AOTH

Review

# The effectiveness of Pilates on respiratory function, functional status and quality of life in patients with ankylosing spondylitis. A systematic review

Anna Christakou[1], Athina Kovaiou[2], Ioannis Benetos[3], Spyridon Pnevmatikos[4]
[1]*Department of Physiotherapy, Biomechanics Laboratory, University of Peloponnese, 231 00 Sparti, Greece*
[2]*Medical School, National and Kapodistrian University of Athens, 11527 Athens, Greece*
*Email: athinakov@gmail.com*
[3]*Third Department of Orthopaedics, Athens University Medical School, KAT Hospital, Athens, Greece*
*Email: ioannisbenetos@yahoo.gr*
[4]*Third Department of Orthopaedics, Athens University Medical School, KAT Hospital, Athens, Greece*
*Email: spyrosgp@med.uoa.gr*

## Abstract

**Background:** Ankylosing spondylitis (AS) is a chronic inflammatory disease primarily affecting the spine and sacroiliac joints, progressively limiting mobility and functional capacity and negatively impacting patients' quality of life. Physiotherapeutic interventions such as the Pilates method are increasingly being explored as complementary approaches to enhance physical function, posture, and respiratory function.
**Objectives:** This systematic review aims to examine the effectiveness of Pilates in improving respiratory function, functional status, and quality of life in patients with AS.
**Methods:** This systematic review was conducted in accordance with PRISMA guidelines. A comprehensive search was performed across PubMed, Scopus, ScienceDirect, Google Scholar, and other databases for randomized controlled trials published in English between 2012 and 2024 with specific key words and Boolen terms. Studies were selected based on defined inclusion and exclusion criteria. Methodological quality was assessed using the PEDro scale.
**Results:** The flow chart showed a total of 7 studies. 5 RCTs studied the effectiveness of the Pilates method on respiratory function, 5 the effect on quality of life and 7 the effect on functional

**Corresponding author**
Athina Kovaiou
athinakov@gmail.com

status. The PEDro scale showed 2 studies of high methodological quality, and 5 studies had fair methodological quality with a mean score of 5.6.
**Conclusions:** In the present systematic literature review Pilates method in patients with ankylosing spondylitis had a positive effect on the functional status, quality of life and respiratory function of the patients. Although most studies showed that Pilates had a positive effect in the measured variables the statistical significance between experimental and control groups varies and is often not consistently confirmed. Limitations of the present study are presented as well as recommendations for future analysis.

**Keywords**

Ankylosing spondylitis; Pilates; physiotherapy; systematic review; randomized controlled trials

## Introduction

Ankylosing spondylitis (AS) is a chronic inflammatory rheumatic disease that primarily affects the axial skeleton, particularly the spine and sacroiliac joints. It commonly manifests as inflammatory back pain, stiffness, and progressive loss of spinal mobility.[1] The underlying pathogenesis involves a complex interaction of genetic predisposition, immune dysfunction, and environmental factors, though it remains not fully understood.[2]

Diagnosis of AS is based on clinical symptoms and imaging, especially magnetic resonance imaging (MRI), to detect early inflammatory changes.[3] As the disease progresses, inflammation can lead to spinal fusion, resulting in significant mobility restriction and respiratory limitations.[4]

Management of AS typically combines pharmacologic treatments—such as NSAIDs, corticosteroids, DMARDs, and biologics—with non-pharmacological approaches like physiotherapy.[5] Physiotherapy plays a critical role in maintaining mobility, managing pain, and preventing functional decline.[6]

Among various physiotherapeutic methods, Pilates has gained attention for its benefits in musculoskeletal conditions. It integrates elements of strength, flexibility, posture, and breathing control, which may be particularly relevant to the functional and respiratory challenges seen in AS.[7,8]

According to the literature review conducted, no study identical to the present one was identified. A systematic review by Cruz et al. examined the effects of the Pilates method on patients with musculoskeletal disorders; however, it did not focus specifically on individuals diagnosed with AS.[9] Another systematic review by Pécourneau et al. was found, which included patients with AS but evaluated a variety of exercise programs, among which Pilates was only one component.[10] Additionally, a more recent systematic review by Pierlot investigated studies related to the use of Pilates in patients with AS, yet it did not explore its impact on respiratory function.[11] Therefore, the present study appears to be the first systematic review internationally that examines the effects of the Pilates method on functional ability, respiratory function, and quality of life in patients with AS.

The present systematic review aims to evaluate the effectiveness of Pilates on respiratory function, functional status, and quality of life in patients with ankylosing spondylitis.

## Materials and Methods

### *Searching Strategy*

A comprehensive search was conducted across several electronic databases, including PubMed, Science Direct, EBSC, BMJ, Research Gate, Scopus and Google Scholar. The search was limited to articles published in English between 2012 and 2024. The keywords used in the search process were «Pilates, ankylosing spondylitis», «respiratory function», «functional status», «quality of life», «physiother-

**Table 1.** Search strategy

| Number | Key-words |
|---|---|
| 1 | ''pilates, ankylosing spondylitis'' |
| 2 | ''respiratory function'' OR ''functional status'' OR ''quality of life'' OR ''physiotherapy'' |
| Final Search | 1 AND 2 |

**Table 2.** Evaluation of studies according to PEDro scale criteria

| Author (Year) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Total Score |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Altan et al (2012) | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 7/10 |
| Acar et al (2023) | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 4/10 |
| Oksuz et al (2018) | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 5/10 |
| Yentur et al (2023) | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 6/10 |
| Oksuz & Unal (2023) | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 5/10 |
| Berea et al (2012) | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 5/10 |
| Nayak et al (2020) | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 7/10 |
| **Mean Score:** | | | | | | | | | | | 5.6/10 |

apy». Table 1 outlines the comprehensive search strategy used.

Two of the authors individually searched the electronic databases and evaluated the articles for inclusion. Any disagreement was settled by mutual consultation with the third author.

The protocol of this review was registered in the open-access online database of PROSPERO (CRD42024616061) prior to initiating the systematic review process.

### *Inclusion and Exclusion Criteria*

The included studies met the following criteria: (a) randomized controlled trials published in English; (b) participants were diagnosed with AS; (c) the experimental group received an exercise program based either exclusively on the Pilates method or on the Pilates method in combination with aerobic exercise or conventional physiotherapy, provided that the control group participated only in aerobic exercise or conventional physiotherapy; (d) the control group received either conventional physiotherapy or aerobic exercise, allowing for a comparison with the Pilates-based intervention; (e) measurable outcomes included at least one of the following: respiratory function, functional status, and quality of life.

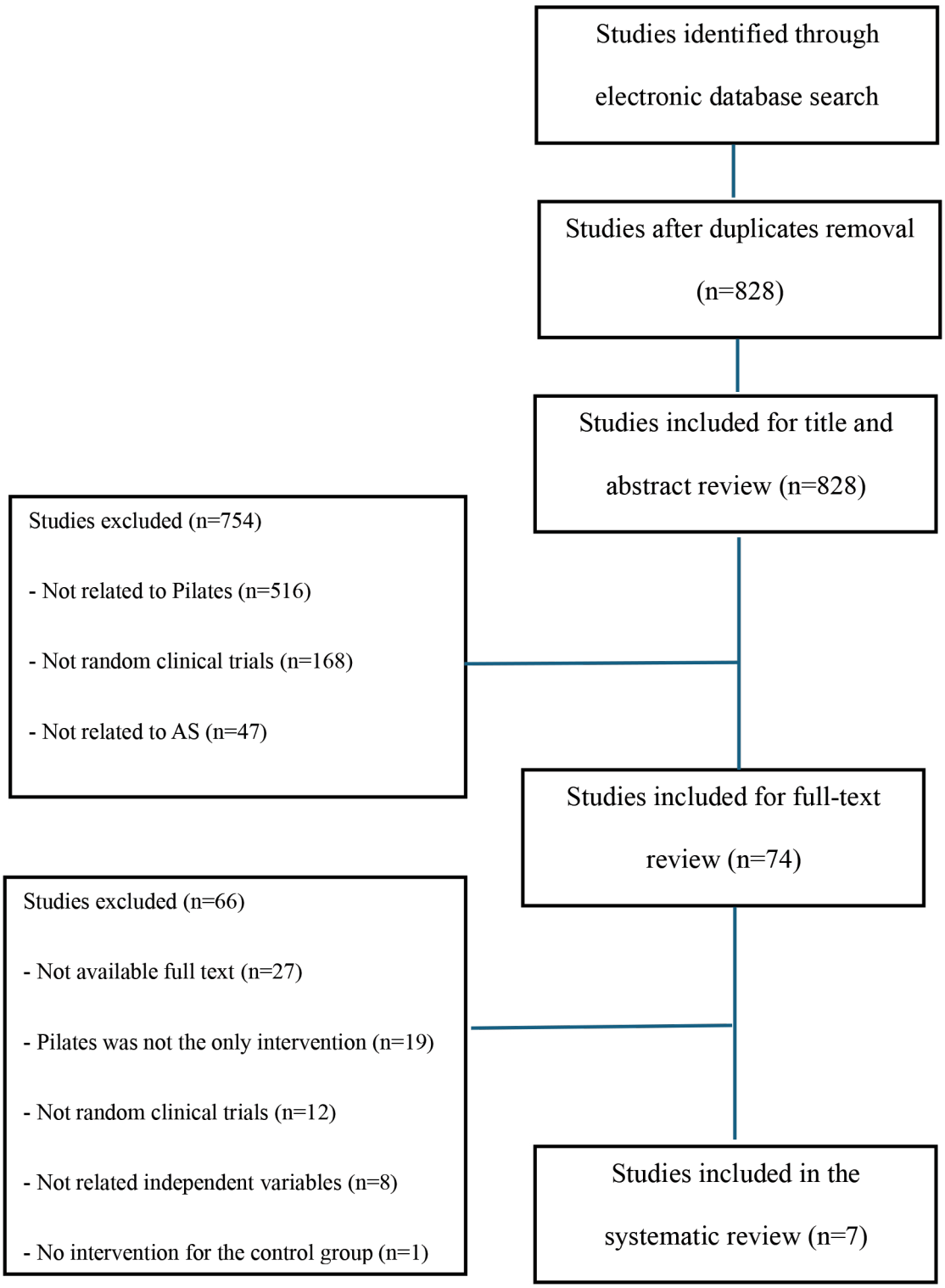
Studies were excluded if they met any of the following criteria: (a) included healthy individuals or participants with conditions other than AS; (b) participants did not complete the Pilates intervention or were not engaged in Pilates-based exercises; (c) did not include the Pilates method as part of the intervention.

Three independent reviewers thoroughly applied the inclusion and exclusion criteria to each study. The final selection of eligible randomized controlled trials was determined by consensus among all three researchers.

### *Methodological Quality*

The Physiotherapy Evidence Database (PEDro) scale was applied to assess the method quality of the included studies.[12] The variables to be examined in the present study are respiratory function, quality of life, and functional status in patients with AS. According to the evaluation of PEDro scale, out of

**Figure 1.** Flow Chart



7 studies, two were considered as high quality and six were considered as fair quality. The mean score of the studies is 5.6 (Table 2).

### *Selection of Studies*

Following the search conducted in electronic databases, a total of 1,240 articles were identified. After removing duplicate entries, 828 articles remained. Of these, 754 were excluded based on their title or abstract. Specifically, 516 articles were unrelated to the Pilates method, while 168 were not randomized controlled trials. Additionally, 47 studies were not related to ankylosing spondylitis, and 23 were not published in English. As a result, 74 studies were selected for full-text review. Among these, 27 were excluded due to unavailability of the full text, 19 did not use Pilates as the sole intervention in the experimental group, 12 were not randomized controlled trials, 8 did not evaluate functional status, quality of life, or the respiratory system, and 1 where the control group received no intervention. Ultimately, 7 randomized controlled trials were included in this systematic review, all of which were assessed using the PEDro scale. The flow chart of the study is presented in Fig. 1.

### *Study Population*

The cumulative study population across the eight reviewed studies comprised a total of 290 patients diagnosed with AS. Among these, 20 patients did not complete the intervention program. Specifically, two individuals withdrew due to personal reasons,[13] while the remaining 18 dropped out due to health-related issues or difficulty adhering to the program.[8]

All study participants were adults, with a mean age of approximately 40 years (40,5±10,1). For example, Berea et al. reported a mean participant age of 35 years,[14] and although the study by Nayak et al. did not provide an exact mean age, it was stated that all participants were under 45 years of age.[13]

### *Measurable Outcomes*

The measured variables of respiratory function, functional status, and quality of life were examined in the present systematic review.

## Results

### *Therapeutic Intervention*

In each study included in the present study, participants were randomly assigned to either an experimental group or a control group. The experimental group either engaged exclusively in Pilates-based exercises or combined Pilates with other forms of physical activity, such as aerobic training, conventional exercises, or physiotherapy. In contrast, the control group participated in similar exercise routines excluding any Pilates-based elements.

Among the 7 studies reviewed, 5 employed a conventional physiotherapy regimen for the control group, while the experimental group followed a Pilates-based program.[8,13,14,15,16] In the remaining 2 studies, the control groups performed aerobic exercises, while the experimental groups participated in a combined program of Pilates and aerobic training.[17,18]

The Pilates exercises were administered by a certified instructor and were performed either at the participants' homes through online platforms (e.g., Zoom, Skype), or participants recorded their sessions and shared the videos with the instructor for feedback.

Regarding the duration of the programs, 4 studies implemented an 8-week protocol,[8,15,17,18] 2 studies used a 12-week duration,[14,16] and 1 study had a 4-week program.[13] Exercise frequency was generally three times per week across the studies, except for Nayak et al., where it was twice weekly.[13] Each session lasted approximately one hour and included a 5-minute warm-up, 5 minutes of fundamental exercises, 40 minutes of the main Pilates workout, and a 10-minute cool-down phase. Table 3 summarizes the characteristics of the included studies.

### *Follow-up*

In all included studies, participants were evaluated at baseline (prior to the intervention) and immediately following the completion of the program. An exception was the study by Berea et al., which included an additional assessment ten days after program initiation, in addition to the final evaluation.[14]

**Table 3.** Characteristics of the included studies

| Study | Population (Exclusions)* | Intervention | Duration & Frequency | Variables | Assessment |
|---|---|---|---|---|---|
| **Altan et al.**[18] | 55 (0): EG = 30, CG =25 | EG: Pilates, CG: Previous Standard treatment | 3x/week for 12 weeks, 1 hour | BASFI, BASDAI, BASMI, ASQOL | Pre, post, and 12 weeks post-intervention |
| **Acar et al.**[8] | 60 (18): EG = 30 (9), CG =30 (9) | EG: Pilates, CG: Conventional physiotherapy | 3x/week for 8 weeks, 1 hour | BASFI, BASDAI, BASMI, ASQOL | Pre and post |
| **Oksuz et al.**[15] | 31 (0): EG = 16, CG =15 | EG: Pilates + aerobic, CG: aerobic | 3x/week for 8 weeks | BASFI, BASDAI, BASMI, back scratch, PFT, RMF | Pre and post |
| **Yentur et al.**[17] | 40 (4): EG = 19 (1), CG =17 (3) | EG: Pilates, CG: Conventional exercises | 3x/week for 8 weeks | BASFI, BASDAI, BASMI, ASQOL, HAQ, PFT, RMF, 6MWT | Pre and post |
| **Oksuz & Unal**[16] | 28 (0): EG = 14, CG =14 | EG: Pilates + aerobic, CG: aerobic | 8 weeks | BASFI, BASDAI, BASMI, back scratch, RMF, 6MWT | Pre and post |
| **Berea et al.**[14] | 30 (0): EG = 15, CG =15 | EG: Pilates + Conventional exercises, CG: Conventional exercises + physiotherapy | Daily 30 minutes for 12 weeks | BASFI, BASDAI, HAQ, RMF | Pre, day 10 and post |
| **Nayak et al.**[13] | 20 (2): EG = 10 (2), CG = 10 | EG: Pilates + Conventional treatment, CG: Self mobilization exercises + Conventional treatment | 3x/week for 4 weeks | BASFI, BASDAI, BASMI | Pre and post |

*EG: experimental group; CG: control group.

Furthermore, the study by Altan et al. reported an additional follow-up assessment conducted 12 weeks after the conclusion of the intervention, corresponding to the 24th week overall.[16]

***Respiratory Function***

Respiratory function was assessed in 6 out of the 8 studies included in this review. In the study by Altan et al., the Chest Expansion Technique was

used to evaluate thoracic mobility and respiratory function.[16] Additionally, Pulmonary Function Tests (PFTs) and Respiratory Muscle Function assessments were employed in the studies by Oksuz et al., Yentur et al., and Berea et al..[14,15,17] PFT comprises a series of diagnostic procedures that evaluate the performance of the respiratory system, including spirometry, lung volume measurements, and bronchoprovocation testing.[19] One key spirometric parameter is the Forced Expiratory Volume in 1 second (FEV1)/Forced Vital Capacity (FVC) ratio, which represents the proportion of the forced vital capacity (FVC) exhaled during the first second of a forced breath (FEV1). A ratio below 70%, especially when FEV1 is disproportionately reduced compared to FVC, indicates the presence of an obstructive defect.

Respiratory Muscle Function testing assesses the strength and endurance of the muscles involved in breathing.[20] This evaluation typically involves measuring respiratory pressures, such as Maximum Inspiratory Pressure (MIP) and Maximum Expiratory Pressure (MEP) and may also include diaphragm ultrasonography and electromyography.

Oksuz and Unal assessed both Respiratory Muscle Function and included the 6-Minute Walk Test (6MWT),[18] a simple, non-invasive, and widely used functional exercise test that measures exercise capacity and overall functional status.[21]

### *Quality of Life*

Quality of life was assessed in 5 of the 8 studies included. The ASQoL (Ankylosing Spondylitis Quality of Life) was used in the studies by Acar et al., Altan et al., and Oksuz & Unal.[8,16,18] This questionnaire is specifically designed to evaluate the quality of life in patients with AS.[22]

In Berea et al.` study, the HAQ (Health Assessment Qustionnaire) was employed.[14] The HAQ is widely used to assess functional ability and quality of life in patients with rheumatic diseases, including AS. It comprises 20 items organized into eight categories of daily living activities. Responses are rated on a 4-point scale ranging from 0 (“no difficulty”) to 3 (“unable to perform”). The final HAQ Disability Index is calculated as the mean of the highest scores in each category, with a possible range from 0 (no disability) to 3 (severe disability).

Lastly, Yentur et al. utilized both the ASQoL and HAQ questionnaires to evaluate quality of life outcomes.[15]

### *Functional status*

Functional status was assessed in all studies included in the present review, using the BASFI (Bath Ankylosing Spondylitis Functional Index), the BASDAI (Bath Ankylosing Spondylitis Disease Activity Index), and the BASMI (Bath Ankylosing Spondylitis Metrology Index).

In addition to these instruments, Oksuz et al. and Oksuz and Unal also utilized the Back Scratch Test, which assesses upper body (particularly shoulder) flexibility.[17,18] In this test, the patient places one hand over the shoulder and the other behind the back, attempting to touch or clasp the fingers behind the spine. If the fingertips touch, flexibility is considered good; if they do not, the distance between the hands is measured.[23]

## Discussion

Physiotherapy can play a key role in managing of AS without relying on medication. Pilates has been proposed as a promising method for AS treatment. The present systematic review aimed to evaluate the effectiveness of Pilates on respiratory function, functional status, and quality of life in patients with AS.

Patients with AS often experience thoracic stiffness due to inflammation of the intervertebral joints, which can impair both respiratory function and mobility.[24] Healthcare professionals utilize specific tools to assess respiratory performance in these individuals. Commonly employed methods include the Chest Expansion Technique, Pulmonary Function Tests (PFTs), assessments of Respiratory Muscle Strength such as Maximum Inspiratory Pressure (MIP) and Maximum Expiratory Pressure (MEP), as well as Cardiopulmonary Exercise Testing (CPET).[25] These diagnostic approaches are essential for evaluating the extent of respiratory involvement and guiding appropriate therapeutic interventions in AS patients.

In the six studies where respiratory function was

measured, it was found that exercises, and more generally the increased frequency of physical activity, positively impacted patients with AS. Specifically, in the studies by Altan et al., Oksuz et al., Yentur et al., Oksuz & Unal, and Berea et al., it was observed that the exercises performed by participants significantly improved their respiratory function in both the experimental and control groups.[14,15,16,17,18] Moreover, all studies reported more favorable outcomes in the experimental groups, which practiced the Pilates method. Specifically, improvements were observed in thoracic expansion, the FEV1/FVC ratio, and respiratory pressures (MIP, MEP). The study by Yentur et al. indicated significant improvements in MIP and MEP, with statistically significant differences between the groups.[18]

The quality of life in patients with AS is significantly impacted by chronic inflammation, pain, stiffness, and mobility limitations. Key factors affecting quality of life include physical pain, stiffness, fatigue, psychological burden, and limitations in social, professional, and sexual life.[26] AS primarily affects younger individuals, limiting their productivity and often forcing them to abandon life plans, leading to social isolation and chronic pain.[27] The quality of life of patients with AS is assessed using various measurement tools that focus on evaluating physical function, pain, psychological status, and social activity. Commonly assessment tools are the ASQoL, the HAQ, and the SF-36 (Short Form-36 Health Survey).

The quality of life of patients with AS was assessed in five of the eight studies. In all these studies,[8,14,15,16,17] significant improvements were observed in the ASQoL and HAQ indices, which assess the quality of life in patients with AS. Specifically, in the experimental groups, where participants practiced the Pilates method, substantial improvements in quality of life were noted. However, in Yentur et al.` study, the differences between the two groups were not statistically significant, although higher scores were observed in the Pilates group on both the ASQoL and HAQ questionnaires.[15] The study by Oksuz and Unal reported statistically significant improvements in both the experimental group, which received combined Pilates and aerobic training, and the control group, which performed aerobic training alone.[17] The addition of Pilates to aerobic training resulted in greater improvements in quality of life.

Functional limitations in AS worsen with age and disease duration. The functional status of patients with AS is evaluated using various measurement tools that focus on physical ability, mobility, and the impact of the disease on daily life. The functional status of patients with AS was measured in all the studies included in this review using the BASFI, BASDAI, BASMI, Back Scratch Test, and TUG test.

In all 8 studies, it was observed that the functional status of participants significantly improved due to the increase in physical activity, in both the experimental and control groups. In Yentur et al., Berea et al., and Nayak et al., improvements in functional status were observed.[13,14,15] However, statistically significant differences were not found between the two groups. The control groups received treatments like conventional physiotherapy or self-mobilization exercises, which can also improve function status. As a result, similar outcomes between groups may reflect the effectiveness of both approaches rather than a lack of benefit from Pilates method. In Acar et al. and Oksuz and Unal, statistically significant differences were observed between the experimental and control groups in the BASDAI and BASMI indices.[8,18] Regarding the study by Altan et al., a significant improvement in the BASFI index was observed in the experimental group, while no notable changes were seen in the control group.[16] Similarly, in Oksuz et al. study, a notable improvement was observed in the BASMI index for the experimental group.[17]

A major limitation of most studies was the small sample size, limiting generalizability.[13,16,17] Acar et al. noted high dropout rates and the absence of sensitive tools for balance assessment.[8] Oksuz and Unal also pointed out that individual, rather than group-based, Pilates was used, which may have overlooked social and psychological benefits.[18] Yentur et al. only evaluated thoracic pain, not general pain levels.[15] Additionally, many studies had short durations, limiting insight into long-term effects. This

review itself faced limitations. The small number of eligible studies, language restrictions (English only), and exclusion of non-randomized trials limited the comprehensiveness of the analysis. Furthermore, the focus on statistical significance over clinical significance may have constrained the interpretation of real-world impact.

**Conclusions**

The present study showed that patients with AS are benefitted from Pilates as a therapeutic intervention. Most studies reported a favorable trend in the evaluated variables (BASDAI, BASFI, BASMI, CPET, FVC, ASQoL, HAQ); however, the statistical significance between experimental and control groups varied and was not consistently confirmed across studies. Further research using randomized controlled trials is needed to validate the current outcomes in a larger study population. Long-term randomized controlled trials with post-intervention follow-up are essential to assess the sustained effects of Pilates. Comparative research between Pilates and other exercise forms, or in combination, would help identify the most effective approaches for AS management.

**Conflict of interest**

The authors declared no conflicts of interest.

## References


1. Braun J, Sieper J. Ankylosing spondylitis. Lancet. 2007;369(9570):1379–1390.
2. Zhu W, He X, Cheng K, Zhang L. Ankylosing spondylitis: etiology, pathogenesis, and treatments. Bone Res. 2019;7:22.
3. Raychaudhuri SP, Deodhar AA. Imaging in ankylosing spondylitis: role of MRI. Best Pract Res Clin Rheumatol. 2014;28(4):615–632.
4. Ebrahimiadib N, Kamrava K, Razeghinejad R, Rezaei A. Impact of spinal fusion on respiratory function in ankylosing spondylitis patients: a systematic review. Clin Exp Rheumatol. 2021;39(1):123–130.
5. Zochling J, Van der Heijde D, Dougados M, Braun J. Current evidence for the management of ankylosing spondylitis: a systematic literature review for the ASAS/EULAR management recommendations in ankylosing spondylitis. Ann Rheum Dis. 2006;65(4):423–432.
6. Poulis D. Role of physiotherapy in ankylosing spondylitis. Acta Orthop Traumatol Hellenica. 2016;67(1):16–21.
7. Byrnes R, Wu PJ, Whillier S. Pilates exercise for musculoskeletal rehabilitation: a systematic review. Phys Ther Rev. 2018;23(1):25–33.
8. Acar S, Oksuz C, Unal O. Pilates exercise program improves respiratory function and quality of life in patients with ankylosing spondylitis: a randomized controlled trial. J Phys Ther Sci. 2023;35(2):150–158.
9. Cruz-Díaz D, Martínez-Amat A, Osuna-Pérez MC, De La Torre-Cruz MJ, Hita-Contreras F. Short- and long-term effects of a six-week clinical Pilates program in addition to physical therapy on postmenopausal women with chronic low back pain: a randomized controlled trial. Disabil Rehabil. 2016;38(13):1300–1308.
10. Pécourneau V, Degboé Y, Barnetche T, Cantagrel A, Constantin A, Ruyssen-Witrand A. Effectiveness of exercise programs in ankylosing spondylitis: a meta-analysis of randomized controlled trials. Arch Phys Med Rehabil. 2018;99(2):383–389.e1.
11. Pierlot L. The effects of Pilates training on respiratory muscle strength in patients with ankylosing spondylitis. J Rehabil Res Dev. 2023;60(1):1–10.
12. De Morton NA. The PEDro scale is a valid measure of methodological quality of clinical trials: a demographic study. Physiotherapy. 2009;95(2):85–91.
13. Nayak U, Subramanian V, Narayan A. Pilates in ankylosing spondylitis: effect on thoracic mobility and respiratory function. Musculoskelet Care. 2020;18(3):193–199.
14. Berea H, Avram R, Constantinescu A, Marinescu E. Effect of Pilates training on patients with ankylosing spondylitis: functional status and quality of life outcomes. Int J Rheum Dis. 2012;15(5):412–418.

15. Oksüz S, Unal E, Arin S. Comparison of the effects of aerobic training alone versus aerobic training combined with clinical Pilates exercises on the functional and psychosocial status of patients with ankylosing spondylitis: a randomized controlled trial. Ann Rheum Dis. 2018;77(Suppl 2):1852.2.
16. Oksüz S, Unal E. Comparison of the effects of aerobic training alone versus aerobic training combined with clinical Pilates exercises on the functional and psychosocial status of patients with ankylosing spondylitis: a randomized controlled trial. Physiother Theory Pract. 2023;39(1):61–71.
17. Yentur EA, Temel V, Cakar M, Durmus D. Pilates-based exercise effects on respiratory and functional parameters in ankylosing spondylitis: a randomized controlled trial. J Rehabil Med. 2020;52(9):jrm00082.
18. Altan L, Korkmaz N, Dizdar M, Yurtkuran M. Effects of Pilates exercises on respiratory function, functional status, and quality of life in ankylosing spondylitis: a randomized controlled study. Clin Rheumatol. 2012;31(8):1165–1172.
19. Ranu H, Wilde M, Madden B. Pulmonary function testing: interpretation and clinical applications. Clin Chest Med. 2011;32(3):509–520.
20. Syabbalo N. Assessment of respiratory muscle strength. Chest. 1998;114(4):1420–1422.
21. Enright PL. The six-minute walk test. Respir Care. 2003;48(8):783–785.
22. Fletcher T. ASQoL questionnaire: validity and use in ankylosing spondylitis patients. Rheumatol Int. 2023;43(4):591–600.
23. Aparicio V, Gallego R, Valverde J, Garcia-Garcia P, Dorado C. The Back Scratch Test as an indicator of upper body flexibility: a systematic review. J Bodyw Mov Ther. 2024;29:15–23.
24. Ragnarsdottir M, Gudjonsson H, Jonsdottir H, Bjarnason AO, Arnardottir S, Kristinsson J. Thoracic stiffness and respiratory involvement in ankylosing spondylitis. Scand J Rheumatol. 2008;37(5):370–377.
25. McKenzie DK, Gandevia SC, Gorman RB, Southon FC, De Troyer A. Respiratory muscle function in ankylosing spondylitis. Chest. 2009;135(3):694–700.
26. Rosenbaum JT, Davey MP, Eversden L, Jois RN. Quality of life in ankylosing spondylitis: impact and assessment. Rheumatology (Oxford). 2019;58(8):1437–1447.
27. Wysocki M, Kruczyński J, Kędra J, Ślusarska B. Psychosocial impact of ankylosing spondylitis on young patients. Clin Rheumatol. 2023;42(2):345–352.

**Cite this paper as**

Christakou A, Kovaiou A, Benetos I, Pnevmatikos S. «The effectiveness of Pilates on respiratory function, functional status and quality of life in patients with ankylosing spondylitis. A systematic review». AOTH. 2025; 76(3):35-44.

**DOI** https://doi.org/10.69133/aoth.v76i3.523