ISSN Print: 2664-7591
ISSN Online: 2664-7605
Impact Factor: RJIF 8-16
IJPCR 2025; 7(2): 95-96
www.pharmaceuticaljournal.in
Received: 03-06-2025
Accepted: 05-07-2025

Varsha Gehlot
Pacific College of Physiotherapy, Pacific Medical University, Udaipur, Rajasthan, India

Dr. Jafar Khan
Pacific College of Physiotherapy, Pacific Medical University, Udaipur, Rajasthan, India

Corresponding Author:
Varsha Gehlot
Pacific College of Physiotherapy, Pacific Medical University, Udaipur, Rajasthan, India

An observational study to analyze the knee weight bearing observation through sensor plate in male & female weight bearing distribution pattern in osteoarthritic changes

Varsha Gehlot and Jafar Khan

DOI: https://www.doi.org/10.33545/26647591.2025.v7.i2b.138

Abstract
Knee osteoarthritis (OA) is a degenerative joint condition marked by cartilage breakdown and progressive joint deformity, such as genu varum or valgum. Biomechanical factors like joint loading patterns, altered gait, Q-angle deviations, and foot arch abnormalities play a crucial role in both the onset and progression of OA. In particular, Grades II-III OA patients often exhibit asymmetrical loading and abnormal plantar pressure distribution, frequently associated with foot arch issues like pes planus or pes cavus. These adaptations increase joint stress and reduce stability, accelerating cartilage degradation.

Sensor plates offer a valuable, objective method to assess weight distribution, center of pressure, and postural alignment during both static stance and dynamic movement. This technology is especially useful in identifying early deviations in gait and loading, which are key contributors to OA progression. Notably, sex-based differences such as higher Q-angles in females can predispose individuals to more severe biomechanical imbalances and higher OA prevalence.

Clinically, sensor-based data can guide interventions such as custom foot orthoses and targeted gait retraining. These strategies aim to optimize biomechanical alignment, redistribute pressure, and reduce joint load, ultimately improving function and slowing OA progression. Early detection and personalized treatment are critical for better long-term outcomes.

Keywords: WOMAC Scale, knee osteoarthritis, sensor plate, group (male and female)

1. Introduction
Knee osteoarthritis (OA) is a degenerative joint disease involving the breakdown of cartilage, leading to pain, stiffness, and deformities such as bowlegs or knock knees. Biomechanical factors, including altered gait, joint misalignment, and foot arch abnormalities, significantly affect OA progression. Sensor plates, embedded with pressure-sensitive sensors, measure weight distribution and center of pressure during movement or standing. These tools assist in diagnosing, monitoring, and guiding rehabilitation by detecting asymmetrical loading patterns, making them vital in the clinical assessment of knee OA and related biomechanical dysfunctions

2. Clinical Relevance and Indian Healthcare Context
In India, osteoarthritis (OA) is a growing public health concern, especially among the aging population and women. With a prevalence of 22-39%, OA significantly impacts mobility and quality of life. This observational study using sensor plates offers valuable clinical insights into gender-specific weight-bearing asymmetries in knee OA. Identifying altered load distribution helps in early diagnosis, personalized rehabilitation, and orthotic interventions. In the Indian context, where access to early orthopaedic care is limited, sensor-based assessments can enhance clinical decision-making, reduce long-term disability, and improve patient outcomes through targeted biomechanical correction and resource-efficient management strategies.

3. Methodology

3.1 Participants

A Total of 60 Patients (aged 55-70 years) with Knee osteoarthritis (OA) were recruited. Inclusion required people with OA Grade 2, 3. Exclusion criteria included Ligament injury, Patellar dislocation and subluxation, fractures, Bursitis.

3.2 Study Design

Observation, randomized controlled trial with two arms:

- **Group A (Male):** Observing the Patients on Sensor Plate.
- **Group B (Female):** Same as Group A

3.3 Duration: 3 months

3.4 Intervention Protocol

- Participant Selection and Recruitment
- Preparation of Sensor Plate
- Data Collection Setup
- Weight Bearing Observation
- Analysis of data

3.5 Outcome Measures

- Sensor plate
- WOMAC Scale

4. Results

4.1 Sensor Plate Analysis

Table 1: Distribution of weight-bearing (Left, Right, and Midline Shift) according to gender and grade of knee osteoarthritis (mean ± SD)

Gender	Grade	Left (%)	Right (%)	Midline Shift (%)
Male	2	48.86±2.07	51.14±2.07	3.98±2.46
Male	3	54.51±2.92	45.49±2.92	9.53±4.88
Female	2	49.13±2.06	50.87±2.06	3.90±1.94
Female	3	52.09±3.40	47.91±3.40	6.55 4.36

4.2 WOMAC Scores by Grade and Gender

Table 2: WOMAC scores (Pain, Stiffness, Function, and Total) according to gender and grade of knee osteoarthritis (mean ± SD).

Gender	Grade	Pain (mean ± SD)	Stiffness	Function	Total WOMAC
Male	2	7.84±2.56	2.74±0.52	24.90±2.96	35.49±3.88
Male	3	13.04±1.38	4.58±0.34	38.53±7.39	56.16±7.61
Female	2	9.56±2.00	3.60±0.62	25.81±4.12	38.98±4.34
Female	3	13.81±2.75	4.89±0.69	39.70±4.19	58.43 5.67

5. Discussion

This observational study revealed that although OA grade distribution between males and females aged 55-70 was statistically similar, functional and biomechanical impairments were more pronounced in grade 3 OA, especially among females. WOMAC scores indicated higher pain and stiffness levels in women, while sensor plate analysis showed greater asymmetry in weight-bearing and midline shift in advanced OA. These findings highlight the importance of early detection of compensatory gait patterns and the need for gender-specific rehabilitation. Tailored interventions focusing on pain management, muscle strengthening, and postural correction can improve outcomes and delay surgical needs in patients with knee osteoarthritis.

6. Conclusion

Grade 3 knee osteoarthritis (OA) is associated with more severe functional impairment and biomechanical alterations compared to grade 2, as shown by higher WOMAC scores and notable asymmetry in weight distribution identified through sensor plate analysis. Patients with grade 3 OA reported increased pain, stiffness, and greater limitations in performing daily activities, reflecting a significant decline in quality of life. While the distribution of OA severity between males and females was statistically similar, females consistently reported worse symptoms across all WOMAC subscales and demonstrated more evident gait deviations. These differences may stem from factors such as hormonal changes post-menopause, lower muscle mass, and anatomical differences like increased Q-angle.

The use of sensor plates in this study provided objective insights into compensatory patterns such as midline shift and unequal limb loading. These adaptations, common in grade 3 OA, serve as short-term pain management strategies but often result in further joint strain and musculoskeletal imbalance over time. Recognizing such patterns early is essential for preventing further degeneration.

These findings emphasize the need for gender-specific assessment and personalized rehabilitation programs that integrate both subjective (WOMAC) and objective (sensor plate) data. Such an approach can enhance treatment precision, improve functional outcomes, and potentially delay OA progression in older adults.

7. References

1. Arumugaraja M, *et al*. Nanocomposite piezoresistive pressure sensor in gait monitoring for arthritis patient. IETE J Res. 2023;69(5):2743-2751.
2. Na A, Buchanan TS. Validating wearable sensors using self-reported instability among patients with knee osteoarthritis. PM R. 2021;13(2):119-127.
3. Hame SL, Alexander RA. Knee osteoarthritis in women. Curr Rev Musculoskelet Med. 2013;6:171-1717.
4. Felson DT, *et al*. Occupational physical demands, knee bending, and knee osteoarthritis: Results from the Framingham Study. J Rheumatol. 1991;18(10):1587-92.
5. Kawakami H, *et al*. Gait analysis system for assessment of dynamic loading axis of the knee. Gait Posture. 2005;21(1):125-130.
6. Rossi R, *et al*. Total knee arthroplasty in the varus knee: Tips and tricks. Int Orthop. 2019;43(1):151-158.
7. Zhuang Z, *et al*. Knee cartilage defect assessment by graph representation and surface convolution. IEEE Trans Med Imaging. 2023;42(2):368-379.
8. Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW. Validation study of WOMAC: A health status instrument for measuring clinically important patient relevant outcomes following total hip or knee arthroplasty in osteoarthritis. J Orthop Rheumatol. 1988;1(1):95-108.
9. McConnell S, Kolopack P, Davis AM. The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC): A review of its utility and measurement properties. Arthritis Care Res. 2001;45(5):453-461.
10. Hurwitz DE, *et al*. Knee pain and joint loading in subjects with osteoarthritis of the knee. J Orthop Res. 1998;16(4):572-579.