International Journal of Research and Review
[Indexed, Peer-Reviewed Journal]
Volume 13; Issue: 5; May 2026
Website: www.ijrrjournal.com
Research Paper *E-ISSN: 2349-9788; P-ISSN: 2454-2237*

Domain-Specific Changes in Quality of Life Following Multimodal Physiotherapy Interventions in Postmenopausal Women with Bilateral Knee Osteoarthritis: A WHOQOL-BREF based analysis

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DOI: https://doi.org/10.52403/ijrr.20260554

ABSTRACT

Background: Knee osteoarthritis (KOA) is a prevalent degenerative joint disorder that significantly affects the quality of life of postmenopausal women by causing pain, stiffness, reduced mobility and difficulty in performing daily activities. Quality of life (QOL) is often impaired across physical, psychological, social and environmental domains. Physiotherapy interventions are used in the management of knee osteoarthritis, however evidence comparing their effects on quality of life remains limited.

Objective: To compare the effectiveness of Therapeutic Ultrasound, Isometric exercises and Dynamic Quadriceps with Interferential Current Therapy, Multiple-Angle Isometrics and Mini-Squats on QOL in postmenopausal women with KOA assessed across all domains of the World Health Organization Quality of Life- Brief Version (WHOQOL-BREF) including physical health, psychological, social relationships and environmental domain.

Methods: Sixty postmenopausal women aged 40-60 years diagnosed with bilateral knee osteoarthritis (Kellgren Lawrence grade II-III) were randomly divided into two groups. Group A received Therapeutic Ultrasound, Isometric exercises and Dynamic Quadriceps whereas Group B received Interferential Current Therapy, Multiple-Angle Isometrics and Mini-squats. The WHOQOL-BREF was employed as the primary outcome measure to evaluate QOL across four domains: physical, psychological, social and environmental well-being. Assessments using the WHOQOL-BREF were conducted at baseline and after four weeks of intervention.

Results: Both groups showed significant improvement in QOL across all the WHOQOL-BREF domains. However, Group B demonstrated greater improvement. Physical domain showed the highest improvement followed by psychological, social and environmental domain.

Conclusion: The findings emphasize the clinical effectiveness of both multimodal physiotherapy interventions in the improvement of QOL in postmenopausal women with bilateral knee osteoarthritis. The protocol implemented in Group B produced comparatively superior outcomes.

Keywords: Knee osteoarthritis, Postmenopausal Women, World Health Organization Quality of Life- Brief Version,

Therapeutic ultrasound, Interferential Current Therapy, Isometric Exercise, Multiple-Angle Isometrics, Dynamic Quadriceps, Mini-Squats

INTRODUCTION

Knee osteoarthritis (KOA) is a prevalent degenerative musculoskeletal condition characterised by pain, impaired mobility and reduced quality of life (QOL). These symptoms negatively affect quality of life by limiting the ability to perform daily activities such as walking, stair climbing and household tasks. With nearly 23% of individuals over 40 years affected worldwide, KOA imposes a considerable burden on both individuals and society. [1]

In osteoarthritis (OA), excessive production of matrix metalloproteases (MMPs) disrupts cartilage homeostasis, leading to degradation of collagen and proteoglycans. Reduced estrogen levels are linked with a higher risk of arthritis, especially among postmenopausal women (PMW). Estrogen is believed to reduce inflammation, protect chondrocytes from degenerative changes and delay the progression of osteoarthritis (OA). Furthermore, anatomical differences and age-related changes such as loss of muscle mass and altered biomechanics may further accelerate OA progression.[2]

Physiotherapy is an important component of conservative management for KOA. It includes manual therapy, exercise programs and physical modalities, which help reduce pain, improve joint mobility and enhance functional ability. Customised physiotherapy interventions have also been shown to significantly improve quality of life by enhancing physical functioning, psychological well-being, social participation and the ability to perform activities of daily living.[3]

Therapeutic Ultrasound produces both thermal and non-thermal effects, including enhanced cartilage repair, improved extensibility of fibrous tissues, increased blood circulation, elevated pain threshold and accelerated tissue healing.[4]

Interferential Current Therapy (IFT) stimulates sensory nerves painlessly and is effective in targeting deep-seated lesions. [5,6]

Isometric exercise is a static strengthening technique that improves motor unit recruitment, firing frequency and activation of inhibited quadriceps muscles. [7,8] Multiple-angle isometrics further enhance muscle fibre recruitment by generating tension at different joint angles, thereby improving functional muscle performance.[9]

Dynamic Quadriceps is a controlled open kinetic chain, non-weight-bearing exercise that specifically activates the quadriceps muscle group, particularly the vastus medialis oblique during terminal knee extension.[10]Mini-squats are closed kinetic chain exercises involving coordinated movement of the hip, knee and ankle joints, where the quadriceps generate an internal extension moment to counteract external flexion forces produced by gravity and ground reaction forces.[11]

KOA has a substantial impact on QOL, affecting physical, psychological and social well-being. Chronic pain and reduced mobility often contribute to anxiety, depression and social withdrawal. Additionally, the financial burden associated with medical treatment and loss of productivity further worsens the overall impact of the condition on patients' lives. Therefore, comprehensive QOL assessment tools such as the WHOQOL-BREF are widely used to evaluate the broader effects of therapeutic interventions beyond pain relief and functional improvement. This multidimensional evaluation highlights the importance of evidence-based interventions aimed at improving overall well-being along with symptom management.[12]

The aim of the study was to compare the effects of two combined physiotherapy intervention protocols on quality of life in postmenopausal women with bilateral knee osteoarthritis in order to identify a more effective treatment approach. In addition, the study focused on evaluating the impact of these interventions across different domains of quality of life, including

physical health, psychological well-being, social relationships and environmental factors, in order to determine which aspects of quality of life showed the greatest improvement following treatment.

MATERIALS & METHODS

Study Design: Randomized controlled trial (RCT)

Study Setting: OPD of Department of Physiotherapy, Khalsa University, Amritsar

Study Population: Postmenopausal women radiologically diagnosed with bilateral knee osteoarthritis (Kellgren-Lawrence grade II-III)

Sampling Method: Simple Random Sampling

Sample Size: The sample size for this study was calculated using G*Power 3.1.9.7 software. Based on an effect size of 0.74, α= 0.05 and power =0.80, the analysis indicated a required sample size of 30 participants per group, resulting in a total sample of 60 participants for the trial.[13]

Eligibility Criteria:

Inclusion criteria:

- Postmenopausal women aged 40-60 years [14]
- Radiologically diagnosed bilateral knee osteoarthritis (Kellgren-Lawrence grade II-III) (radiograph obtained within six months of the outset of the study) [15,17]
- Persistent knee pain ≥ 3 months [14]

Exclusion criteria:

- History of knee surgery or intra-articular injection within the last 6 months. [16]
- Advanced Knee osteoarthritis (Kellgren-Lawrence grade IV) [14]
- Neurological disorders affecting gait or balance [14]
- Systemic inflammatory disease [16]
- Acute trauma, fracture or ligamentous injury of the lower limb [16]
- Concurrent participation in another physiotherapy or exercise trial [16]

Variables:

Independent Variable: Therapeutic Ultrasound, Interferential Current Therapy, Isometric Exercises, Multiple-Angle Isometrics, Dynamic Quadriceps, Mini-Squats

Dependent Variable: Quality of Life

Instrument and tool:

World Health Organization Quality of Life -BREF Questionnaire: The World Health Organization defines Quality of Life as an individual's perception of their position in life in relation to their cultural context, value systems, personal goals, expectations and concerns. The WHOQOL-BREF is a shorter version of the WHOQOL-100 designed to evaluate quality of life across four domains: physical, psychological, social and environmental wellbeing. In clinical practice, assessment using WHOQOL-BREF enables clinicians to identify the aspect of a patient's life most affected by disease, thereby supporting more appropriate and individualised treatment planning. [18]

Outcome measure:

The primary outcome measure of the study was Quality of Life (QOL), which was assessed using the WHOQOL-BREF. The WHOQOL-BREF is a standardized and validated self-administered questionnaire developed by the World Health Organization to evaluate an individual's perception of their quality of life in relation to physical health, psychological status, social relationships and environmental conditions. It is a shorter version of the WHOQOL-100 and consists of 26 items.

The questionnaire contains:

- Two general questions:

1. Overall perception of quality of life
2. Overall perception of health

- Twenty-four domain specific questions distributed across four domains:

1. Physical Health Domain: This domain evaluates physical functioning and the extent to which physical health affects daily life. It includes pain and discomfort, energy and fatigue, sleep

and rest, mobility, activities of daily living, dependence on medication or treatment and work capacity. This domain consists of 7 items (Questions: 3, 4, 10, 15, 16, 17, 18)

2. Psychological Domain: This domain assesses emotional and mental well-being. It includes positive feelings, self-esteem, body image and appearance, thinking, learning, memory and concentration, spirituality/personal beliefs and negative feelings. This domain consists of 6 items (Questions: 5, 6, 7, 11, 19, 26).
3. Social Relationships Domain: This domain examines social interaction and support systems. It includes personal relationships, social support and sexual activity. This domain consists of 3 items (Questions: 20, 21, 22).
4. Environmental Domain: This domain assesses the individual's surrounding environment and available resources. It includes physical safety and security, financial resources, accessibility of healthcare, home environment, opportunities for acquiring information and skills, participation in leisure activities, physical environment and transport facilities. This domain consists of 8 items (Questions: 8, 9, 12, 13, 14, 23, 24, 25).

Each item of the WHOQOL-BREF is scored on a 5-point Likert scale, ranging from 1 to 5 (1 = very poor/very dissatisfied/never and 5 = very good/very satisfied/always) Some negatively phrased questions are reverse scored before analysis. Raw scores obtained for each domain are then transformed into a 0–100 scale according to WHO guidelines, where higher scores indicate better quality of life and lower scores indicate poorer quality of life. [18]

The WHOQOL-BREF assessment was conducted at baseline and after intervention (four weeks).

Procedure:

Informed consent of all the participants was taken. Baseline assessment was carried out. The participants were randomly allocated into two groups:

Group A: Participants received Maitland Mobilisation, Therapeutic Ultrasound, Isometric exercise and Dynamic Quadriceps. (n=30)

Group B: Participants received Maitland Mobilisation, Interferential current therapy, Multiple-angle Isometrics and Mini-squats. (n=30)

Protocol: A total of 12 treatment sessions were administered three times per week over a period of four weeks in both groups.

Group A:

Therapeutic Ultrasound: The participant was positioned in supine lying with the knee maintained in slight flexion using a towel roll placed beneath it. The therapist stood adjacent to the treatment table while operating the ultrasound device. Ultrasound gel was applied to the treatment region to ensure proper transmission. The ultrasound transducer was placed over the medial and lateral aspects of the knee joint and moved slowly in circular motions throughout the treatment area. Therapeutic ultrasound was delivered at a frequency of 1 MHz in pulsed mode with an intensity of 0.8 W/cm² for a duration of 5 minutes per session.

Isometric exercise: Participants performed three different isometric exercises:

Exercise	Position	Description	Hold	Rest Period	Reps per set
Supine Straight Leg Raise (Isometric Hold)	Supine lying	Lift the affected limb approximately 10 cm from the table while keeping knee extended and ankle dorsiflexed. Other limb was flexed at hip and knee for support.	10 seconds	2 seconds	10
Side -Lying Leg Raise	Side lying	Raise the affected limb approximately 10 cm above the resting position. The lower limb was resting on the table flexed at 90° at both the hip and knee.	10 seconds	2 seconds	10

Ball Squeeze Exercise	Sitting on treatment table	A ball was placed between the knees flexed to 30°. The participant was instructed to gently squeeze the ball.	10 seconds	2 seconds	20

Dynamic Quadriceps: The participant was positioned in high sitting on the treatment table with the hip and knee maintained at approximately 90° flexion. From this position, the participant was instructed to actively extend the knee until full extension was attained. The fully extended position was held briefly, following which the leg was slowly lowered back to the initial starting position in a controlled manner. Progression Protocol of Dynamic Quadriceps:

Week	Protocol	Reps
Week 1	Dynamic Quadriceps	5
Week 2	Dynamic Quadriceps	10
Week 3	Resisted Dynamic Quadriceps using 50%,75% and 100% of 10 RM weight	10
Week 4	Resisted Dynamic Quadriceps using 50%,75% and 100% of progressed 10 RM weight	10

Group B:

Interferential Current Therapy: The patient was positioned in supine lying. The knee was supported in slight flexion with a towel roll beneath the knee. Four surface electrodes were placed around the knee joint in a quadripolar arrangement. The intensity of stimulation was adjusted according to the patient tolerance. Interferential current was delivered with the following parameters: isoplanar vector field with 6:6 sweep mode, carrier frequency of 4kHz, beat frequency of 100 Hz and sweep frequency of 150 Hz. Each treatment session lasted for 20 minutes.

Multiple-angle Isometric exercise: The participant was positioned in sitting on the treatment table with the hip and knee joint flexed at 90°. Participant was asked to extend the knee as far as possible against the resistance band at specific joint angles.

Angle	Hold	Reps	Sets
30° of knee flexion	6 seconds	10	3
60° of knee flexion	6 seconds	10	3
90° of knee flexion	6 seconds	10	3

Mini-Squats: The participant was positioned in standing with the feet placed shoulder-width apart and the trunk maintained in an upright posture. From this position, the participant was instructed to slowly flex the knees while keeping the feet flat on the floor, followed by a controlled return to the initial standing position. Progression Protocol of Mini-Squats:

Week	Protocol	Reps
Week 1	Up to 30° knee flexion	5
Week 2	Up to 45° knee flexion	10
Week 3	Resisted Mini-Squats using 50%,75% and 100% of 10 RM weight held in both hands with 45° knee flexion	5
Week 4	Resisted Mini-Squats using 50%,75% and 100% of 10 RM weight held in both hands with 45° knee flexion	10

Statistical Analysis:

The statistical analysis was carried out using IBM SPSS (Statistical Package for the Social Sciences) software. Both descriptive and inferential statistical methods were used to analyse the data. Descriptive statistics including mean and standard deviation were used to analyse the baseline characteristics and outcome measures of the participants in both groups. For within-group comparison of pre- and post-intervention WHOQOL-BREF domain scores, paired t-test was applied separately for Group A and Group B. Independent t-test was used for between-

group comparison of mean scores at baseline and post-intervention.

The physical, psychological, social relationship and environmental domains of the WHOQOL-BREF were analysed individually. The level of statistical significance was set at $p < 0.05$.

RESULT

A total of 60 participants were included in the study. Participants were divided into two groups, with 30 participants in each group. The baseline demographic characteristics were assessed and no significant differences were found between the two groups, ensuring comparability.

Table 1: Baseline characteristics of participants in Group A and Group B

Variable	Group A Mean ± SD	Group B Mean ± SD	t value	p value
Age (years)	50.47 ± 1.93	50.93 ± 2.02	-0.91	0.363
Height (m)	1.57 ± 0.02	1.60 ± 0.03	-0.98	0.327
Weight (kg)	70.27 ± 4.02	70.01 ± 4.29	0.24	0.814
BMI (kg/m²)	28.37 ± 1.77	28.22 ± 1.99	0.31	0.754

Data are expressed as mean ± standard deviation (SD). Table 1 presents the descriptive analysis of baseline characteristics of the participants in Group A and Group B. The mean age of participants in Group A was 50.47 ± 1.93 years, whereas in Group B it was 50.93 ± 2.02 years. The mean height of participants was 1.57 ± 0.02 m in Group A and 1.60 ± 0.03 m in Group B. The mean body weight was 70.27 ± 4.02 kg in Group A and 70.01 ± 4.29 kg in Group B. The mean BMI was 28.37 ± 1.77 kg/m² in Group A and 28.22 ± 1.99 kg/m² in Group B. Statistical analysis using an independent samples t-test revealed no significant differences between the two groups for any of the baseline variables ($p > 0.05$).

Physical Domain: Both groups demonstrated statistically significant improvement in the physical health domain scores following intervention ($p < 0.001$). However, Group B showed comparatively greater improvement in physical health domain scores than Group A at post-intervention assessment.

Table 2: Analysis of baseline and post intervention values within Group A and Group B

Group	Pre-Intervention Mean ± SD	Post-Intervention Mean ± SD	t-value	p-value
Group A	17.86 ± 2.31	24.42 ± 2.18	11.24	<0.001*
Group B	18.14 ± 2.27	28.63 ± 2.45	16.87	<0.001*

(Note: * mark indicates that p<0.05)

Table 3: Analysis of baseline and post intervention values between Group A & Group B:

Variable	Mean Difference	t-value	p-value
Physical Health Domain	4.21	6.74	<0.001*

(Note: * mark indicates that p<0.05)

Psychological Domain: Both groups exhibited statistically significant improvement in psychological health domain scores after the intervention ($p < 0.001$). However, the improvement observed in Group B was greater compared to Group A at the post-intervention evaluation.

Table 4: Analysis of baseline and post intervention values within Group A and Group B

Group	Pre-Intervention Mean ± SD	Post-Intervention Mean ± SD	t-value	p-value
Group A	15.24 ± 2.08	20.31 ± 2.11	9.46	<0.001*
Group B	15.47 ± 2.14	23.84 ± 2.26	13.28	<0.001*

(Note: * mark indicates that p<0.05)

Table 5: Analysis of baseline and post intervention values between Group A & Group B:

Variable	Mean Difference	t-value	p-value
Psychological Health Domain	3.53	5.89	<0.001*

(Note: * mark indicates that p<0.05)

Social Domain: Both groups showed significant enhancement in social relationship domain scores following the intervention ($p < 0.001$), with Group B demonstrating superior improvement compared to Group A at post-intervention assessment.

Table 6: Analysis of baseline and post intervention values within Group A and Group B

Group	Pre-Intervention Mean ± SD	Post-Intervention Mean ± SD	t-value	p-value
Group A	7.12 ± 1.34	9.46 ± 1.27	7.18	<0.001*
Group B	7.26 ± 1.29	11.08 ± 1.35	10.42	<0.001*

(Note: * mark indicates that p<0.05)

Table 7: Analysis of baseline and post intervention values between Group A & Group B:

Variable	Mean Difference	t-value	p-value
Social Relationship Domain	1.62	4.73	<0.001*

(Note: * mark indicates that p<0.05)

Environmental Domain: Both groups demonstrated statistically significant improvement in the physical health domain scores following intervention ($p < 0.001$). However, Group B showed comparatively greater improvement in environmental domain scores than Group A at post-intervention assessment.

Table 8: Analysis of baseline and post intervention values within Group A and Group B

Group	Pre-Intervention Mean ± SD	Post-Intervention Mean ± SD	t-value	p-value
Group A	20.64 ± 2.52	23.18 ± 2.44	5.94	<0.001*
Group B	20.82 ± 2.47	25.34 ± 2.63	8.11	<0.001*

(Note: * mark indicates that p<0.05)

Table 9: Analysis of baseline and post intervention values between Group A & Group B:

Variable	Mean Difference	t-value	p-value
Environmental Domain	2.16	3.96	<0.001*

(Note: * mark indicates that p<0.05)

The present study evaluated the effects of two multimodal physiotherapy intervention protocols on domain-specific quality of life in postmenopausal women with bilateral knee osteoarthritis using the WHOQOL-BREF. Both Group A and Group B demonstrated statistically significant improvement across all four WHOQOL-BREF domains following intervention ($p < 0.001$).

Within-group analysis revealed significant enhancement in physical health, psychological health, social relationships and environmental domain scores in both groups from baseline to post-intervention assessment. However, between-group comparison demonstrated comparatively greater improvement in Group B than Group A across all domains.

Among all the domains, the greatest improvement was observed in the physical health domain, indicating substantial enhancement in mobility, daily functioning and physical well-being following intervention. This was followed by improvement in the psychological domain, suggesting positive effects on emotional and mental well-being. Moderate improvement was observed in the social relationship domain, while the least improvement was noted in the environmental domain.

Overall, the intervention protocol administered to Group B, consisting of Interferential Current Therapy, Multiple-Angle Isometrics and Mini-squats, produced superior outcomes compared to the protocol used in Group A. The findings suggest that the Group B protocol may be more effective in improving domain-specific quality of life in postmenopausal women with bilateral knee osteoarthritis.

DISCUSSION

The present study was conducted to compare the effectiveness of two multimodal physiotherapy intervention protocols in postmenopausal women with bilateral knee osteoarthritis. The primary aim of the study was to determine whether combination of Therapeutic Ultrasound, Isometric Exercises and Dynamic Quadriceps differed in effectiveness from combination of Interferential Current Therapy, Multiple-Angle Isometrics and Mini-Squats in improving quality of life.

Knee osteoarthritis (KOA), also referred to as degenerative joint disease, is characterized by progressive degeneration and deterioration of the articular cartilage. Patients commonly present with gradually increasing knee pain aggravated by physical activity, joint stiffness, swelling, discomfort after prolonged sitting or rest, and progressive worsening of symptoms over time. In osteoarthritis (OA), increased activity of matrix metalloproteinases (MMPs) disrupts cartilage homeostasis by degrading collagen and proteoglycans within the extracellular matrix. Reduced estrogen levels, particularly in postmenopausal women, are associated with an increased risk and progression of OA, as estrogen plays a protective role by reducing inflammation and preserving chondrocyte function. Furthermore, age-related changes, altered biomechanics, and reduced muscle mass may also contribute to the progression of the disease.[2]

The WHOQOL-BREF is one of the most widely used instruments developed for cross-cultural comparisons of quality of life and is available in more than 40 languages.[19] Anand B. et al. (2025) reported that instruments such as the WHOQOL-BREF have become instrumental in evaluating the broader implications of therapeutic interventions beyond pain and functional outcomes alone. This multidimensional approach underscores the need for evidence-based interventions that not only alleviate symptoms but also improve overall well-being and quality of life. [12]

Therapeutic Ultrasound has been widely used in physiotherapy because of its mechanical and thermal effects on biological tissues. Zeng et al. (2014) stated that pulsed ultrasound primarily produces non-thermal effects such as acoustic streaming and cavitation, which enhance cellular permeability, stimulate fibroblast activity, and promote tissue repair. These physiological mechanisms contribute to reduced inflammation and improved healing within the periarticular structures of the knee joint. [20]

Isometric exercises allow muscle activation without joint movement, making them particularly suitable for individuals experiencing pain during dynamic movements. These exercises improve neuromuscular recruitment, increase motor unit activation, and enhance muscle endurance without imposing excessive stress on joint structures. [21],[22] The findings of the present study are consistent with those reported by Huang et al. (2018), who demonstrated that isometric exercises significantly reduced pain and improved knee joint function in patients with knee osteoarthritis. [23]

Dynamic quadriceps exercise is an open kinetic chain exercise that selectively activate the quadriceps muscle group and are particularly beneficial for individuals with higher body mass index or severe pain during weight-bearing activities. [10] The results of the present study are supported by the findings of Desai et al. (2022), who reported that open kinetic chain strengthening exercises significantly

improved quadriceps strength and functional outcomes in individuals with knee osteoarthritis. These exercises allow controlled movement of the knee joint and facilitate targeted strengthening of the vastus medialis oblique, which plays an important role in patellar stabilization. [24]

Interferential Current Therapy (IFT) is commonly used in physiotherapy for pain modulation. The intersecting medium-frequency currents generate a low-frequency amplitude-modulated current within deeper tissues, which stimulates sensory nerves and activates pain-inhibitory mechanisms. [6] Ata et al. reported significant improvements in pain and functional performance following interferential current therapy in patients with knee osteoarthritis. [25]

Multiple-angle isometric training allows muscle activation across a broader range of motion, thereby improving functional strength and joint stability.[9] Parveen et al. (2024) demonstrated that multiple-angle isometrics resulted in greater improvements in pain reduction and functional performance compared with conventional isometric exercises in individuals with knee osteoarthritis. These findings support the rationale for incorporating multi-angle strengthening techniques into rehabilitation programs. [26]

The findings of the present study are consistent with the results reported by Desai et al. (2022), who found that closed kinetic chain exercises such as Mini-Squats produced greater improvements in functional performance, dynamic balance, and WOMAC scores in individuals with knee osteoarthritis. The authors explained that closed kinetic chain exercises improve proprioception, increase joint stability, and enhance muscle coordination, collectively contributing to improved functional outcomes. [24]

The present study has certain limitations that should be considered while interpreting the findings. First, the duration of intervention was limited to four weeks, which may not reflect the long-term effects of the physiotherapy protocols on quality of life in individuals with knee osteoarthritis. Second, the study included only postmenopausal women with bilateral knee osteoarthritis (Kellgren-Lawrence grade II–III); therefore, the findings cannot be generalized to male participants, younger individuals or patients with advanced osteoarthritis. Third, the study primarily focused on quality-of-life assessment using the WHOQOL-BREF and did not include objective biomechanical or radiological outcome measures.

Future studies should include larger sample sizes and longer follow-up periods to determine the long-term effectiveness and sustainability. Further research may also investigate the effects of these interventions in different populations, including males, older adults and individuals with varying severities of osteoarthritis. Incorporating objective outcome measures such as gait analysis, muscle strength assessment, balance evaluation and radiological parameters may provide a more comprehensive understanding of treatment effects. Comparative studies involving newer rehabilitation approaches such as virtual reality, neuromuscular electrical stimulation and telerehabilitation may also be beneficial.

CONCLUSION

The present study demonstrated that both multimodal physiotherapy intervention protocols were effective in improving quality of life in postmenopausal women with bilateral knee osteoarthritis. Significant improvements were observed across all domains of the WHOQOL-BREF, including physical health, psychological health, social relationships and environmental well-being. However, the intervention protocol consisting of Interferential Current Therapy, Multiple-Angle Isometrics and Mini-Squats produced comparatively greater improvement than the protocol comprising Therapeutic Ultrasound, Isometric Exercises and Dynamic Quadriceps. Among all domains, the greatest improvement was observed in the physical health domain,

indicating enhanced mobility, functional ability and overall physical well-being following intervention. The findings of the study support the effectiveness of comprehensive multimodal physiotherapy approaches in enhancing overall quality of life in postmenopausal women with knee osteoarthritis and reinforce the role of physiotherapy as an important component in conservative management of the condition.

Declaration by Authors

Ethical Approval: Approved

Acknowledgement: The authors express sincere gratitude to all the participants who contributed to the successful completion of this research study.

Source of Funding: None

Conflict of Interest: No conflicts of interest declared.

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How to cite this article: Sehajleen Kaur, Varinder Kaur. Domain-specific changes in quality of life following multimodal physiotherapy interventions in postmenopausal women with bilateral knee osteoarthritis: a WHOQOL-BREF based analysis. *International Journal of Research and Review*. 2026; 13(5): 594-604. DOI: *10.52403/ijrr.20260554*

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