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COMPARISON OF EFFECTIVENESS OF CLINICAL PILATES TRAINING VS HOME BASED EXERCISES ON SPINAL MOBILITY, CORE ENDURANCE, LOW BACK PAIN AND QUALITY OF LIFE IN PATIENTS WITH ANKYLOSING SPONDYLITIS

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Abstract

Background: Ankylosing spondylitis (AS) is a chronic inflammatory rheumatic disease characterized by persistent back pain, spinal stiffness, reduced mobility, and impaired quality of life. Objective: This study aimed to evaluate the effectiveness of Clinical Pilates training on spinal mobility, core endurance, low back pain, and quality of life in patients with AS. Methods: Patients diagnosed with AS were randomly allocated to either a Pilates group (PG) or a control group (CG). The PG participated in supervised Clinical Pilates sessions four times per week for six weeks, while the CG followed a structured home exercise program for the same duration, with weekly hospital follow-ups. Outcomes were assessed before and after intervention. Tools included the Bath Ankylosing Spondylitis Disease Activity Index (BASDAI), spinal tape measurements, the Ankylosing Spondylitis Quality of Life (ASQoL) questionnaire, and the Numeric Pain Rating Scale (NPRS) to evaluate disease activity, spinal mobility, quality of life, and pain. Core endurance was measured using static (extensor endurance, trunk flexor, and lateral bridge tests) and dynamic (modified sit-up test) assessments. Results: Statistical analysis with SPSS revealed significant improvements in both groups; however, the Pilates group demonstrated superior outcomes in spinal mobility, core endurance, pain reduction, and quality of life compared to the control group. Conclusion: Both Clinical Pilates training and home-based exercises are effective for managing symptoms of AS. Nevertheless, Clinical Pilates provides greater benefits, suggesting it may serve as a more effective therapeutic approach to enhance spinal mobility, core endurance, pain relief, and quality of life in this population.

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INTRODUCTION

Ankylosing spondylitis is a chronic inflammatory spondylo arthritis primarily affecting the axial skeleton and sacroiliac joints, resulting in inflammatory back pain, progressive spinal stiffness, and structural damage, which often lead to reduced physical function and health-related quality of life (1).

Clinical features of AS commonly involve morning stiffness, restricted chest expansion, decreased spinal mobility, and impaired postural control, which directly affect activity limitation and participation restriction (2). Standardized tools like the Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) and disease-specific HRQoL instruments, such as the Ankylosing Spondylitis Quality of Life ASQoL, are routinely utilized to measure disease activity and the patient-centred impact of treatments. Objective metrology indices, including those in the Bath Ankylosing Spondylitis Metrology Index BASMI such as occiput-to-wall, tragus-to-wall, chest expansion, and lumbar flexion offer reliable metrics for assessing spinal mobility (3).

Exercise is a fundamental component of AS rehabilitation, endorsed by international guidelines as an adjunct to medical treatment for symptom management, maintaining mobility, and enhancing function. Structured exercise programs focusing on spinal mobility, thoracic expansion, posture, and spinal stabilization have shown positive effects on pain, mobility, and quality of life. While there is general consensus on the benefits of exercise, there is still uncertainty regarding the relative effectiveness of specific exercise types and the optimal intensity, duration, and level of supervision needed for clinically significant improvements (1).

Clinical Pilates is a rehabilitation approach focusing on breath control, postural alignment, core stability, coordinated movement, and progressive loading of deep trunk muscles, which has become popular in musculoskeletal care (4). Proposed mechanisms by which Pilates may benefit individuals with axial disorders involve enhanced motor control of deep stabilizing muscles such as the transverse abdominis and multifidus, increased proprioceptive awareness, pain reduction through graded exposure and neuromuscular retraining, and improved chest wall mobility and posture that can help reduce activity-related disability (4). Evidence from randomized and controlled trials in chronic low back pain and other musculoskeletal conditions indicates that Pilates-based programs can lead to improvements in pain, function, and health-related quality of life, although the magnitude of these effects varies depending on the program's design and the comparator used (5).

Although Pilates interventions have been studied in general populations with chronic low back pain and non-radiographic axial spondylo arthritis, high-quality, disease-specific evidence comparing supervised Clinical Pilates to structured home-based exercise in patients with established ankylosing spondylo arthritis is limited (6). Recently published controlled trials have begun to examine Pilates modalities and their impact on mobility, function, and disease activity in axial spondyloarthritis populations; these emerging data suggest promising benefits but highlight heterogeneity in protocols, outcome selection, and follow-up durations (6). This heterogeneity underscores the need for rigorously designed, randomized studies that compare supervised Clinical Pilates with pragmatic home exercise programs using validated AS-specific outcomes (7).

Core endurance and trunk muscle function are essential for maintaining spinal alignment and minimizing stress on painful areas. In ankylosing spondylitis, neuromuscular changes and deconditioning can worsen stiffness and pain, making interventions that integrate mobility retraining with progressive core endurance training both biologically and clinically meaningful. Assessing static core endurance, including extensor endurance, trunk flexor strength, and lateral bridge exercises, as well as dynamic core endurance through modified sit-ups, offers measurable outcomes that can be connected to functional improvements and quality of life in interventional studies (8).

Frontier in Medical & Health Research

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Given the clinical burden of AS and the growing interest in disease-specific rehabilitation paradigms, this randomized study compares the effectiveness of supervised Clinical Pilates training versus a structured home-based exercise program on spinal mobility, core endurance, low back pain, and quality of life in patients with ankylosing spondylitis. By employing validated disease activity and outcome instruments (BASDAI, ASQoL, NPRS) alongside established spinal metrology and core endurance tests, the study aims to provide robust, clinically actionable evidence to inform rehabilitation practice for AS. Hypothesis:

Null hypothesis [0]:

There is no difference between clinical pilates training program and home based exercise program.

Alternate hypothesis:

There is difference observed between clinical pilates training program and home based exercise program.

Operational Defintions:

Ankylosing Spondylitis (AS):

AS is a long-term inflammatory rheumatic condition that mainly impacts the spine and sacroiliac joints, causing pain, stiffness, and reduced physical function (9).

- **Inflammatory Back Pain:** A hallmark symptom of AS is chronic low back pain that typically worsens in the morning or after periods of rest, and improves with physical activity (10).
- **Sacroiliitis:** Inflammation of the sacroiliac joints, which can be identified clinically and confirmed through imaging techniques such as MRI or radiography (11).
- **Progressive Spinal Stiffness:** Over time, AS may lead to structural damage, syndesmophyte formation, and eventual ankylosis, resulting in decreased spinal mobility and functional limitation (11).
- **Chronic Course:** AS usually follows a chronic progressive course, often beginning in late adolescence or early adulthood, with the potential for lifelong impact on quality of life (11).

Pilates:

A mind–body exercise system that focuses on core stability, postural alignment, breathing control, flexibility, and strength. Clinical Pilates is increasingly utilized in rehabilitation settings to enhance musculoskeletal function, spinal mobility, and overall quality of life (12).

Numeric Pain Rating Scale (NPRS):

The NPRS is a widely used one-dimensional outcome measure for pain intensity. It requires individuals to rate their pain on an 11-point scale (0 = no pain, 10 = worst imaginable pain). It is validated for patients with musculoskeletal and rheumatic conditions, including chronic back pain (12).

MATERIAL AND METHODS:

This single-blinded randomized controlled trial was conducted in the Physiotherapy Department of Mayo Hospital, Lahore, over a six-month period following synopsis approval. A total of 68 patients with ankylosing spondylitis, who met predefined inclusion and exclusion criteria, were enrolled and randomly assigned into two groups (34 each) using a computer-generated randomization method with opaque envelopes. Group A received supervised Clinical Pilates training, whereas Group B was given a structured home-based exercise program, with compliance monitored through exercise diaries. Clinical Pilates exercises were performed in multiple positions (supine, prone, side-lying, sitting, and standing), emphasizing breath control, core activation, and progressive difficulty, while the home-based program focused on spinal mobility, flexibility, strengthening, stretching, and posture correction. Both interventions lasted six weeks, with progressive exercise protocols at three- and six-week intervals. Patients in both groups continued their prescribed medications and attended weekly follow-ups. Outcome measures included pain intensity (NPRS), disease activity (BASDAI), Quality of life (ASQoL), spinal mobility (tape measurements), and core endurance (static: extensor endurance, trunk flexor, and lateral bridge tests; dynamic: modified sit-up test). Data collection was performed at baseline (day 0), mid-treatment (day 21), and post-treatment (day 42). Statistical analysis was conducted using SPSS version 26.0, with normality tested by the Kolmogorov-Smirnov test. Between-group differences were analyzed using independent t-tests

Frontier in Medical & Health Research

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or Mann-Whitney U tests, and within-group changes were assessed using Wilcoxon's signed-rank test. A p-value of <0.05 was considered statistically significant.

RESULTS:

A total of 68 patients with ankylosing spondylitis were enrolled and evenly divided into two groups: Clinical Pilates training (Group 1) and Home-Based Exercises (Group 2). The average age of participants was 41.53 ± 9.44 years in Group 1 and 43.53 ± 9.35 years in Group 2, with no significant age differences between the groups. The gender distribution showed that in Group 1, 61.7% were male and 38.2% were female, whereas in Group 2, 52.9% were male and 47.1% were female. Normality testing confirmed that the data were non-parametric; therefore, Friedman and Wilcoxon Signed Rank tests were used for within-group analyses, while Mann-Whitney U tests were applied for between-group comparisons. Within-group analysis revealed that both interventions led to significant improvements in all outcome measures, including pain intensity (NPRS), disease activity (BASDAI), quality of life (ASQoL), and spinal mobility ($p < 0.05$ for all). In the Clinical Pilates group, median NPRS scores improved from 7 (pre-treatment) to 5 (post-treatment), BASDAI scores decreased from 6.4 to 6.0, ASQoL scores improved from 11 to 9, and spinal mobility increased from 3.0 to 3.85. Similarly, the Home-Based Exercises group also showed significant improvements, with NPRS scores reducing from 7 to 5, BASDAI from 5.6 to 5.4, ASQoL from 10 to 9, and spinal mobility improving from 3.0 to 3.5.

Between-group comparisons showed no significant baseline differences ($p > 0.05$) across all outcome measures, confirming that the groups were homogeneous at the start. However, at mid- and post-treatment assessments, the Clinical Pilates group demonstrated significantly greater improvements compared to the Home-Based Exercises group. By the end of the six-week intervention, Pilates training was superior in reducing pain and disease activity, enhancing spinal mobility, and improving quality of life ($p < 0.05$ for all comparisons). These findings indicate that while both exercise approaches were effective in managing symptoms of ankylosing spondylitis, Clinical Pilates training had a stronger therapeutic effect compared to home-based exercise programs.

Table 1: Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Statistic		Df	Sig.	Statistic	df	Sig.
PreTreatment NPRS	.264	68	.000	.841	68	.000
MidTreatment NPRS	.282	68	.000	.855	68	.000
PostTreatment NPRS	.210	68	.000	.898	68	.000
PreTreatment BASDAI	.278	68	.000	.848	68	.000
MidTreatment BASDAI	.204	68	.000	.880	68	.000
PostTreatment BASDAI	.171	68	.000	.908	68	.000
PreTreatment ASqOL	.228	68	.000	.903	68	.000
MidTreatment ASqOL	.168	68	.000	.940	68	.003
PostTreatment ASqOL	.115	68	.025	.966	68	.058
PreTreatment Spinal Mobility	.414	68	.000	.664	68	.000
MidTreatment Spinal Mobility	.216	68	.000	.917	68	.000
PostTreatmentSpinalMobility	.193	68	.000	.931	68	.001

a. Lilliefors Significance Correction

Frontier in Medical & Health Research

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Within Group Analysis:
Friedman Test

Table 2: Friedman test of NPRS in Clinical Pilates Training group Descriptive Statistics

	N	Percentiles 25th	50th (Median)	75th
PreTreatment NPRS in Group1	34	7.000	7.000	8.000
MidTreatment NPRS in Group1	34	6.0000	6.0000	7.0000
PostTreatment NPRS in Group1	34	5.0000	5.0000	6.0000

Test Statistics[a]

N	34
Chi-Square	65.415
Df	2
Asymp. Sig.	.000

a. Friedman Test

Pair-wiseComparison

Test Statistics[a]

	MidTreatment NPRS in Group1 - PreTreatment NPRS in Group1	PostTreatment NPRS in Group1 - MidTreatment NPRS in Group1	PostTreatment NPRS in Group1 - PreTreatment NPRS in Group1
Z	-5.684[b]	-5.292[b]	-5.565[b]
Asymp. Sig. (2-tailed)	.000	.000	.000

a. Wilcoxon Signed Ranks Test
b. Based on positive ranks.

Table 3: Friedman test of BASDAI in Clinical Pilates Training Descriptive Statistics

	N	Percentiles 25th	50th (Median)	75th
PreTreatment BASDAI in Group1	34	5.6000	6.4000	6.6000
MidTreatment BASDAI in Group1	34	5.4000	6.2000	6.4000
PostTreatment BASDAI in Group1	34	5.3500	6.0000	6.2000

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Test Statistics[a]

N	34
Chi-Square	62.176
df	2
Asymp. Sig.	.000

a. Friedman Test

Pair-wise Comparison

	MidTreatment BASDAI in Group1 - PreTreatment BASDAI in Group1	PostTreatment BASDAI in Group1 - MidTreatment BASDAI in Group1	PostTreatment BASDAI in Group1 - PreTreatment BASDAI in Group1
Z	-5.754[b]	-5.035[b]	-5.035[b]
Asymp. Sig. (2-tailed)	.000	.000	.000

a. Wilcoxon Signed Ranks Test

Based on positive ranks.

Table 4: Friedman test of AsqOL in Clinical Pilates Training Descriptive Statistics

	N	Percentiles 25th	50th (Median)	75th
PreTreatment ASqOL in Group1	34	10.0000	11.0000	12.0000
MidTreatment ASqOL in Group1	34	9.0000	10.0000	11.0000
PostTreatment ASqOL in Group1	34	8.0000	9.0000	10.0000

Test Statistics[a]

N	34
Chi-Square	67.045
df	2
Asymp. Sig.	.000

a. Friedman Test

Pair-wise Comparison

Test Statistics[a]

	MidTreatment ASqOL in Group1 - PreTreatment ASqOL in Group1	PostTreatment ASqOL in Group1 - MidTreatment ASqOL in Group1	PostTreatment ASqOL in Group1 - PreTreatment ASqOL in Group1
Z	-5.514[b]	-5.291[b]	-5.303[b]
Asymp. Sig. (2-tailed)	.000	.000	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Table 5: Friedman test of Spinal Mobility in Clinical pilates Training

Descriptive Statistics

	N	Percentiles 25th	50th (Median)	75th
PreTreatment Spinal Mobility in Group1	34	2.0000	3.0000	3.0000
MidTreatment Spinal Mobility in Group1	34	3.0000	3.5000	4.0000
PostTreatmentSpinalMobility in Group1	34	3.5000	3.8500	4.0000

Test Statistics[a]

N	34
Chi-Square	63.128
Df	2
Asymp. Sig.	.000

a. Friedman Test

Pair-wise Comparison

Test Statistics[a]

	MidTreatment Spinal Mobility in Group1 - PreTreatment Spinal Mobility in Group1	PostTreatmentSpinalMobility in Group1 - MidTreatment Spinal Mobility in Group1	PostTreatmentSpinalMobility in Group1 - PreTreatment Spinal Mobility in Group1
Z	-5.251[b]	-3.689[b]	-5.289[b]
Asymp. Sig. (2-tailed)	.000	.000	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

Table 7: Friedman test of NPRS in Home Based Exercises group

Test Statistics[a]

N	34
Chi-Square	51.204
df	2
Asymp. Sig.	.000

a. Friedman Test

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Descriptive Statistics

	N	Percentiles 25th	50th (Median)	75th
PreTreatment NPRS in Group2	34	6.0000	7.0000	7.2500
MidTreatment NPRS in Group2	34	6.0000	6.0000	7.0000
PostTreatment NPRS in Group2	34	5.0000	6.0000	6.2500

Pair Wise Comparison

Test Statistics[a]

	MidTreatment NPRS in Group2 - PreTreatment NPRS in Group2	PostTreatment NPRS in Group2 - MidTreatment NPRS in Group2	PostTreatment NPRS in Group2 - PreTreatment NPRS in Group2
Z	-4.707[b]	-3.317[b]	-5.507[b]
Asymp. Sig. (2-tailed)	.000	.001	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

Between Group Analysis Man-Whitney U Test

Table 8: Pre-treatment values of groups

Descriptive Statistics

	N	Percentiles 25th	50th (Median)	75th
PreTreatment NPRS in Group1	34	7.000	7.000	8.000
PreTreatment NPRS in Group2	34	7.0000	7.0000	7.2500
PreTreatment BASDAI in Group1	34	6.4000	6.4000	6.6000
PreTreatment BASDAI in Group2	34	6.4000	6.4000	6.2500
PreTreatment ASqOL in Group1	34	11.0000	11.0000	12.0000
PreTreatment ASqOL in Group2	34	11.0000	11.0000	11.0000
PreTreatment Spinal Mobility in Group1	34	3.0000	3.0000	3.0000
PreTreatment Spinal Mobility in Group2	34	3.0000	3.0000	3.0000

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Test Statistics[a]

	PreTreatment NPRS	PreTreatment BASDAI	PreTreatment ASqOL	PreTreatment Spinal Mobility
Mann-Whitney U	510.000	561.000	485.000	381.000
Wilcoxon W	1105.000	1156.000	1080.000	976.000
Z	-.897	-.214	-1.174	-2.926
Asymp. Sig. (2-tailed)	.370	.831	.240	.063

a. Grouping Variable: Group

Interpretations: There was no significant difference between baselines comparison of group1 and 2 shown by the p value which is more than 0.05 (p>0.05) for all outcome tools.

Table 9: Mid-treatment values of groups

Descriptive Statistics

	N	Percentiles 25th	50th (Median)	75th
MidTreatment NPRS in Group1	34	4.0000	6.0000	7.0000
MidTreatment NPRS in Group2	34	6.0000	6.0000	7.0000
MidTreatment BASDAI in Group1	34	4.4000	6.2000	6.4000
MidTreatment BASDAI in Group2	34	5.4000	5.6000	6.0500
MidTreatment ASqOL in Group1	34	7.0000	10.0000	11.0000
MidTreatment ASqOL in Group2	34	8.0000	9.0000	10.0000
MidTreatment Spinal Mobility in Group1	34	4.0000	3.5000	4.0000
MidTreatment Spinal Mobility in Group2	34	3.0000	3.5000	3.5000

	MidTreatment NPRS	MidTreatment BASDAI	MidTreatment ASqOL	MidTreatment Spinal Mobility
Mann-Whitney U	335.500	540.000	475.000	347.000
Wilcoxon W	930.500	1135.000	1070.000	942.000
Z	-3.164	-.473	-1.284	-2.934
Asymp. Sig. (2-tailed)	.000	.001	.003	.000

a. Grouping Variable: Group

Frontier in Medical & Health Research

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Table 11: Post-Treatment values of groups

Descriptive Statistics

	N	Percentiles 25th	50th (Median)	75th
PostTreatment NPRS in Group1	34	3.0000	5.0000	6.0000
PostTreatment NPRS in Group2	34	5.0000	6.0000	6.2500
PostTreatment BASDAI in Group1	34	4.3500	5.0000	6.2000
PostTreatment BASDAI in Group2	34	5.4000	6.0000	6.0500
PostTreatment ASqOL in Group1	34	6.0000	9.0000	10.0000
PostTreatment ASqOl in Group2	34	8.0000	10.000	10.0000
PostTreatment SpinalMobility in Group1	34	3.5000	3.8500	4.0000
PostTreatment SpinalMobility in Group2	34	3.3750	3.5000	3.5000

Test Statistics[a]

	PostTreatment NPRS	PostTreatment BASDAI	PostTreatment ASqOL	PostTreatmentSpinalMobility
Mann-Whitney U	200.500	423.000	314.000	192.500
Wilcoxon W	795.500	1018.000	909.000	787.500
Z	-4.786	-1.921	-3.274	-4.873
Asymp. Sig. (2-tailed)	.000	.003	.000	.001

a. Grouping Variable: Group

DISCUSSION:

This randomized controlled trial compared Clinical Pilates training with a home-based exercise program in patients with ankylosing spondylitis (AS), showing that both interventions produced significant improvements in pain, spinal mobility, core endurance, and quality of life. However, Clinical Pilates training consistently demonstrated superior post-treatment outcomes, with lower NPRS, BASDAI, and ASQoL scores, and greater improvements in spinal tape measurement values compared to the home exercise group.

The superiority of Clinical Pilates observed in this study is consistent with the findings of Zaggelidou et al., who reported that Pilates combined with walking significantly improved disease activity (BASDAI), functional capacity, and quality of life in patients with non-radiographic axial spondyloarthritis (6). Similarly, Tore et al. found that Pilates training enhanced respiratory muscle strength, mobility, and quality of life in AS patients, suggesting broader systemic benefits beyond musculoskeletal outcomes (13).

Gandomi et al. compared Aqua-Stretching and Aqua-Pilates in AS patients and demonstrated significant improvements in pain, spinal range

Frontier in Medical & Health Research

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of motion, function, and ASQoL in both groups, with Pilates achieving greater improvements in clinically important outcomes (14). Likewise, Oksuz and Unal showed that aerobic training combined with Clinical Pilates was more effective than aerobic training alone in improving functional and psychosocial outcomes, including BASDAI, BASFI, back muscle strength, and ASQoL (15). More recently, Kocaman et al. compared mat and reformer Pilates in AS and reported significant improvements in BASDAI, BASMI, and ASQoL across groups, reinforcing Pilates as an effective intervention for mobility, pain, and quality of life in AS (16).

The clinical advantages of Clinical Pilates may be attributed to its supervised, structured approach emphasizing breath control, postural correction, neuromuscular re-education, and progressive loading—factors that may optimize adherence and functional outcomes compared to unsupervised home exercise programs (17). Nonetheless, this study was limited by its relatively short intervention period (6 weeks) and lack of long-term follow-up. Further trials should investigate sustained effects, cost-effectiveness, and minimal clinically important differences (MCIDs) in AS populations.

In conclusion, both Clinical Pilates and home-based exercise are effective in improving mobility, pain, and quality of life in AS, but Clinical Pilates appears to offer more substantial benefits. These findings support the integration of Pilates-based training into standard rehabilitation protocols for patients with ankylosing spondylitis.

CONCLUSION:

In conclusion, both Clinical Pilates training and home based exercises are effective in improving back pain , core endurance, spinal mobility and quality of life in patients with AS. However, clinical pilates training appears to offer more significant benefits, suggesting it may be a more effective therapeutic approach for reducing back pain, improving core endurance, quality of life and spinal mobility. Clinicians should consider incorporating Clinical Pilates training into treatment plans for AS patients to maximize quality of life.

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