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Original article

Do self-efficacy, body mass index, duration of onset and pain intensity determine performance on selected physical tasks in individuals with unilateral knee osteoarthritis?

B.O.A. Adegoke [a], O.H. Boyinde [b], A.C. Odole [a, *], C.O. Akosile [c], A.I. Bello [d]

[a] Physiotherapy Department, College of Medicine, University of Ibadan, Ibadan, Nigeria
[b] Physiotherapy Department, Jos University Teaching Hospital, Jos, Nigeria
[c] Department of Medical Rehabilitation, College of Health Sciences, Nnamdi Azikwe University, Nnewi Campus, Anambra State, Nigeria
[d] Department of Physiotherapy, College of Allied Health Sciences, Korle-Bu, Ghana

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ABSTRACT

Purpose: To investigate the contributions of Pain Self-Efficacy (PSE), Function Self-Efficacy (FSE), Body Mass Index (BMI), duration of onset of Knee OsteoArthritis (KOA) and Present Pain Intensity (PPI) to performance on Stair Task Test (STT), Timed Up-and-Go (TUG) and 20-Meter Walk Test (20-MWT) and explore correlations among the variables in individuals with unilateral KOA.
Methods: Participants were 51 (22 male, 29 female) consecutively-selected patients with unilateral KOA. Participants' self-efficacy (PSE, FSE), and PPI were assessed using Arthritis Self-Efficacy Scale and Box Numerical pain scale respectively. Participants' performance on STT, TUG and 20-MWT was also assessed. Data were analyzed with Pearson product moment correlation and Stepwise linear regression at alpha level of 0.05.
Results: Participants' mean age, duration of KOA onset and BMI were 52.18 ± 10.69 years, 30.29 ± 29.03months and 26.06 ± 3.86 kg/m^2 respectively. Participants' scores on 20MWT, TUG and STT had significant direct correlations with each other and with PPI while PPI had significant indirect correlations with PSE ($r = -0.59$) and FSE ($r = -0.56$). PSE had significant direct correlation ($r = 0.65$) with FSE. Both PSE and FSE had significant but low inverse correlations with scores on the performance tests. PPI explained about 43% or more of the variance in 20-MWT, TUG and STT. PPI and onset of KOA explained 62% of variance in 20-MWT while PPI and BMI jointly explained 60% of variance in TUG.
Conclusion: Though PSE and FSE significantly correlated with scores on the performance tests, PPI, duration of OA and BMI were the significant determinants of performance.

1. Introduction

Osteoarthritis (OA) is a classic debilitating age-related disorder characterized by slow progressive articular cartilage destruction, ultimately leading to disabling pain and joint dysfunction (Anderson and Loeser, 2010; Anna et al., 2013). The knee is the weight-bearing joint most often affected by OA (Anna et al., 2013). Pain and stiffness which are the most common symptoms of OA are usually accompanied by limitation in activities of daily living (ADL) such as getting up from a chair, walking, balancing and using a flight of stairs (Hinman et al., 2002; American College of Rheumatology ACR, 2012). The reduction in ADL is brought about because in response to pain and stiffness, patients with OA reduce their activities which further induces muscle atrophy and poses greater limitation to functional activities (Kraemer et al., 2004; ACR, 2012).

Self-efficacy is a psychosocial factor that has been identified as a determinant of functional outcomes in chronic conditions (Harrison, 2004). It correlates with pain and physical function in OA (Sharma et al., 2003); hence functional self-efficacy has been found to be an important factor affecting the functional performance outcome for people with OA of the knee (Harrison, 2004). Maly et al. (2007) reported that self-efficacy is a determinant of walking performance in older adults with knee osteoarthritis. Pain is the most common presenting symptom in patients with knee

* Corresponding author. Physiotherapy Department, College of Medicine, University of Ibadan, PMB 5017, GPO, Ibadan, Nigeria.
E-mail address: adesola_odole@yahoo.com (A.C. Odole).

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osteoarthritis (Creamer et al., 2000) and the primary stressor that motivates individuals with OA to seek medical care (Creamer, 2000). The influence of self-efficacy belief on pain and disability in patients with chronic pain has been documented (Creamer et al., 2000; Rejeski et al., 2001). Low self-efficacy has also been identified as a predictor of reduced physical function and disability in patients with knee OA (Creamer et al., 2000; Benyon et al., 2010).

The risk of incident radiographic knee OA has been reported to be significantly increased among individuals with higher baseline Body Mass Index (BMI) (Cooper et al., 2000) and obesity has been listed as one of the principal risk factors for knee OA (Syed and Davis, 2000). Further, higher BMI has been associated with poorer physical function (Appovian et al., 2002; Schoffman et al., 2013). However, the link between BMI, self-efficacy and function has not been exhaustively studied.

There is a need for a better understanding of sources of mobility limitation in individuals with OA. Further, findings from studies on the relationship between functional performance and self-efficacy in OA have been equivocal. There appears to be a dearth of studies on the relationship between self-efficacy, physical functioning and pain intensity in patients with unilateral knee OA. The primary objective of this study was hence to investigate the contributions of each of self-efficacy and pain intensity to scores on three physical performance tests (stair test, timed up-and-go test and 20-m walk test) in patients with unilateral knee OA. The study's secondary objective was to explore the correlations among the variables. Our research hypotheses were that self-efficacy and pain intensity will contribute significantly to scores on the performance tests and the variables will be significantly correlated with each other.

2. Methods

2.1. Participants

Fifty one patients (22 male, 29 female) with unilateral OA of the knee participated in this cross-sectional study. Participants were newly-referred for physiotherapy by their physicians and had radiographic evidence of knee OA (formation of osteophytes on the tibial spines, narrowing of joint cartilage, reduced joint space etc.) as reported by radiologists. Clinical symptoms of knee pain plus any of following three criteria: age over 50years, stiffness, crepitus, bony tenderness and enlargement, established by the American College of Rheumatology (ACR) were used to further screen participants at the beginning of the study to confirm the presence of knee OA (ACR, 2012). Participants were recruited through consecutive sampling and have not undergone corrective surgery or knee replacement, and had no hip or spinal arthritis or other musculoskeletal problem of the back, hip or ankle (Creamer et al., 2000).

This study's protocol was approved by the Ethics Committee of Jos University of Teaching Hospital, Nigeria. Participants' informed consent (oral and written) was also obtained. Data on participants' age, sex, occupation, and history of present complaint were collected via interview and their age and weight assessed using standardized procedures prior to testing.

3. Tests

3.1. Pain intensity

Participants' present pain was assessed using the Box Numerical Pain Scale (BNPS). The scale consists of 11 numbered boxes (0–10) arranged in a descending order with 0 indicating no pain and 10 indicating the worst pain imaginable (McDowell and Newell, 1996; Kumar and Tripathi, 2014). The numbers chosen by the participants corresponded to their pain intensity; the more intense the pain, the higher the number. The responsiveness of the BNPS has been reported to be comparable to that of the visual analogue scale but superior to that of the verbal rating scale (Bolton and Wilkinson, 1998; Hartrick et al., 2003; Kumar and Tripathi, 2014).

3.2. Self-efficacy

Participants completed the Arthritis Self-efficacy Scale (Lorig et al., 1989). They were also enjoined to seek clarification where necessary. The Arthritis Self-efficacy Scale has 20 items characterizing the participant's belief concerning completion of tasks related to pain management and function. The instrument has 3 subscales namely: self-efficacy in pain management (5 items), self-efficacy in function (9 items) and self-efficacy in other symptoms' management (6 items). Each item is scored on a scale of 1–10 with 1 indicating very uncertain (least self-efficacy) and 10 being very certain (greatest self-efficacy). The three subscales of the instrument have been reported to have test-retest reliability coefficients of 0.85–0.90 (Lorig et al., 1989). Only the pain and function subscales were used in this study.

3.3. Performance

Participants went through three functional tests namely: Stair test (Skelton and McLaughlin, 1996), Timed Up and Go test (Podsiadlo and Richardson, 1991; Kennedy et al., 2005) and 20-m walk test (Harrison, 2004). The tests were selected because they are time efficient, simple to perform with minimal instruction, require minimal staff training, and can be conducted within a clinical setting (Loudon et al., 2002).

3.4. Timed up and go test

The ability to rise from a chair and walk has been reported to be impaired in patients with OA of the knee (Alghadir et al., 2015) hence the test was used to assess this ability in the participants. The test was performed with participants bare-footed. The participant (who was sitting on a chair with arm rests) was asked to rise immediately from the chair without using the arm rests for support on hearing the command 'GO'. Participant then walked at a self-paced, comfortable speed over a distance of 3 m along a marked corridor and returned through the same distance to sit on the chair. Timing with an electronic stop watch started when the participant took the first step and stopped when he/she returned to the chair. The score/dependent variable for the test was the time in seconds taken to complete the task. The reliability, minimal detectable change and responsiveness of the test have been established (French et al., 2011; Alghadir et al., 2015).

3.5. Stair test

The test which is used to assess functional ability in patients with OA was performed using the procedure outlined by Kennedy et al. (2002). Participant who was barefooted was asked to ascend and descend a flight of six stairs of 20-cm height on the ascending side and 15-cm height on the descending side. On the command 'Go', participant commenced the test by ascending and then descending the flight of stairs at a self-selected comfortable pace using the handrail if required (Kennedy et al., 2002). The participant's score was calculated as the time between the instance when the first foot was off the floor to ascend the flight of stairs and when both feet were on the floor after completing the descent. Timing was done with an electronic stop watch. The dependent variable was the time in seconds taken to complete the test. Stair walking test has been shown to have acceptable measurement properties of test-retest reliability, responsiveness and measurement error (Kennedy et al., 2005; Mizner et al., 2011).

3.6. 20-m walk test

The 20-m walk test is a physical function measure commonly used in clinical research studies and rehabilitation clinics to measure gait speed and monitor changes in patients' physical function over time (Motyl et al., 2013). This test was conducted as described by Motyl et al. (2013) on a corridor of 25- meter length and 2- meter width, already marked out at 1 m intervals and free of any obstacles to free walking. The participant was instructed to walk at his own pace over the middle 20-m distance along the corridor. Timing with an electronic stop watch started as the participant took the first step. The dependent variable was the time in seconds taken to walk the distance. The reliability and sensitivity of this test has been proven (Motyl et al., 2013).

3.7. Data analysis

Data were summarized using mean, standard deviation and range. Independent *t*-test was used to compare male and female participants' characteristics and scores on the dependent variables. Bivariate correlations among age, BMI, present pain intensity (PPI), 20-m walk test score (20MWTS), TUG, stair test score (STS), pain self-efficacy (PSE) and function self-efficacy (FSE) were determined with Pearson product correlation coefficient. Stepwise multiple regression modelling was used to determine the relative contributions of variables that were significant in the bivariate analysis on participants' performances on the physical tasks. Alpha level was set at 0.05.

4. Results

Mean age of participants was 52.18 ± 10.69 years (range = 40–75years). Participants' mean BMI and duration of KOA onset were 26.06 ± 3.86 kg/m^2 and 30.29 ± 29.03months respectively. Participants' characteristics, scores on the performance tests, present pain intensity and self-efficacy are presented in Table 1. Bivariate correlations among the variables are presented in Table 2. Scores on the performance tests (20MWT, TUG, STT) had significant direct correlations with each other and with PPI while PPI had significant indirect correlations with PSE ($r = -0.59$) and Function Self-efficacy (FSE) ($r = -0.56$) and PSE had significant direct correlation ($r = 0.65$) with FSE. Partial correlations between the variables after controlling for age, duration of osteoarthritis and BMI are presented in Table 3. After controlling for age, time since onset of OA and BMI, the correlations among the performance measures, PPI and PSE remained significant but stronger. However, though correlations between FSE and the performance measures and PPI remained significant, they were weaker. The stepwise linear regression models for the 20-MWT, TUG and STT are shown in Table 4. The PPI explained about 44% or more of the variances in 20-MWT, TUG and STT. Further, PPI and time since onset of OA jointly explained 62% of the variance in 20-MWT while PPI and BMI jointly explained 59.8% of the variance in TUG.

Table 1
Participants' characteristics and scores on physical tasks, pain and self-efficacy.

Variable	Mean	S.D	Median	Range
Age (yrs)	52.18	10.69	50.00	40–75
BMI (kg/m^2)	26.06	3.86	25.21	20.4–36.9
Onset (months)	30.29	29.03	24.00	2–120
STT (s)	10.55	2.82	10.00	6–16
TUG (s)	11.43	3.03	11.00	7–18
20MW (s)	21.12	3.25	20.03	16–28
PPI	5.86	2.01	6.00	3–7
PSE (%)	63.14	15.84	64.00	28–90
FSE (%)	72.88	16.11	77.00	32–98

STT = stair test task score, TUG = timed-up-and go test score, 20MW = 20-m walk test score, PPI = present pain index, PSE = pain self-efficacy score, FSE = functional self-efficacy score.

5. Discussion

The primary objective of the study was to investigate the contributions of self-efficacy, body mass index, duration of onset of knee osteoarthritis and pain intensity as determinants of performance on three physical performance tests (stair test, timed up-and-go test and 20-m walk test) in patients with unilateral knee OA. Results of the stepwise linear regression indicated that pain intensity alone contributed substantially to the variance in all the three performance tasks while pain intensity plus duration of onset of OA and pain intensity plus BMI contributed significantly to the variances in the 20-MWT and TUG tests respectively. Although both pain self-efficacy and function self-efficacy had significant negative correlations with all the performance tests, the correlations were indeed low using the classification of correlation coefficients by Munro (1997). Thus, their coefficients of determination (r^2) ranged from 15% to 20% for pain self-efficacy and 8%–12% for function self-efficacy thus implying that only 8%–20% of the variability in one variable was accounted for by the other. This was probably why both pain self-efficacy and function self-efficacy were not significant determinants of performance on the physical performance tests. Our findings support that of Edwards et al. (2014) who reported the maintenance of the significant relationships between physical performance and each of joint pain, self-reported OA, and clinical OA after adjustment for demographic and lifestyle factors. This suggests that demographic and lifestyle factors which are also individually associated with lower physical performance are not the sole mediators of the earlier reported associations. The authors further opined that the reduction in the strength of the relationships between physical performance and self-reported OA after adjusting for pain and stiffness may suggest that an individual reports OA largely due to symptom perception and to a lesser extent due to other features of OA. Our findings are contrary to those from Maly et al. (2005) in which functional self-efficacy contributed 45% or more of the variance in the 6-min walk, timed " up and go", and stair-climbing task. It is instructive to note that unlike in our study, the study in reference did not consider both pain and duration of onset of knee OA in the stepwise analysis. We therefore suspect that self-efficacy is modulated to a large extent by pain intensity and duration of onset of the OA.

The study's secondary objective was to explore the relationship among self-efficacy, pain intensity and scores on the three performance tests in individuals with knee OA. A significant inverse correlation was found between pain self-efficacy and pain intensity among the participants, thus suggesting that those with better pain self-efficacy reported lower pain intensity. A plausible reason could be that as participants' confidence in managing pain increased; they perceived their pain as less severe hence the rating of their pain reduced. Arstein (2000) had earlier reported a significant and direct correlation between pain reduction and pain self-efficacy. The finding is consistent with the general concept of self-efficacy being important in pain perception. Thus, it has been opined that regardless of the condition, the better an individual's perceived pain self-efficacy, the longer the individual endures increasing pain stimulation (Bandura et al., 1987). Patients with knee OA may hence report a high level of pain when their pain self-efficacy is low. Self-

Table 2
Pearson correlation coefficients for physical performance measures and independent variables.

	Age	BMI	Onset	20-MWT	TUG	STT	PPI	PSE	FSE
Age	1.00	−0.24**	0.61**	0.19	−0.08	0.05	−0.21	0.20	0.05
BMI		1.00	−0.18	−0.15	−0.31*	−0.18	−0.00	−0.16	−0.13
Onset			1.00	0.40**	0.14	0.13	0.07	−0.01	−0.30*
20-MWT				1.00	0.76**	0.73**	0.71**	−0.37**	−0.41**
TUG					1.00	0.87**	0.71**	−0.41**	−0.42**
STT						1.00	0.66**	−0.35*	−0.34*
PPI							1.00	−0.59**	−0.56**
PSE								1.00	0.65**
FSE									1.00

**Correlation is significant at 0.01 level (1-tailed).
*Correlation is significant at 0.05 level (1-tailed).

Table 3
Partial correlations among variables after controlling for age, duration of osteoarthritis and BMI.

	20MWT	TUG	STT	PPI	PSE	FSE
20MWT	1.00	0.78*	0.75**	0.74**	−0.39*	−0.29*
TUG		1.00	0.88**	0.72**	−0.45**	−0.34*
ST			1.00	0.69**	−0.39*	−0.31*
PPI				1.00	−0.56**	−0.52**
PSE					1.00	0.68**
FSE						1.00

**Correlation is significant at 0.01 level (1-tailed).
*Correlation is significant at 0.05 level (1-tailed).

Table 4
Models of physical performance measures (n = 51).

Dependent Variable	Model	R^2	F
20-Minute Walk Test (m)	Present pain intensity	0.505	50.058
	Present pain intensity & Duration of onset of OA	0.623	39.667
Timed "Up & Go" Test (s)	Present pain intensity	0.506	50.231
	Present pain intensity & Body mass index	0.598	35.725
Stair-climbing task (s)	Present pain intensity	0.438	38.206

efficacy has thus been reported to correlate with pain and physical function in OA (Sharma et al., 2003). This will ordinarily imply that strategies aimed at improving the level of pain self-efficacy of patients with knee OA may assist in reducing the reported pain intensity. However, considering our finding that pain intensity rather than pain self-efficacy significantly predicted performance on the physical function tests, it will be more instructive to focus on alleviating the patient's pain.

Significant inverse correlations (though weak) were found between functional self-efficacy and scores (performance) on the three task performance tests. Thus, time to accomplish the performance tasks reduces as functional self-efficacy improves. Self-efficacy has been reported to be a determinant of walking performance in older adults with knee osteoarthritis (Maly et al., 2007). This finding is in line with the recommendation of Maly et al. (2005) that therapies aimed at improving physical performance and relieving pain should also include strategies for enhancing self-efficacy. Such strategies include identifying and emphasizing an individual's past and present success or achievement, advising the individual to observe successful behaviours of others and giving positive feedback on his performance (Bandura et al., 1987). Among the strategies that have been recommended for enhancing self-efficacy in people with knee OA are arthritis self-management programmes, decreasing pain through cognitive techniques such as distraction and guided imagery, promoting relaxation and exercise and providing strategies for managing anxiety and depression (Lorig et al., 1989; Barlow et al., 1998).

Significant positive correlations as should be expected were found between pain intensity and performances on all the timed performance tests among participants in this study. Thus, as participant's pain increased, time taken to accomplish the tasks increased. This finding is partly consistent with that of Maly et al. (2005) who reported significant association between pain and performance on the 6-min walk test but not with performances on both stair climbing and timed-up-and-go tests among individuals with knee OA. Although poorer functional capacity has been associated with high pain intensity and physical performance score has been found to decrease with increased pain intensity, the association between pain and functional limitations in individuals with knee OA is by no means clear (Creamer et al., 2000). A direct but not significant correlation between pain and physical performance of function in patients with knee OA has been reported (Adegoke et al., 2012) and in patients with low back pain (Adegoke and Ezeukwu, 2010). Pain is the most important symptom in patients with osteoarthritis and the primary reason why sufferers from the disease seek treatment (Creamer, 2000). Although it has been opined that the determinants of pain and disability are different, it is generally assumed that disability would improve as a result of improvement in pain (Baker and McAllindon, 2000). Findings from this study suggest that pain reduction may be necessary for improved functional performance in patients with osteoarthritis of the knee.

After controlling for age, BMI and duration of onset of knee osteoarthritis, correlations among the performance measures, pain intensity and pain self-efficacy not only remained significant but also became stronger while correlations between functional self-efficacy, performance scores and pain intensity though still significant were reduced. This finding suggests that the relationships between both pain self-efficacy and functional self-efficacy and the performance measures were influenced by the patients' characteristics of age, duration of onset of knee osteoarthritis and BMI. However, while the variables positively influenced functional self-efficacy, they negatively influenced pain self-efficacy. Studies (Appovian et al., 2002; Schoffman et al., 2013) have reported inverse correlation between BMI and physical function. In line with this finding, in this study, BMI was negatively associated with all the performance measures though only significantly with the TUG score. However, the negative correlation between BMI and the physical function scores in this study actually suggests suggest that the time taken to accomplish the task reduces as BMI increases. One would have expected that the time taken to accomplish the tasks would be longer with increased BMI. We cannot readily find an explanation for this finding though significant interaction between

BMI and ethnicity on the odds of OA has been reported (Wright et al., 2008).

Participants in this study were however considerably younger than those in two previous studies. Thus, while the mean age of participants in this study was 52.18 ± 10.65 years, participants in the studies by Harrison (2004) and Maly et al. (2005) were 69.2 ± 8.8 years and 68.3 ± 8.8 years. There was also greater variability in the age of participants in this study. This age difference might have accounted for the observed differences between findings from previous related studies earlier cited.

5.1. Limitations

A limitation of our study is the sample size especially considering the fact that we considered nine variables. It is plausible that the results would have been somehow different if the sample size was larger. However, the sample size in our study compared favourably with the sample sizes in previous related studies (Harrison, 2004; Maly et al., 2005). Further, we cannot make definitive statements on causal relationships among the variables investigated because of this study's cross-sectional design. We hence suggest a longitudinal study to determine the nature of the bidirectional relationship among the variables investigated.

6. Clinical implication

Findings from this study indicated that although self-efficacy for pain and function had significant negative but low correlations with performances on 20-MWT, STT and TUG, they were not significant contributors to performance on the tasks. Instead, pain intensity was a major determinant of performance on the tasks. This suggests that the focus in the management of osteoarthritis should be on the patient's pain and not self-efficacy. However, considering the significant inverse relationship between self-efficacy domains and pain, reduction in pain may ultimately lead to improved self-efficacy.

7. Conclusion

Significant negative correlations were found between pain self-efficacy and pain intensity and between functional self-efficacy and performance while there was a positive correlation between pain intensity and performance in individuals with unilateral osteoarthritis of the knee. Pain intensity was a significant determinant and hence a significant mediator of performance on 20-MWT, stair task and timed-up-and go. However, based on the results of this study, other factors cannot be ruled out especially in view of the significant but low correlations between both pain self-efficacy and function self-efficacy and scores on the performance tests.

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