"EFFECT OF NORDIC WALKING AND EXERCISES ON STRENGTH AND DISABILITY IN PATIENTS WITH GRADE I KNEE OSTEOARTHRITIS"

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Abstract

Osteoarthritis (OA) of the knee is one of the most common degenerative joint conditions, particularly affecting adults in their mid-30s and above who engage in repetitive stress activities. In the early stages, especially Grade I OA, patients typically present with pain, reduced quadriceps strength, joint stiffness, and mild functional limitations that gradually worsen if timely intervention is not provided. Conservative management exercises —including therapeutic exercises, strengthening programs, ROM training, and activity modification—remains the first line of treatment for improving pain and function. However, recent literature has highlighted the potential value of aerobic and functional gait-based exercises, such as Nordic walking, which provide a whole-body movement pattern, greater activation of upper extremity muscles, and improved postural control. Nordic walking increases stride length, enhances muscle recruitment, and reduces mechanical stress on the knee joint through pole-assisted offloading. Studies suggest that integrating Nordic walking with standard conservative physiotherapy may result in superior improvements in pain, mobility, and quality of life compared to traditional methods alone. Despite growing interest, evidence is still limited in the Indian population, especially among individuals with early-stage OA. There is a need to explore whether adding Nordic walking to conventional physiotherapy can produce greater outcomes in terms of quadriceps strength, postural control measured via pressure biofeedback, and functional disability measured by the WOMAC scale. Therefore, the present study attempts to compare the effectiveness of Nordic walking combined with exercises versus exercises alone in Grade I knee osteoarthritis. Fifty participants diagnosed with Grade 1 knee OA were selected and divided into two groups (n = 25 each). Group A received Nordic Walking along with conservative exercises, while Group B received only exercises. Participants had no prior knee injuries and were within the age range of 30–45 years. Outcome measures included the WOMAC Score and Pressure Biofeedback values to assess muscle activation and functional improvement. Pre- and post-intervention values were statistically analyzed to determine changes in pain, disability, and quadriceps strength. Both groups demonstrated improvement, but Group A showed significantly greater reductions in pain and disability. Group A showed a marked improvement in pressure biofeedback values and a higher reduction in WOMAC scores compared to Group B. Improvements were more prominent in participants with higher baseline symptoms and consistent adherence to the Nordic Walking sessions

Keywords: Knee Osteoarthritis, Nordic Walking, Conservative Therapy, Pressure Biofeedback, WOMAC, Quadriceps Strength, Early Intervention.

Introduction

Osteoarthritis of the knee, is a degenerative joint disease that occurs when the protective cartilage that cushions the end soft bones wear down overtime. it is the most common type of arthritis and can typically affect joints in the hands, knees, hip and spine. Causes of osteoarthritis are aging, joint injury or overuse, obesity, genetics, bone deformities [(1)]

Osteoarthritis (OA) is the most common joint disease, causing disability and reduction of quality of life and participation in social activity. Now considered a whole joint disease, OA is characterised by cartilage loss, subchondral bone changes, synovial inflammation and meniscus degeneration.(1)

The hallmark symptom of knee OA is pain and two different patterns of pain have been describedaccording to the disease stage. In the early phases of the disease, pain is related to activityand becomes more constant over time, while in the late stages there is 'background pain'interspersed with unpredictable intense pain. Radiographic evidence of OA is a relatively latemarker for the structural evolution of the disease. Large epidemiological studies have demonstrated that X-ray abnormalities often occur in the absence of pain. The prevalence of asymptomatic knee. OA among adults aged 45 >years was 12% and 11%, respectively, in the Framingham study and Johnston County Osteoarthritis Project .One possible reason is that pain-sensitive features in the joint are not visualised by the radiographs. Early osteochondral defects and meniscal tears detected by MRI have been found incidentally in middle-aged and elderly people and are often not associated with knee pain or other symptoms. This finding highlights the concept that EOA changes can be asymptomatic and pain, stiffness and aching may occur later in the history of the disease when the OA pathological process is far advanced.(6)

OA is also known as a common joint disorder showing focal cartilage loss, new bone formation and involvement of all joint tissues, introducing the new concept of OA as a whole joint disease;however, the diagnosis is still based on symptoms (usage-related pain, short-lived stiffness), functional limitation, clinical and radiographic findings, and risk factors (age, gender, body mass index (BMI), occupation, family history of OA, history of knee injury, etc)(5)

Osteoarthritis is classified into four grades based on the severity of joint damage using the kellgren- lawrence grading system
This system assesses changes seen on x ray such as joint space narrowing, bone spurs, and cartilage loss , common metric of OA progression is the Kellgren–Lawrence (K–L) scale, traditionally used to assess the severity of radiographic knee OA. This categorical scale incorporates important radiographic features of OA into one scale of increasing severity. The use of the K–L scale has been criticized because its individquidistant from each other. Consequently, estimates of the proportion of patients that progress from one category to the next may not be comparable for all starting points. Since the K–L scale is still used in clinical settings for making treatment decisions, its value in assessing knee OA progression warrants continued investigation.(4)

Kellgren-lawrence scale(4)

Grade0-no signs of osteoarthritis

Grade1-doubtful narrowing of joint space and possible small osteophytes Grade 2- definite osteophytes and possible joint space narrowing
Grade 3- multiple osteophytes, definite joint space narrowing, some sclerosis, and possible bone deformity

Grade4- large osteophytes ,severe joint space narrowing ,marked sclerosis, and definite bone deformity

Methodology

Study Design: Experimental study

Study Setting: Orthopedic hospital in and around pune

Sample Size: 50

Tools and Materials Used: Pen, Paper, Nordics walking poles , Pressure biofeedback, Stop watch , WOMAC scale , Pillow, Plinth

Inclusion Criteria: Diagnosed Grade1osteoarthritis patient , 30 to 45 age group people

Exclusion Criteria: Any lower limb deformities other than OA, Any cardiovascular component involment

Outcome Measures: Western Ontario and mc master universities osteoarthritis index [womac] scale, Pressure biofeedback

Procedure

Throughout the study, ethical consideration were strictly observed.Study will begin with the presentation of synopsis to an ethical committee and clearance will be obtained

The study involve data collection, examination, imaging study to confirm the injury. We will divide the sample in 2 groups of 25 each The first group will practice Nordic walking with exercises and the second group will practice only exercises. In first group perform Nordic walking and exercises for nordic walking was given for 4 weeks (4 session per week)

Nordic walking

- Stand tall with your shoulders relaxed, chest up , and eyes looking straight forward.
- Hold a pole in each hand on a diagonal angle backward (they should be angled so the base of the pole is behind you). Your hand should lightly grip the pole.
- As you take a step forward with your left foot, bring the right pole forward so that the base of the pole lands on the ground to the side of you (do not bring the pole in front of you).
- push the pole into the ground behind you as you take a step with your right foot. As you fully extend your arm, loosen your grip so that your palm is almost fully open.This allows your arm to go through a larger range of motion and prevent wrist injury.
- As this occurs, bring your right foot and left pole forward (close your grip as the pole lands to push it off of the ground) and continue the motion.

Exercises

1 Rom exercises

Heel slides, Quadriceps stretch, Hamstring stretch

2 Strengthening exercises

Straight leg raise, Step up, Glute bridges

3 Balance

Single leg stand, Heel to toe walk

4 Aerobic exercises

Walking (15-20) mins

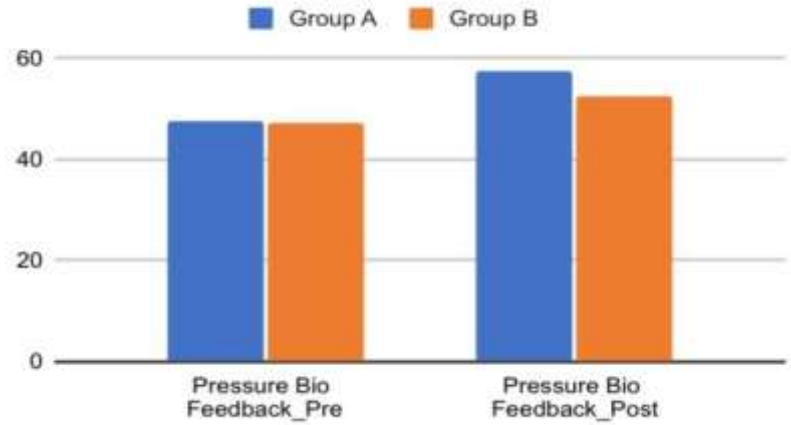
Data Analysis

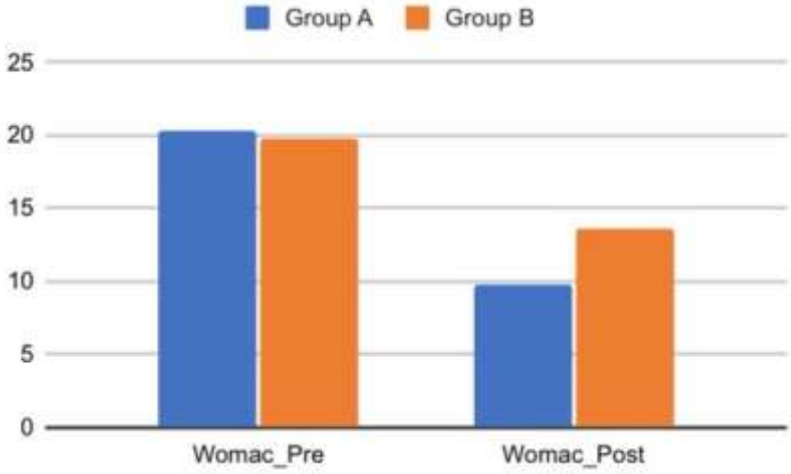
Statistical analysis was carried out using SPSS version 26. The data were screened for normality using the Shapiro– Wilk test. The pre- and post-intervention data for Group A (Nordic walking + exercises) were normally distributed ($p > 0.05$) and hence analyzed using paired t-tests. In Group B (exercises only), strength values violated the normality assumption ($p < 0.05$) and were therefore analyzed using the Wilcoxon signed-rank test, whereas WOMAC scores were analyzed using paired t-tests. Between-group comparisons of mean

change scores were performed using independent t-tests for normally distributed data and Mann–Whitney U tests for non-parametric data.

Table 1. Baseline Characteristics of Participants (N = 50)

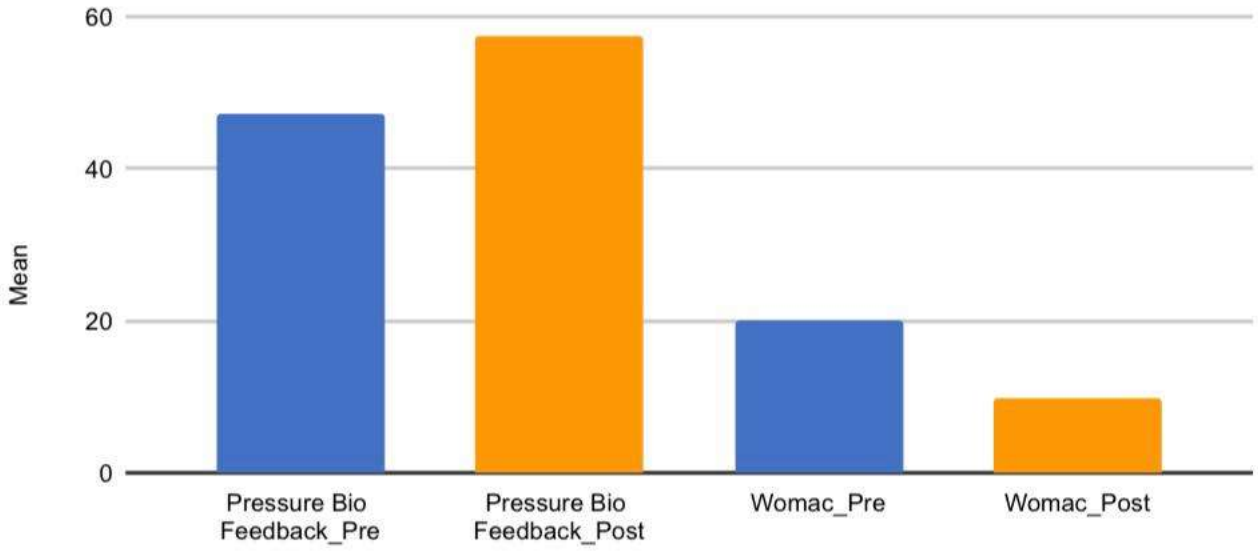
Variable	Group A (Nordic + exercises) (n = 25)	Group B (Exercises Only) (n = 25)	t / U (df = 48)	p-value
Age (years)	38.40 ± 3.37	39.20 ± 3.73	t = 0.83	0.41
Pressure Biofeedback (mmHg, Pre-test)	47.36 ± 1.55	47.24 ± 1.39	t = 0.27	0.79
WOMAC Score (Pre-test)	20.24 ± 2.55	19.80 ± 2.77	t = 0.61	0.54





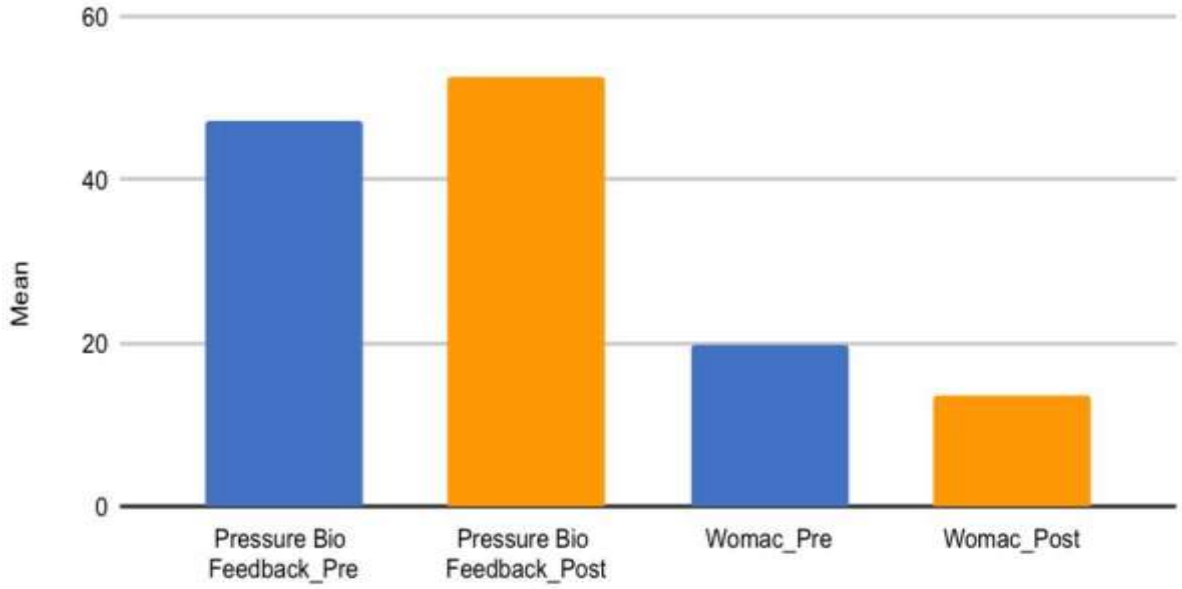
At baseline, there were no statistically significant differences between groups for age, pre-intervention strength, or WOMAC scores ($p > 0.05$). This indicates that both groups were comparable before intervention.

Table 2. Within-Group Comparison for Group A (Nordic Walking + Conservative Treatment)						
Outcome Measure	**Pre-Test Mean ± SD**	**Post-Test Mean ± SD**	**Mean Difference**	**t (df = 24)**	**p-value**	**Effect Size (Cohen's d)**
Pressure Biofeedback (mmHg)	47.36 ± 1.55	57.56 ± 2.55	10.2	26	< 0.001 ***	5.21
WOMAC Score	20.24 ± 2.55	9.80 ± 2.78	10.4	25.3	< 0.001 ***	5.06



Group A demonstrated a highly significant improvement in both muscle strength and quality of life ($p < 0.001$), with very large effect sizes, confirming the strong efficacy of Nordic walking combined with exercises

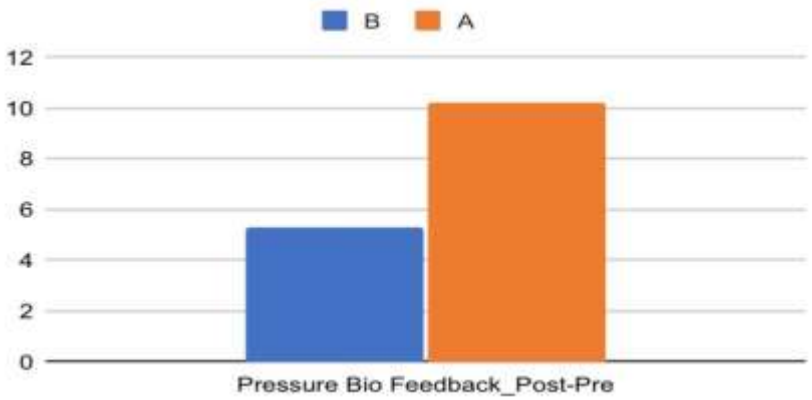
Table 3. Within-Group Comparison for Group B (Exercises Only)							
Outcome Measure	**Pre-Test Mean ± SD**	**Post-Test Mean ± SD**	**Mean Difference**	**Test Type**	**Test Statistic**	**p-value**	**Effect Size**
Pressure Biofeedback (mmHg)	47.24 ± 1.39	52.52 ± 1.48	5	Wilcoxon	W = 0	< 0.001 ***	r = 1.00
WOMAC Score	19.80 ± 2.77	13.60 ± 2.52	6.2	t (24) = 19.6	—	< 0.001 ***	d = 3.92

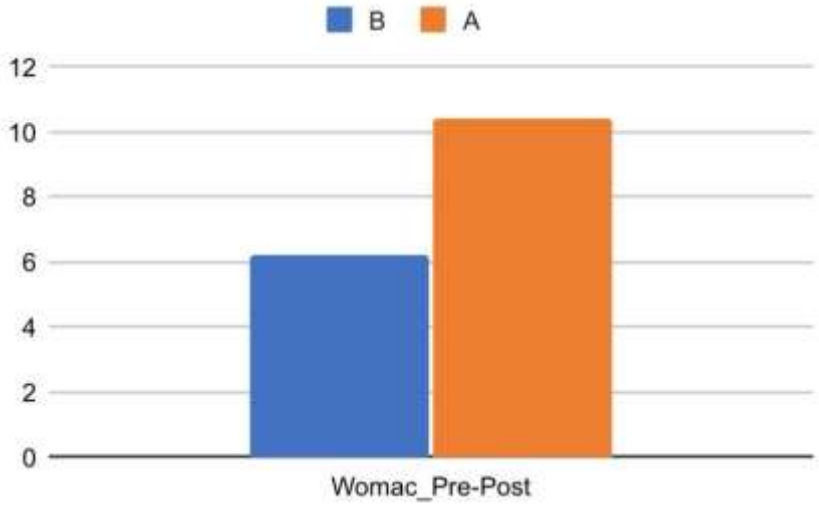


Group B also showed statistically significant improvement in both strength and WOMAC scores ($p < 0.001$), but the magnitude of improvement was smaller compared to Group A.

Table 4. Between-Group Comparison of Mean Change Scores (Post – Pre Differences)

Variable	Group A Mean ± SD	Group B Mean ± SD	Test Used	Statistic (df = 48)	p-value	Effect Size
Pressure Biofeedback (Δ)	10.20 ± 1.96	5.28 ± 1.65	t-test	t = 9.62	< 0.001 ***	d = 2.72
WOMAC Score (Δ)	10.40 ± 2.06	6.20 ± 1.58	Mann–Whitney U	U = 31.5	< 0.001 ***	r = 0.90

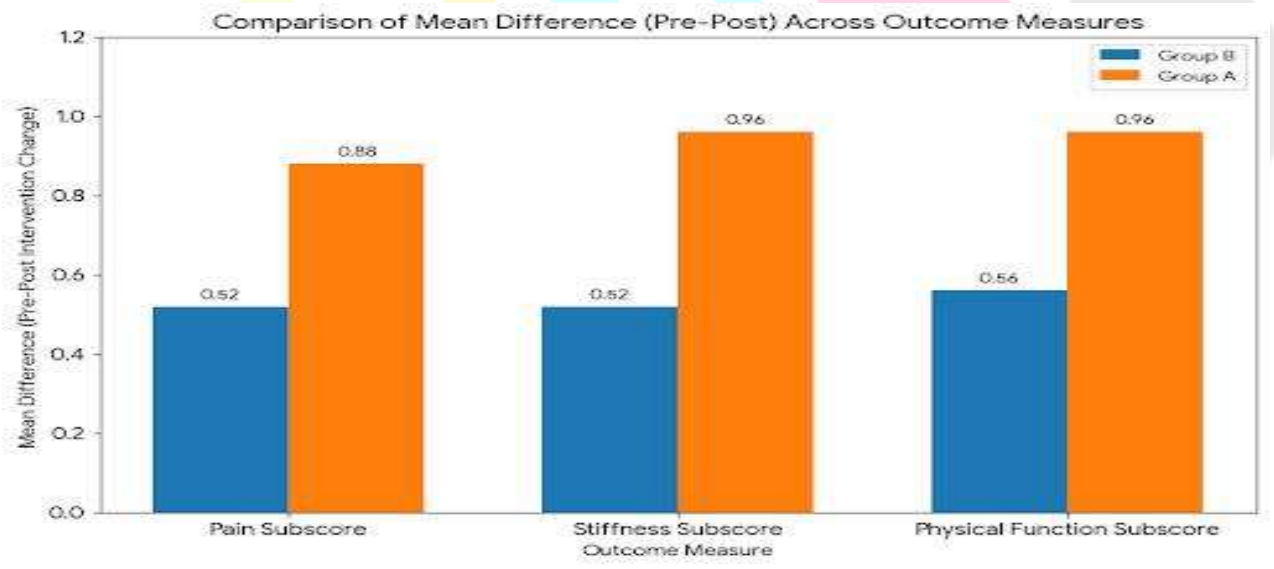




Intergroup analysis revealed significantly greater improvement in both strength and quality of life in Group A compared to Group B ($p < 0.001$). This indicates that Nordic walking adds substantial benefit over conventional exercise treatment alone.

Table 5. within group comparison (pre - post WOMAC changes)

Outcome Measure	Group	Mean Difference ± SD	Test Used	Test Statistic	p-value	Effect Size
Pain Subscore	A	0.88 ± 0.44	Wilcoxon	W = 231.0	< 0.001 ***	r = 1.00
	B	0.52 ± 0.51	Wilcoxon	W = 91.0	< 0.001 ***	r = 1.00
Stiffness Subscore	A	0.96 ± 0.54	Wilcoxon	W = 231.0	< 0.001 ***	r = 1.00
	B	0.52 ± 0.59	Wilcoxon	W = 78.0	< 0.001 ***	r = 1.00
Physical Function Subscore	A	0.96 ± 0.61	Wilcoxon	W = 210.0	< 0.001 ***	r = 1.00
	B	0.56 ± 0.58	Wilcoxon	W = 91.0	< 0.001 ***	r = 1.00



Both groups showed statistically significant improvement in pain, stiffness, and physical function following intervention ($p < 0.001$). However, mean change scores were consistently higher in Group A, indicating greater clinical improvement with the experimental program.

Discussion

The study was conducted to check the effects of Nordics walking and exercises on strength and disability in patient with grade 1 knee osteoarthritis using pressure biofeedback and womac scale by dividing the sample in two groups 1st group using Nordics walking and exercises and 2nd group doing only the exercises .The result of the study revealed a statistically significant improvement in strength and reduce in disability in both groups, with a greater mean improvement observed in 1st group compared to 2nd group

Both groups were comparable at baseline for age, muscle strength, and WOMAC scores

($p > 0.05$), indicating true comparability and validity of post-intervention differences.

The increase in pressure biofeedback values in Group A reflects enhanced quadriceps activation and strength, likely due to the dynamic and weight-bearing nature of Nordic walking, which recruits both upper and lower body muscles and improves overall stability

The significant reduction in WOMAC scores indicates improvement in pain, stiffness, and physical function, highlighting that Nordic walking not only improves strength but also translates into better daily functional performance and quality of life.

Group B also improved significantly, which supports the effectiveness of conservative physiotherapy (strengthening, stretching, and lifestyle modification) as a base management strategy for early osteoarthritis.

Similar studies have shown that regular Nordic walking improves pain, balance, and functional mobility in mild-to-moderate knee OA patients. The magnitude of improvement in this study (Cohen's $d > 2.5$) is notably large, supporting the clinical relevance of Nordic walking as a low-impact, accessible, and effective adjunct to traditional care.

Nordic walking poles assist in distributing body weight, thereby reducing knee joint compressive forces and minimizing pain during movement.

The reciprocal arm-leg coordination increases energy expenditure and muscle engagement, promoting neuromuscular re-education and postural stability.

Improved joint proprioception and lower-limb muscle strength contribute to better load distribution and delay disease progression.

The aerobic component of Nordic walking likely enhances blood flow and synovial fluid circulation, leading to improved joint nutrition and reduced stiffness.

WOMAC score improvement indicates reduced pain, improved stiffness, and enhanced physical function.These functional outcomes align with the biopsychosocial model of rehabilitation, emphasizing that improved physical performance translates to better daily living activities and mental well-being.

Patients often report higher exercise enjoyment and adherence to Nordic walking compared to traditional strengthening routines — a key factor for long-term success in OA management.

In contrast to standard conservative therapy, Nordic walking offers both resistance and aerobic benefits in one activity, making it a more comprehensive intervention.

Incorporating Nordic walking into early OA management could reduce dependency on analgesics and NSAIDs, minimizing long-term side effects.

It is cost-effective, requires minimal equipment, and can be easily implemented in community rehabilitation programs.

Nordic walking can be performed in group settings, offering social support, motivation, and reduced depression/anxiety—important psychosocial benefits for chronic OA patients.

Exercise enjoyment and variety increase adherence, a common limitation in conventional therapy programs·

Results

- The study included 50 sample (25 per group) of grade 1 osteoarthritis of knee patient
- The level of significance was set at $p < 0.05$. At baseline, there was no significant difference between the groups in age, pre-intervention pressure biofeedback values, or WOMAC score ($p > 0.05$), confirming group homogeneity
- Overall, the findings indicate that both interventions led to improvement in muscle strength and disabilities among participants with grade 1 knee osteoarthritis; however, the combination of Nordic walking with exercises produced markedly superior results compared to exercises alone. This suggests that Nordic walking is an effective adjunct therapeutic modality for improving functional outcomes in early knee osteoarthritis.

Conclusion

- Both exercises and Nordics walking showed significant improvement in grade 1 osteoarthritis
- But Nordics walking with exercises showed greater improvement compared to exercises alone
- Therefore incorporating both therapy together can improve strength and quality of life in grade 1 osteoarthritis of knee patient

Future Scope

- Larger sample size
- Long term follow up
- Comparing Nordics walking with other aerobic and resistance based programs like cycling and aquatic therapy to identify the most effective strategies for early oa management
- Qualitative assessment (patient satisfaction, adherence) would add valuable insights into the parcticality of Nordics walking interventions

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