Original Article

DOI: 10.7860/JCDR/2023/66496.18722

Influence of Self-efficacy on Strength and Physical Function among Individuals with Knee Osteoarthritis: A Cross-sectional Study

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ABSTRACT

Introduction: Knee osteoarthritis affects the elderly, potentially leading to disability, with varying symptoms and fatigue. The hip and knee joints experience discomfort, stiffness, reduced mobility, and depression. Muscle weakness, linked to lower limb atrophy, heightens the risk of falls. Self-efficacy, which is confidence in performing tasks despite discomfort, impacts knee strength and function. Factors such as age, education, depression, and physical decline shape self-efficacy. However, the impact of self-efficacy on osteoarthritis health outcomes is unclear due to reduced activity levels. The present study aims to explore the influence of self-efficacy on knee osteoarthritis function and strength.

Aim: To identify the influence of self-efficacy on physical function and muscle strength in individuals with knee osteoarthritis.

Materials and Methods: A cross-sectional study was conducted in Department of Physiotheraphy with 73 participants who met the inclusion criteria. The study took place between October 2022 and April 2023, spanning a period of six months, at KS Hegde Charitable Hospital in Mangaluru, Karnataka, India. Hip-knee muscle strength was measured using a push-pull dynamometer, physical function was assessed using the Timed Up and Go (TUG) test, and self-efficacy was evaluated using the Arthritis Self-efficacy Scale-8. All tests were performed once on the same day, with a five-minute rest between each test. Within-group differences were identified using an Independent T-test, and between-group analysis was conducted using Analysis of Variance (ANOVA).

Results: The mean age of the participants was 60.2±6.5 years, and the Basal Metabolic Index (BMI) was 25.2±2.0 kg/m^2. A statistically significant difference with a p-value of 0.001 was observed in hip abductor, knee flexor, knee extensor, and TUG tests between the high and low self-efficacy grades. The time taken for the TUG test also showed significance with a p-value of 0.001. Individuals with high levels of self-efficacy had better scores in physical function as well as muscle strength. No association was found between self-efficacy and KL grading.

Conclusion: Participants with higher self-efficacy demonstrated good muscle strength in the hip muscles and good physical function. The study concluded that individuals with high self-efficacy grades had better muscle strength and mobility compared to those with low scores in both strength and mobility.

Keywords: Mobility, Muscle strength, Physical function, Timed up and go

INTRODUCTION

Knee osteoarthritis is typically caused by wear and tear on the articular cartilage. It is most prevalent in the elderly and may eventually lead to disability. Clinical symptoms, along with the intensity and rate of progression of the disease, differ from individual to individual. It often leads to activity avoidance, worsening symptoms, weight gain, and muscle weakness. However, these symptoms typically increase in severity and frequency, resulting in more fatigue over time [1-4].

The presence of muscle weakness has been identified as a significant indicator of discomfort and reduced function in individuals with osteoarthritis, leading to a high-risk of falls [5]. Muscle atrophy is associated with progressive muscle weakness in osteoarthritis, and muscle damage is related to degenerative changes in articular cartilage [6-10]. Self-efficacy refers to an individual's confidence in their capacity to successfully complete a task with the intention of attaining a specific goal, such as alleviating pain or engaging in regular physical activities despite experiencing discomfort and stiffness [11]. According to Bandura's social cognitive theory, higher levels of self-efficacy are found to be associated with higher levels of functional mobility among individuals with knee osteoarthritis [12]. Various individual factors contribute to self-efficacy [13]. Self-efficacy plays a crucial role in shaping an individual's health-related actions and choices. It refers to a person's confidence in their ability to effectively accomplish a particular goal or behaviour in order to attain a desired result. This belief in one's capability greatly affects the willingness to embrace new health behaviours, as it guides a person's objectives and actions. This makes the individual mobile and resilient to pain [14]. Despite having severe grades of knee osteoarthritis, certain individuals are mobile and physically active due to resilience [15].

The present study aimed to identify the influence of self-efficacy on physical function and muscle strength in individuals with knee osteoarthritis. The primary objective is to identify the influence of self-efficacy on hip muscle strength and physical function. The secondary objective is to identify the influence of BMI on physical function.

MATERIALS AND METHODS

The cross-sectional study was conducted in Department of Physiotherapy at KS Hegde Charitable Hospital, Mangaluru, Karnataka, India from October 2022 to April 2023 and was approved by the NITTE Institutional Ethics Committee with reference number Ref: NIPT/IEC/Min//04/2021-22. Purposive sampling was used as the sampling method, and participants were recruited from the Orthopaedic Department of KS Hegde Charitable Hospital, Mangaluru, Karnataka, India. Flyers and pamphlets were distributed to patients in the hospital to recruit participants.

Inclusion criteria: Subjects with a radiological diagnosis of knee osteoarthritis with KL grading 3-4, presenting with unilateral or bilateral knee osteoarthritis, and within the age range of 45-70 years were included in the study [16]. Despite having severe grades, the subjects exhibited good mobility and resilience, which prompted the study authors to include this population type in the Indian scenario.

Exclusion criteria: Patients with a history of previous knee surgeries, any lower extremity injuries within the previous three months, and a radiological diagnosis of knee osteoarthritis with KL grading 1-2 were excluded from the study.

Sample size calculation: Based on an alpha error of 5%, a standard deviation of muscle strength of 0.39, and an estimation error of 0.09 [17], the required sample size was calculated to be 73 using n-Master software version 2. The sample size calculation was performed using the formula $n=Z^{2*}\sigma^2/E^2$. The final sample size was determined to be 73.

Study Procedure

A total of 73 participants were recruited based on the inclusion and exclusion criteria. In cases of bilateral knee osteoarthritis, the self-reported painful knee was examined.

Outcome measures: Outcome measures assessed included strength, physical function, and self-efficacy.

Strength: A Mechanical Push/Pull Dynamometer (MPPD) from Baseline Fabrication Enterprises Inc., USA, was used to assess the strength of the hip abductor, knee flexor, and extensor muscles. These muscles were considered in the study as biomechanical considerations have shown that these muscles are the stabilisers of the hip and knee. Participants received standardised oral instructions before each test, with verbal encouragement from the examiner.

For hip abductor strength assessment, participants lay supine with fully extended hips and knees, and the dynamometer was positioned laterally near the ankle joint. They performed an isometric hip abduction contraction for five seconds, with one minute of rest between legs. For knee flexor assessment, participants sat with hips and knees at 90° angles, and the dynamometer was placed on the lower limb's posterior surface near the ankle joint. Isometric knee flexion contractions were held for five seconds, with one-minute rest intervals. Knee extensor testing occurred in a seated position with hips and knees at 90° angles, and the dynamometer was positioned anteriorly near the ankle joint. Participants, holding the table's edges, executed 5-second isometric knee extension contractions with one minute of rest between legs. High test-retest reliability was demonstrated for knee extension and flexion strength exertions with the handheld dynamometer (ICC2,3=0.83-0.96) [18]. The examiner applied horizontal resistance to sustain isometric contractions throughout all tests.

Physical function: The TUG test was used to assess functional mobility. A standard chair with armrests was utilised for the test. Participants were instructed to stand up from the chair, using the armrests if necessary, walk past a line located 3 meters away, turn around, and return to the chair. The time taken by the participants from rising from their chairs to returning to their seats was recorded. The TUG test was found to have good validity when correlated with gait speed, with a Pearson's correlation coefficient of 0.75 [19]. In knee osteoarthritis participants, the TUG test demonstrated excellent intra- and inter-rater reliability, with an Intraclass Correlation Coefficient (ICC) of 0.97 and 0.96, respectively [20].

Self-efficacy was assessed using the Arthritis Self-efficacy Scale-8 (ASES-8). The ASES-8 is derived from the original ASES and includes two items from the Pain subscale, four items from the ASES other symptoms subscale, and two new items related to preventing pain and fatigue from interfering with activities. Each item is scored by circling a number between 1 and 10. A higher score indicates greater self-efficacy. The scale score is calculated as the mean of the eight items. The ASES-8 has high reliability, with a Cronbach's alpha ranging from 0.87 to 0.94. The validity of the scale is moderate, with correlations ranging from 0.13 to 0.36 [21].

To obtain precise measurements, calibrated personal scales were used to weigh participants, a stadiometer was used for height measurement, and a measuring tape was employed. Participants were measured for height and weight while wearing light indoor clothing and without shoes. Body Mass Index (BMI) was then calculated based on the height and weight measurements. BMI values of 18.5-22.9 kg/m^2 were chosen to represent "normal BMI," 23-24.9 kg/m^2 to represent "overweight BMI," and ≥25 kg/m^2 to represent "obese BMI" [22].

STATISTICAL ANALYSIS

The collected data were summarised using descriptive statistics, including frequency, percentage, mean, and standard deviation. The independent sample t-test was used to assess the differences in age, BMI, hip abductor strength, knee flexor strength, knee extensor strength, and TUG test scores across different levels of self-efficacy. One-way Analysis of Variance (ANOVA) was employed to assess the differences in TUG test scores based on BMI grading. The Pearson's correlation coefficient was used to examine the associations between the TUG test and variables such as BMI, hip abductor strength, knee flexor strength, and knee extensor strength. A p-value less than 0.05 was considered statistically significant. The data were analysed using version 26.0 of Statistical Package for Social Sciences (SPSS) software (SPSS Inc.; Chicago, IL).

RESULTS

The present study was conducted among 73 individuals with knee osteoarthritis. The mean age of the study participants was 60.2±6.5 years, and the mean BMI was 25.2±2.0 kg/m^2.

The majority of the participants were females (64.4%), and KL grading of 4 was found among 44 (60.3%) of the cases. Most of them were obese (46.6%), followed by overweight (35.6%) and normal weight (17.8%). A low arthritis self-efficacy scale-8 grading was found among 53.4% of the cases, while 46.6% reported a high-grade. The majority had a KL grading of 4 (44%), and most of the participants were obese (46.6%). Regarding self-efficacy grading, 53.4% had a low score, and 46.6% had a high score, as shown in [Table/Fig-1].

Variables	Gender	Frequency	%
Gender	Male	26	35.6
	Female	47	64.4
KL grading	Three	29	39.7
	Four	44	60.3
BMI grading (kg/m^2)	Normal	13	17.8
	Overweight	26	35.6
	Obese	34	46.6
Arthritis self-efficacy scale-08 grading	Low	39	53.4
	High	34	46.6

[Table/Fig-1]: Gender, KL grading, BMI grading and arthritis self-efficacy scale-8 grading.

[Table/Fig-2] shows that an independent sample t-test was used to compare BMI according to KL grading and self-efficacy grading. There was a difference in BMI according to KL grading ($p<0.007$) and self-efficacy grading ($p<0.002$).

Variables		BMI			
		Mean	SD	"t"	p-value
KL grading	Three	24.4	1.7	-2.76	0.007*
	Four	25.7	2.1		
Self-efficacy grading	High	24.4	2.1	-3.24	0.002*
	Low	25.9	1.7		

[Table/Fig-2]: Comparison of BMI according to KL grading and self-efficacy grading. t: Independent sample t-test; *Significant

The independent sample t-test was used to compare hip abductor, knee flexor, and knee extensor between the arthritis self-efficacy scale-08 grading. There was a significant difference (p<0.001) in hip abductor, knee flexor, and knee extensor between the arthritis self-efficacy scale-08 grading for both sides, as shown in [Table/Fig-3]. The independent sample t-test was used to compare the TUG test between the arthritis self-efficacy scale-08 grading. There was a significant difference in the TUG test between the arthritis self-efficacy scale-08 grading in both seconds (p<0.001) and steps (p<0.025), as depicted in [Table/Fig-4].

Variables		Right				Left			
		Mean	SD	t	p-value	Mean	SD	t	p-value
Hip abductor (Kg)	Low	10.6	2.1	-15.65	<0.001*	10.3	2.5	-10.10	<0.001*
	High	18.5	2.2			17.5	3.6		
Knee flexor (Kg)	Low	9.3	2.5	-13.52	<0.001*	9.0	3.2	-9.06	<0.001*
	High	18.1	3.1			16.6	3.9		
Knee extensor (Kg)	Low	9.5	3.0	-6.59	<0.001*	9.1	3.5	-4.99	<0.001*
	High	14.9	3.9			13.0	3.2		

[Table/Fig-3]: Comparison of hip abductor, knee flexor, knee extensor between Arthritis Self-efficacy scale-8 grading.
t: Independent sample t-test; *Significant

Variables		Mean	SD	"t"	p-value
Timed Up and Go (TUG) (Seconds)	Low	19.2	2.6	3.41	0.001*
	High	17.1	2.6		
Timed Up and Go (TUG) (Steps)	Low	17.2	3.1	2.28	0.025*
	High	15.6	3.2		

[Table/Fig-4]: Comparison of Timed Up and Go (TUG) test between arthritis self-efficacy scale-8 grading.
t: Independent sample t-test; *Significant

The one-way ANOVA was used to compare the TUG test according to BMI grading. There was a difference (p<0.001) in the TUG test according to BMI grading for both seconds and steps. This is noted in [Table/Fig-5].

Varaibles	Weight	Mean	SD	"F"	p-value
Timed Up and Go (TUG) (Seconds)	Normal	15.4	1.0	13.83	<0.001*
	Overweight	17.9	2.2		
	Obese	19.5	2.9		
Timed Up and Go (TUG) (Steps)	Normal	13.6	1.9	12.91	<0.001*
	Overweight	15.8	2.0		
	Obese	18.0	3.5		

[Table/Fig-5]: Comparison of Timed Up and Go (TUG) according to BMI grading.
"F": One-way ANOVA; *Significant

To determine the relationship between the TUG test and BMI, the Pearson's correlation coefficient was used as shown in [Table/Fig-6]. There was a positive correlation (p<0.001) between the TUG test (Both seconds and steps) and BMI.

Correlations	"r"	p-value
Timed Up and Go (TUG) (seconds) and BMI (kg/m^2)	0.576	<0.001*
Timed Up and Go (TUG) (steps) and BMI (kg/m^2)	0.539	<0.001*

[Table/Fig-6]: Relation between Timed Up and Go (TUG) test and BMI.
"r": Pearson correlation coefficient; *Significant

The independent sample t-test was used to compare the TUG (seconds) according to KL grading and self-efficacy grading. There was a significant difference (p<0.001) in the TUG (seconds) according to self-efficacy grading, as noted in [Table/Fig-7].

		Timed Up and Go (TUG) (seconds)			
		Mean	SD	"t"	p-value
KL grading	3	17.5	2.4	-1.74	0.086
	4	18.6	3.0		
Self-efficacy grading	High	17.1	2.6	-3.41	0.001*
	Low	19.2	2.6		

[Table/Fig-7]: Comparison of Timed Up and Go (TUG) according to KL grading and self-efficacy grading.
"t": Independent sample t-test; *Significant

DISCUSSION

In knee osteoarthritis, evaluating muscle strength and physical functionality is crucial due to the presence of symptoms such as pain, muscle weakness, joint instability, joint stiffness, and swelling. Hip abductors are responsible for maintaining femoropelvic alignment and femoral head stability. Hip abductor weakness is also associated with knee osteoarthritis [23]. Additionally, knee extensor and hip muscle forces collaborate in daily living motions (e.g., standing up, stair climbing), which can cause knee discomfort in people with knee OA. Therefore, patients with knee OA often exhibit increased hip muscle activity to compensate for decreased knee extension muscle during knee joint stress [24]. Self-efficacy beliefs are likely to have a substantial impact on older people with knee pain and their ability to maintain a functional level, especially those affected by chronic, debilitating osteoarthritis and lower extremity muscular weakness [15].

Extensive research has been conducted on the associations between the development of activity limitations and osteoarthritis. The avoidance model explains how activity limits emerge in osteoarthritic patients [25]. According to this theory, individuals who have previously experienced pain during physical activity anticipate that further activity will only increase their discomfort or worsen their current condition. Consequently, they may avoid physical activity, leading to muscular atrophy [26]. Holla JFM et al., study, have established a clear link between exercise avoidance, activity restrictions, and decreased muscle strength [25].

In the present study, a significant interaction between strength and self-efficacy is shown to influence the evaluated muscle strength. Participants with higher self-efficacy scores demonstrated better muscle strength compared to participants with lower self-efficacy scores, even though both groups were in advanced stages of osteoarthritis. It was hypothesised that individuals with high self-efficacy perceive challenges as tasks to be completed and are better equipped to bounce back from failures and disappointments. As a result, they engage in approach coping. On the other hand, individuals who lack self-efficacy tend to resort to avoidance coping because they feel that challenging tasks and circumstances are beyond their capacity. It is also likely for individuals with low self-efficacy to experience activity limitations without a clear physical cause, regardless of the severity of their disease, as demonstrated by Benyon K et al., 2010 [27].

Thus, in the context of knee osteoarthritis, individuals with a higher sense of self-efficacy are more likely to engage in consistent physical activity and achieve better outcomes. Patients with high self-efficacy are more likely to adopt and maintain healthy behaviours compared to those with low self-efficacy. They may also experience a higher quality of life, fewer mobility issues, and less pain. The ability of older people with knee osteoarthritis to maintain a functional level is significantly impacted by self-efficacy beliefs. As demonstrated by the current study, there is a relationship between self-efficacy and TUG timing, with individuals having higher self-efficacy performing better than those with lower self-efficacy.

The TUG test requires coordinated quadriceps and hamstring activity when transitioning from sitting to standing. A previous study indicated that lower-extremity strength, walking speed, mobility, and perceived task-related limitations all influenced the performance

of elderly individuals with knee osteoarthritis on the TUG test. Marconcin P et al., concluded that compared to strength and gait speed, pain and other arthritis symptoms may not be as crucial for functionality [28]. Therefore, the present study also reinforces the link between lower limb muscle strength and better mobility scores in the TUG test.

The present study reveals a significant association between the TUG test and self-efficacy. The results are consistent with a study conducted by Chen X et al., where they found that the TUG test is associated with mobility and balance. Individuals with high self-efficacy scores performed better in terms of movement and completing the test. They also mentioned that this test can be used as a predictor to assess the mobility of individuals with knee osteoarthritis [29]. Harding GT et al., demonstrated that individuals with knee osteoarthritis have a longer stance phase and a longer double step time, which was attributed to an increase in the duration of double limb support, as noted in another study by Kılıçoğlu O et al., [30,31]. In our current study, TUG test scores are higher, indicating reduced gait speed. This prolonged double limb support time may be a compensatory mechanism to lessen joint loading during the stride, as the dynamic load is transmitted to both lower limbs.

The weakening associations between physical capacity and self-reported osteoarthritis, as observed in this study, may suggest that individuals primarily report osteoarthritis based on their perception of symptoms and, to a lesser extent, other features of osteoarthritis. However, the current study does not assess pain or the duration of knee osteoarthritis onset and its symptoms. Therefore, it is suspected that the severity of pain and the duration of osteoarthritis onset have a significant impact on self-efficacy. Schoffman DE et al., demonstrated an inverse relationship between BMI and physical function [32]. The inverse relationship between physical function scores and BMI indicates that as BMI increases, more time is needed to execute tasks. The findings of the present study support that an individual's BMI, rather than the severity of osteoarthritis, influences the relationships between self-efficacy and functional activity. Physical performance was found to be inversely correlated with BMI and TUG score.

The results of present study did not find a significant relationship between BMI and gender among participants. This is not in line with the research conducted by Samma L et al., where a significant correlation between BMI and age and gender was found. This difference could be attributed to the selection of participants in this study, where most participants had similar BMI values [33]. However, there is a significant association between BMI and self-efficacy scales in this study, which aligns with the results of a study conducted by Liou D and Kulik L, (2020). They suggested that self-efficacy influences behaviour patterns, leading to sedentary behaviour or increased food consumption, which, in turn, affects body weight and can contribute to obesity in individuals [34]. The present study also confirms the findings by Otoshi K et al., which state that KL grading and gender have no significant relation. They also mention that self-efficacy is an individual's pattern and is not related to gender [35]. Additionally, they concluded that individuals with higher BMI tend to have higher grades in KL grading, while self-efficacy scoring shows a significant association with individual physical function and social interaction. These findings align with the results of the present study, which demonstrate a significant association between BMI and KL grading.

Limitation(s)

The present study has limitations, including a relatively small number of participants due to the high severity of the disease in these stages and the likelihood of many patients opting for surgery to alleviate pain and symptoms. Additionally, present study did not consider the various types of functional tasks and activities of daily living in which the participants were previously engaged.

CONCLUSION(S)

Self-efficacy has a significant influence on individuals with knee osteoarthritis, impacting both their muscle strength and physical function. Regardless of the severity of their illness, individuals with higher self-efficacy scores are more likely to experience fewer activity limitations, enabling them to maintain their muscle strength. The level of self-efficacy can also impact an individual's mobility, as those with higher levels of self-efficacy are more likely to engage in healthy behaviours and thus maintain a functional level of performance.

Acknowledgement

The authors would like to express their gratitude to all the participants for their participation in present study.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Jul 13, 2023
- Manual Googling: Sep 14, 2023
- iThenticate Software: Oct 13, 2023 (12%)

ETYMOLOGY: Author Origin

EMENDATIONS: 7

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Jul 12, 2023**
Date of Peer Review: **Aug 12, 2023**
Date of Acceptance: **Oct 15, 2023**
Date of Publishing: **Nov 01, 2023**