilize the limb and shifts the weight forward in the stance phase. Loss of hip extension, hip abduction and ankle plantar flexor range along with muscle weakness may also be a contributor to risk of fall [32].

The present study found no correlation ($r = 0.005$) between 5 Times Sit-To-Stand test (5T-STs) which was a measure for balance and Fall Efficacy Scale -International (FES-I) for fear of fall. These findings are in line with the study conducted by Kamaruzzaman *et al.* (2020). They found that neither presence of knee pain, knee pain severity nor poor balance led to falls over 12 months [33]. However, there was limited evidence to support the present study findings. Majority of the studies when reviewed found correlation between balance and fear of fall which is in contradiction to the present study findings. Gupta (2018) [34], Bhedi *et al.* (2015) [35], Khalaj N *et al.* [11], Hill (2013) [36] found significant correlation between balance and fear of fall in knee OA.

Researchers have put forth that there are multiple factors operate which may affect balance. E.g., Hadjistavropoulos T *et al.* (2012) proposed that anxiety had a direct relationship with balance even after controlling all the medical risk factors of falling [37]. Other factors like the visual, proprioceptive and vestibular systems also help in maintaining balance. The present study excluded the

participants who had vestibular disturbances. According to sensory weighting theory, the visual, proprioceptive and vestibular systems compensate for each other to maintain balance and prevent fear of fall. In the present study these factors might be compensating for proprioceptive disturbance in patients with knee OA thereby maintaining balance and preventing fear of fall [38]. Studies found that neither presence of knee pain, knee pain severity nor poor balance led to falls over 12 months in moderate to severe knee pain, they found that protective mechanisms like increased vigilance, compensatory strategies and reduced physical activity may compensate for poor balance and prevent fall [33].

The present study found to have weak negative correlation ($r = -0.18$) between 2 Minute Walk Test (2MWT) (which was a measure of endurance) and Fall Efficacy Scale – International (FES-I) for fear of fall. 2MWT was used as a measure of endurance. Thus, with decrease in the endurance there is increase in the fear of fall. These findings were in line with Alnahdi *et al.* (2012). They found that OA knee participants had significant association of quadriceps endurance, maximal angular velocity during knee extension with time required to walk 15m [39]. Kamide N *et al* (2019) found significant moderate negative correlation between FES-I and walking speed [40].

Probable mechanism proposed by researchers for weak negative correlation between endurance and fear of fall can be explained as knee OA participants had 67% lower quadriceps endurance and 60% lower extension angular velocity during knee extension compared to healthy individuals. Due to lower quadriceps endurance and less angular velocity during knee extension more time is required to complete the 15-m walk [39].

Conclusion

The present study concludes that: There is moderate positive correlation between strength and fear of fall in OA knee patients. There was no correlation between balance and fear of fall in OA knee patients. There was weak negative correlation between endurance and fear of fall in OA knee patients. Therefore, there was correlation between functional ability and fear of fall in OA knee patients.

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