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Correlation of postural stability and functional performance with psychological factors in subjects with knee osteoarthritis

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Abstract
Objective: To evaluate postural stability and functional performance and study its relationship with psychological factors (pain catastrophizing, kinesiophobia and pain self-efficacy) in patients with knee osteoarthritis which will help us plan an effective treatment protocol in future.
Methods: 40 patients with knee osteoarthritis were included in this study. Postural stability and functional performance were tested using Multidirectional Reach test and 9-Step stair climb test respectively. Self-report measures were used to assess the following: pain catastrophizing (Pain Catastrophizing Scale-PCS), fear avoidance beliefs (Tampa Scale for Kinesiophobia TSK-11) and self-efficacy (Pain Self-Efficacy Questionnaire-PSEQ).
Results: There was a significant negative correlation of forward reach with pain catastrophizing and kinesiophobia and a significant positive correlation of forward reach with pain self-efficacy. There was no significant correlation of backward reach with all psychological factors (PCS, TSK-11, PSEQ). There was a significant negative correlation of both lateral reaches with pain catastrophizing and significant positive correlation with pain self-efficacy. There was a significant positive correlation of functional performance (stair climb test time) with pain catastrophizing and kinesiophobia.
Conclusion: It can be concluded that psychological factors affect postural stability and functional performance in subjects with knee osteoarthritis and hence should be considered in treatment planning and intervention.

Keywords: knee osteoarthritis, pain catastrophizing, self-efficacy, fear, functional performance

1. Introduction
Worldwide, fourth leading cause of disability is estimated to be Osteoarthritis (OA) [1]. Osteoarthritis is the most frequent joint disease with prevalence of 22% to 39% in India [2, 3]. Its prevalence increases with age and generally affects women more frequently than men [4]. In developing countries, it is strongly associated with aging and heavy physical occupational activity which is required livelihood for many people in rural communities [5]. Osteoarthritis (OA) is a chronic degenerative disorder characterized by loss of articular cartilage, subchondral bone remodelling, formation of osteophytes, change in synovium, joint capsule, ligaments and periarticular muscles [6, 7]. Pain in affected joints is the most common symptom of OA. Swollen joints, stiffness and restricted range of motion are other osteoarthritis signs and symptoms [8].
Postural stability and proprioception can be affected by OA which can lead to decreased balance thereby increasing the risk of fall during dynamic activities [9, 10]. Postural stability is the ability to control the center of mass in relationship to the base of support [11]. Age has a detrimental effect on all determinants of balance, but the deterioration may be accelerated in the areas of proprioception and strength in those with knee osteoarthritis [12]. The deterioration in postural stability can lead to falls in older adults which can have serious consequences such as soft tissue injury, joint dislocation, fracture, loss of independence, and even mortality [13]. Also, good postural stability is required for numerous activities of daily life such as shifting and transfer of weight, transitioning between sitting and standing, leaning, reaching, bending forward, and locomotion. Reduced postural stability in patients with knee OA causes difficulties in performing activities of daily living or recreation thereby affecting the quality of life [10]. Thus, improving the postural stability of older adults with knee osteoarthritis has become an important challenge in an aging population.
The functional consequences of knee osteoarthritis are also profound, because of its high prevalence and the related lower extremity mobility limitations [14]. People with knee OA find difficulty in walking, staircase climbing and transferring. These mobility tasks form an important component of rehabilitation for these patients [15].
It has been suspected that, certain osteoarthritis patients do not improve in function, despite concentrated treatment efforts to improve mechanical variables (strength and obesity), because of psychosocial issues [16]. Pain is complex perceptual experience, influenced by wide range of psychosocial factors like emotions, social and environmental context, socio-cultural background, the meaning of pain to the person, and beliefs, attitudes, expectations. Chronic pain, (pain that persists for months and years) such as in OA, influences all aspects of a person's functioning: emotional, interpersonal, vocational, and physical [17].
Fear-avoidance model proposed by Vlaeyen and Linton (2000) (Figure 1) is the most influential models to explain psychological factors in the experience of pain. It explains how patients with an acute or subacute pain condition can transition over time to a chronic state of depression,

disability, and inactivity. Fear of pain develops because of cognitive interpretation of pain as threatening (pain catastrophizing) [18, 19]. These dysfunctional interpretations give rise to pain-related fear, and associated safety seeking behaviours such as avoidance and hypervigilance, that can be adaptive in the acute pain stage, but paradoxically worsen the problem in case of chronic pain [20]. Pain catastrophizing can be defined as an exaggerated, negative orientation towards pain where a relatively neutral event is irrationally made into a catastrophe. The person starts imagining the worst possible result that could happen but accepts it as the given result [18, 21]. There is a strong relationship between fear and pain [22]. Kinesiophobia (kinesis=movement, phobia= fear) was coined by Kori *et al* in 1990, and is defined as an "excessive, irrational, debilitating, fear of physical movement and activity resulting from a feeling of vulnerability to physical injury or reinjury" [23]. This fear of movement could be acquired over time due to repeated painful stimulus [24]. In the absence of fear-avoidance beliefs about pain, individuals are likely to confront pain problems and become more engaged in active coping to improve function [18].

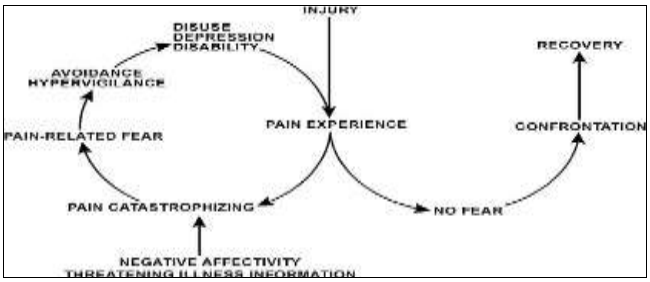

Fig 1: Fear Avoidance Model

Another important model for the development of persistent pain problems is the Self-Efficacy Model. Self-Efficacy is a personal conviction that a person can successfully perform certain required behaviours in a given situation. As compared to people with positive efficacy, those with weak efficacy expectancies might not be able to emit coping responses or persist in the presence of obstacles and aversive consequences. They have a feeling that pain is uncontrollable and unmanageable, given the physical demands of daily life [17]. This model requires patients to take efforts to understand the nature of their pain problem, plan self-care strategies for dealing with pain flare-ups, learn to overcome functional problems effectively, and utilize available resources wisely [18]. Painful and disabling knee osteoarthritis, affects older adults, where the role of self-efficacy perceptions in the context of maximizing coping efforts would potentially be magnified, due to the dual challenges posed by the disease as well as the aging process [25, 26].

From this, we can infer that various psychological factors can also have important implications in patients with knee osteoarthritis.

2. Methods

A Cross-sectional, correlational type of study was conducted in a tertiary care center for duration of 6 months. Using Software Primer of Biostatistics, 95% confidence level and 80% power of study, estimated sample size was 40. Patients with age more than 45 years, no fall history, knee pain for more than 3 months, pain on numerical pain rating scale (NPRS) between 4-10 and Kellgren-Lawrence grades between 2-4 were included in the study. Individuals with traumatic, rheumatic, infective, congenital conditions affecting the spine or lower limbs and patients with knee replacement of either knee were excluded. Participants were selected from the hospital and community via Orthopaedic Surgeon referral and word of mouth. 55 OA patients were consulted out of which 40 were selected for study based on inclusion criteria. Institutional ethics committee approval was taken prior to the commencement of study. The purpose of the study, study procedure was explained to participants and informed written consent was taken.

2.1 Outcome Measures:

Postural stability was assessed using Multidirectional reach test (MDRT). In this test, a measure tape is affixed on the wall at the level of subject's acromion process, horizontal to floor. The distance between feet is about 10cm. Without moving their feet and taking a step, the subjects were instructed to reach as far in the direction given as possible keeping the hand along the measure tape. Subjects could use their arm of choice for forward and backward directions and respective arm for right and left lateral reaches. The start and end positions of the middle finger of the outstretched hand was recorded and the difference represented the total reach for that direction. Three readings were taken and their mean was calculated for subsequent analysis [27].

Functional performance was assessed using 9-step stair climb test. The subject is asked to ascend and descend 9 flight of stairs as quickly as possible but in a safe manner. Use of handrail and walking aid was permitted if needed and recorded. The total time taken to ascend and descend steps was recorded using a stopwatch. The subject could stop and rest if needed but the time keeps going [28].

Self-report measures including Pain Catastrophizing Scale, Tampa Scale for Kinesiophobia and Pain Self-Efficacy Questionnaire were recorded.

Pain Catastrophizing Scale (PCS) was developed by Sullivan and colleagues in 1995 to develop comprehensive evaluation instrument that would encompass different perspectives of catastrophizing. It has 3 dimensions: rumination, magnification and helplessness. Total score is out of 52. Higher score indicates more catastrophizing [21].

Tampa scale for Kinesiophobia (TSK) was originally developed by Miller, Kori and Todd in 1991 for assessing fear of movement/re-injury. TSK-11 has 11 components with total score being 44. Higher the score, more is the fear of movement and re-injury [24].

Pain Self-Efficacy Questionnaire (PSEQ) is a 10-item questionnaire used to assess confidence, people with ongoing pain have while performing activities in pain. A total score ranging from 0-60 is calculated by adding the scores for each item. Higher scores reflect stronger self-efficacy beliefs [29].

2.2 Data analysis

The data was entered using Microsoft Office 2013 and analysed using a statistical software. Normality of data was assessed using the One – Sample Kolmogorov – Smirnov Test. Parametric tests (Pearson's correlation, unpaired t-test) were used whenever data passed the test of normality and non- parametric tests (Spearman's correlation, Mann-Whitney test) whenever data did not pass normality. P value less than 0.05 was considered as statistically significant.

3. Results

55 patients were screened for eligibility and 40 were enrolled in the study. Out of 40 patients enrolled, 18 had come through word of mouth and 22 by an Orthopaedic referral. Study consisted of 13 males (33%) and 27 females (67%) with mean age of 57.2 years. According to Kellgren-Lawrence grades, 15 patients had grade 2, 16 had grade 3 and 9 patients had grade 4 knee OA.

Results showed that: (Table 1, Table 2)

There was significant negative correlation of forward reach with pain catastrophizing and kinesiophobia and significant positive correlation with pain self-efficacy. This indicates that more pain catastrophizing and kinesiophobia and less pain self-efficacy, lesser is the distance for forward reach.

Similarly, there was negative correlation of backward reach with pain catastrophizing and kinesiophobia and positive correlation with pain self-efficacy but it was not statistically significant.

There was significant negative correlation of both lateral reaches with pain catastrophizing and significant positive correlation with pain self-efficacy.

There was significant positive correlation of functional performance (stair climb test time) with pain catastrophizing and kinesiophobia.

There was no significant correlation of functional performance with pain self-efficacy.

Table 1: Correlation between postural stability and psychological factors

SR No.	Correlation	R Value	P- Value	Significance
1	Forward reach and PCS	-0.4371	0.0048	Very significant
2	Forward reach and TSK-11	-0.3489	0.0273	Significant
3	Forward reach and PSEQ	0.5424	0.0003	Extremely Significant
4	Backward reach and PCS	-0.1036	0.5325	Not Significant
5	Backward reach and TSK-11	-0.075	0.6453	Not Significant
6	Backward reach and PSEQ	0.1785	0.1607	Not Significant
7	Right lateral and PCS	-0.3543	0.0249	Significant
8	Right lateral and TSK-11	-0.2392	0.1494	Not Significant
9	Right lateral and PSEQ	0.4935	0.0012	Very Significant
10	Left lateral and PCS	-0.3177	0.045	Significant
11	Left lateral and TSK-11	-0.09	0.5776	Not Significant
12	Left lateral and PSEQ	0.3718	0.018	Significant

Abbreviations: PCS- Pain Catastrophizing Scale, TSK- Tampa Scale for Kinesiophobia, PSEQ- Pain Self-Efficacy Questionnaire.

Table 2: Correlation between functional performance and psychological factors

Sr No.	Correlation	R value	P-Value	Significance
1	Stair climb test time and PCS	0.5164	0.0006	Extremely significant
2	Stair climb test time and TSK-11	0.3047	0.055	Not quite significant
3	Stair climb test time and PSEQ	-0.1766	-0.2756	Not significant

Abbreviations: PCS- Pain Catastrophizing Scale, TSK- Tampa Scale for Kinesiophobia, PSEQ- Pain Self-Efficacy Questionnaire.

4. Discussion

The results of the study support the proposed hypothesis and show that pain catastrophizing and fear avoidance were negatively correlated with postural stability and performance while the role of self –efficacy was positively correlated. This association can be explained with respect to the Biopsychosocial model.

This model views illness as dynamic and reciprocal interaction between biological, psychological, and sociocultural variables that shapes the person's response to pain. It is an integrated model that incorporates mechanical and physiological processes as well as psychological and social-contextual variables that may cause and perpetuate chronic pain.

According to this model, some form of physical pathology in the muscles, joints, or nerves generate nociceptive input to the brain. Perception involves the interpretation of nociceptive input and identifies the type of pain. Appraisal involves the meaning that is attributed to pain and influences subsequent behaviours. These appraisals are influenced by the beliefs each person develops over his or her lifetime. On the basis of these beliefs and the appraisal process, the person may choose to ignore pain and continue working, walking, socializing, and engaging in previous levels of activity or may choose to leave work, refrain from all activity, and assume the sick role [17].

Baert AC I *et al* examined the relationship of pain catastrophizing, kinesiophobia, and maladaptive coping strategies, with muscle strength, pain, and physical performance in patients with knee osteoarthritis (OA). The psychosocial variables accounted for more overall variability in isometric muscle strength than demographic and medical variables (age, pain, BMI and structural severity) combined. These findings fit the fear avoidance model that for some patients, pain experience will lead to fear of movement or to a maladaptive coping style. In the long term, avoidance of movement and physical inactivity will result in physical changes (muscle weakness) [30].

Thus, in knee OA patients, high pain catastrophizing, kinesiophobia and low pain self-efficacy may reinforce the muscle weakness which might lead to impaired proprioception. Muscle weakness and impaired proprioception would ultimately negatively affect postural stability.

Similarly, in a study by Verbunt JA *et al*, they evidenced that increased psychologic distress and level of current pain, tended to cause increased inhibition of muscle activity, leading to submaximal performance in chronic low back pain patients [31]. Also, in a study done by C. Ekdahl in Rheumatoid Arthritis, it was concluded that physiological as

well as psychological aspects ought to be considered in rehabilitation programmes for postural control [32].

In our study, positive correlation between functional performance (stair climb test time) and pain catastrophizing is very significant and correlation between performance and kinesiophobia is not quite significant. (p value almost reaching significant levels).

This finding is consistent with study done by Sinikallio SH *et al* where a higher pain catastrophizing and kinesiophobia was associated with higher pain score and poor functional ability [33]. In another study, Rapp SR *et al* concluded that less catastrophic thinking and prayer, greater ignoring and reinterpretation of pain sensations and stronger perceptions of pain control were associated with less disability and better physical function [34].

In contrast to this, Baert AC *et al* concluded that pain catastrophizing, kinesiophobia and maladaptive coping strategies were not associated with knee pain or physical performance. One of the reasons they analysed was that pain experience is different for every individual patient. Altered central nociceptive processing plays a significant role in moderate to severe symptomatic knee OA. In them, clinical picture is dominated by sensitization of central nervous system and enhanced nociceptive facilitation due to psychosocial factors. Thus, in knee OA, different people experience pain for different reasons [30].

In current study, it was also observed that correlation between functional performance and pain self-efficacy was not significant. This is consistent with study by Maly MR *et al*, who compared self-report measures with physical performance in knee OA. Performance measures included six-minute walk test (6MWT), timed up and go test (TUG) and stair climbing task. They reported a significant correlation between functional self-efficacy and all performance measures, but the correlation between pain self-efficacy and performance measures was not significant except with 6MWT. Functional self-efficacy explained 45% of the variance in the performance scores [16].

However, the present study had certain limitations-it is a cross-sectional study and though an association between psychological factors with both stability and performance has been found, direct causality cannot be inferred. Further longitudinal studies are needed to confirm the hypothesis that these maladaptive cognitions influence in the generation and maintenance of postural stability and performance in these patients. Also, only stair climb test was used to assess functional performance. Other performance measures like 6-minute walk test and timed up and go test etc. can be used to see if there are any differences.

5. Conclusion

The results of the study showed that there is correlation of postural stability and functional performance with psychological factors in knee osteoarthritis patients. Hence, assessment and treatment planning should take into account individual differences in pain beliefs and attitudes. Interventions focussed on decreasing pain catastrophizing and kinesiophobia and improving self-management such as therapeutic pain education, graded exposure, graded physical and social activation and cognitive behavioural therapy might be useful.

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