Manual Therapy, Posturology & Rehabilitation Journal

RESEARCH ARTICLE

Effects of a single Pilates session on anxiety levels: Where you practice matters

Cezimar C. Borges[1], Weder A. Silva[2], Polissandro M. Alves[1], Patrícia Roberta dos Santos[3], Rebeca F. Souza[1], Uitairany do P. Lemes[4], Amanda Maria de S. Romeiro[5]

[1]Goiás State University (UEG), Itumbiara (GO), Brazil
[2]Graduate Program in Human Movement and Rehabilitation of Evangelical University of Goiás (UniEVANGÉLICA), Anápolis (GO), Brazil
[3] Zarns Medical School, Itumbiara (GO), Brazil
[4] University Center of Goiatuba (UNICERRADO), Goiatuba (GO), Brazil
[5] Federal University of Goiás, Goiânia (GO), Brazil

Abstract

Background: Anxiety are among the most common mental disorders across different populations. **Objective:** This study aimed to evaluate the effects of a single Pilates session on anxiety symptoms in two different practice environments. **Method:** The sample included 26 individuals, divided into two groups: Outdoor Pilates (OP, n = 9) and Studio Pilates (SP, n = 17). Each session lasted approximately 50 minutes and comprised a warm-up, followed by mobility and muscle-strengthening exercises using dynamic and static movements targeting the upper and lower limbs as well as the trunk. Anxiety "state" was assessed using the State-Trait Anxiety Inventory (STAI-S). **Results:** Mean anxiety scores decreased in both the OP group (Δ% = –33.1, d = 1.41) and the SP group (Δ% = –17, d = 0.72). A positive correlation was observed between recent distress and pre-session anxiety levels (Pearson's r = 0.70, R^2 = 0.489), while a negative correlation was found between habitual physical activity and anxiety (Pearson's r = –0.543, R^2 = 0.294), both statistically significant at $p < 0.01$. **Conclusion:** A single Pilates session, whether conducted outdoors or in a studio, positively impacts anxiety levels in adults. However, the reduction in anxiety was more pronounced in the outdoor environment, suggesting greater effectiveness in natural settings.

Keywords: Anxiety; exercise; physical activity; pilates training.

BACKGROUND

The dynamics of today's fast-paced life introduce stressors that tend to negatively affect human relationships and, undoubtedly, the development of both the physical and mental health of individuals within this context[1.] Anxiety and depression are among the most common mental disorders across different populations.

According to the World Health Organization (WHO), 3.6% of the global population-approximately 264 million people-suffer from anxiety disorders, with a higher prevalence among women[2]. It is estimated that in the Americas, 7.7% of women are affected by anxiety disorders[2]. In Brazil, the prevalence has been increasing significantly, reaching around 5.8% of the population, which corresponds to approximately 12 million individuals, making it the country with the highest number of people diagnosed with anxiety worldwide[2]. Anxiety is considered a fundamental emotion for self-preservation in human experience, and its conceptualization is complex.

It can cause physiological changes perceived as a state of alertness and may also lead to recurrent mental disorders[3].

Corresponding author: Cezimar Correia Borges
Email: cezimar.borges@ueg.br

Received: 24 Mai, 2025
Accepted: 07 Jan, 2026
Published: 25 Fev, 2026

As a non-pharmacological intervention for managing anxiety, the regular practice of physical activity-whether spontaneous or structured, the latter referred to as "physical exercise"-has been increasingly recognized as highly beneficial for mental health outcomes[4]. In fact, accumulating evidence suggests that physical activity may be as effective as psychological and pharmacological treatments for depression and anxiety[5,6]. Among these practices, Pilates has gained widespread recognition around the world[7,8].

This approach emerged as an integration of Eastern and Western philosophies, incorporating exercises inspired by Yoga, Tai Chi, martial arts, gymnastics, and other variations, all structured around six guiding principles: concentration, centering, fluidity, breathing, precision and control[9]. It has attracted many followers, mainly due to its demonstrated benefits in addressing musculoskeletal and joint disorders, as well as its use as an exercise to improve physical conditioning. Traditionally, Pilates is practiced either trough Mat Pilates, Pilates with equipment, or a combination of both methods[9-11].

Additionally, various studies have reported the benefits of Pilates in reducing psychopathological symptoms[8, 12]. For instance, Guidotti et al. recently demonstrated that individuals engaged in regular Pilates practice showed significant reductions in anxiety, depression and stress symptoms.

In this context, there is a consensus in the literature that the Pilates method improves both physical parameters and overall mental health. However, the specific effects on aspects of mental health remain relatively underexplored in scientific researc[8,13,14]. Therefore, the objective of this study was to evaluate the effects of a single Pilates session on anxiety levels in individuals practicing Pilates in two different environments: a traditional studio setting and an outdoor setting.

MATERIALS AND METHODS

Study participants

The study sample consisted of 26 female participants, divided into two groups: outdoor Pilates (OP, n = 9) and studio Pilates (SP, n = 17). The immediate effects of a single Pilates session were evaluated by comparing pre-session (PRE) and post-session (POST) anxiety levels.

Inclusion and eligibility criteria participation in study were as follows: being at least 18 years old, having a minimum of six months of Pilates practice experience, self-reporting as healthy, signing the Free and Informed Consent Form, and completing the anxiety assessment questionnaire in full. Participant characteristics are presented in Table 1.

Table 1. Sociodemographic characteristics, weekly frequency of physical activity and self-reported stress experienced by participants in the two study scenarios

Group	Age	Frequency of physical activity (weekly)	Recent disturbance
OP (n = 9)	41.44 ± 9.77*	1 to 2 (n = 5) 3 to 4 (n = 3) 5 or more (n = 1)	No (n = 2) A little (n = 3) Quite a lot (n = 2) Very much (n = 2)
SP (n= 17)	40.70 ± 9.77*	1 to 2 (n = 4) 3 to 4 (n = 9) 5 or more (n = 4)	No (n = 6) A little (n = 9) Quite a lot (n = 1) Very much (n = 1)

Note: OP = outdoor Pilates, SP = studio Pilates, W = woman. M = man, * = the data presented are mean ± standard deviation.

The Pilates sessions were conducted in two distinct physical environments: an outdoor leisure area located near a river in a municipality in the southern region of Goiás, Brazil, and a traditional indoor Pilates studio. Participants were recruited through open invitations distributed via digital media, including social networks and announcements within local Pilates studios.

The composition of the indoor group was determined by convenience sampling, consisting of regular practitioners from a pre-selected studio. As an additional criterion, each participant could only be allocated to one group to ensure the independence of subjects across groups, as outlined in the study design shown in Figure 1.

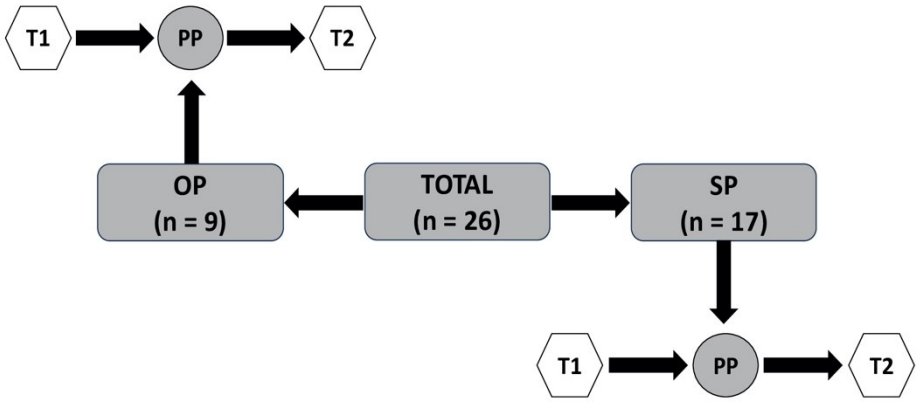

Figure 1. Study design and application times of anxiety measurement testes

Note: OP = outdoor Pilates; SP = studio Pilates; T1 = PRE test; T2 = POST test; PP = Pilates practice.

Anxiety symptoms levels were assessed before (PRE) and immediately after (POST) the Pilates session in both groups: OP and SP.

This study complies with the ethical guidelines set forth in resolution No. 466/2012 of the National Health Council (CNS) for research involving human subjects and was approved by the Research Ethics Committee of the State University of Goiás (CEPE/UEG), under approval No. 3,434,781.

Study protocol

Each Pilates session lasted approximately 50 minutes and consisted of exercises primarily targeting mobility and strength in the trunk and limbs, with an emphasis on stretching and muscular engagement. In the outdoor environment, the Mat Pilates method was employed, featuring a sequence of exercises including a warm-up, mobility/stretching for the upper and lower limbs and trunk, as well as both dynamic and static (isometric) movements targeting the scapular, hip, knee, and ankle regions. Special attention was given to strengthening the abdominal muscles and spinal erectors.

The studio session followed a mixed-method approach, incorporating both mat and equipment-based exercises. The exercise sequence and targeted body regions mirrored those used in the outdoor session, with some exercises substituted to accommodate the use of Pilates apparatus. Both interventions were led by the same instructor – a licensed physical education professional with a specialization in Pilates and over 10 years of practical experience.

Each dynamic exercise was performed in three to four sets of 15 to 30 repetitions, depending on the body segment and type of movement. Isometric exercises were held for 30 seconds to 1 minute. The total training volume (sets x repetitions, duration) did not differ significantly between session ($p < 0.05$).

In both sessions, the fundamental principles of Pilates (Contrology) were upheld. In addition to the environmental characteristics, the outdoor session was conducted collectively in a single group setting. In the studio, participants worked in smaller groups, alternating between exercises performed on the mat and on equipment.

Instruments for data collection

A structured sociodemographic questionnaire was administered, including questions on personal information (age, sex, marital status), health status, length of experience with Pilates, regular engagement in physical activity, and recent experiences of stress or emotional disturbance within the past few weeks. Some questions were presented in a multiple-choice format, using an intensity scale ranging from 0 (none) to 4 (very much).

Additionally, an anxiety assessment questionnaire was used. Anxiety "state" was evaluated using the State-Trait Anxiety Inventory – State version (STAI – S), which consists of 20 objective, Likert-type items. These items assess how the individual feels at the moment in relation to perceived tension, apprehension, nervousness, and worry. Each response contributes to a cumulative total score representing the participant's current anxiety level[15,16].

The STAI - S was administered twice to each participant: once before (PRE) and once within five minutes after (POST) the Pilates session. Completion time for the questionnaire ranged from 2 to 5 minutes.

Statistical analysis

The Shapiro-Wilk test was used to assess the distribution characteristics of the measured anxiety variables, revealing normality in three out of the four conditions evaluated (PRE and POST in both groups).

Descriptive statistics included mean, standard deviation, median, percentage variation/magnitude of effect, and frequency. A 95% confidence interval (CI) was applied.

To compare PRE and POST anxiety levels, the paired t-test and Wilcoxon signed-rank test were used, with a significance level set at $p < 0.05$. Correlation between variables were examined using Person's r (with a significance threshold of $p < 0.01$) and the squared correlation coefficient (R^2). The magnitude of the differences between PRE and POST conditions was calculated using Cohen's d effect size, based on syntax manually input into IBM SPSS Statistics, version 21.0.

RESULTS

Pilates sessions significantly reduced state anxiety scores ($p < 0.05$) compared to pre-activity levels, regardless of the environment in which the session was conducted.

However, the reduction in anxiety was more pronounced in the group that performed the activity outdoors, showing a 33.1% decrease and a large effect size (d = 1.41). In contrast, the studio group exhibited a 17% reduction, with a moderate effect size (d = 0.72) (Table 2).

Table 2. Results of anxiety scores, PRE and POST Pilates sessions in studio and outdoor conditions measured using the STAI - S questionnaire

	Mean±SD (PRE)	Mean±SD (POST)	Δ %	Effect siz (*d*)	Median (PRE)	Median (POST)
OP	51.22 ± 12,24	34.22 ± 11,87*	– 33,1%	1.41	55	34 †
SP	41.17 ± 9,91	34.17 ± 9,31*	– 17%	0.72	39	34 †

Note: SD = Standard deviation. Δ % = Percentage variation d = Cohen's d. *Significant difference ($p < 0.05$) POST x PRE (paired t-test). † Significant difference ($p < 0.05$) POST x PRE (Wilcoxon test).

The mean and extreme levels of state anxiety in the PRE condition – prior to the Pilates sessions - were higher in the outdoor group compared to the studio group. Following the intervention, anxiety levels in the outdoor group remained elevated relative to the studio group (Figure 2).

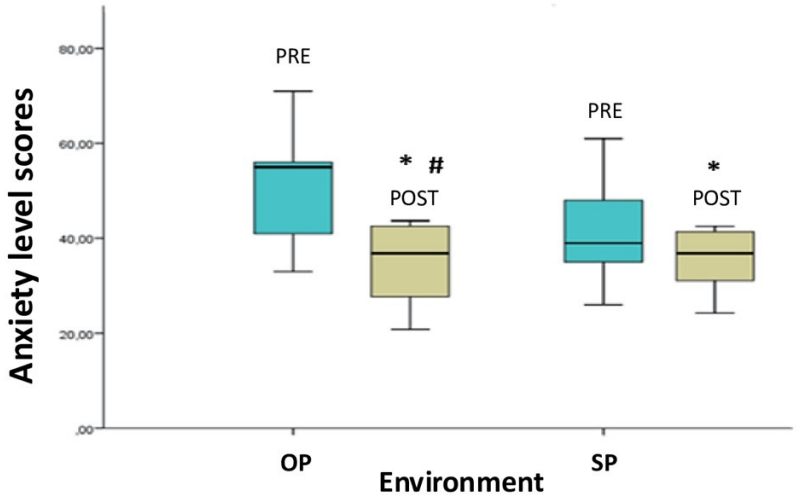

Figure 2. Box plot graph with the statistical values of the position of the anxiety scores measured PRE and POST Pilates sessions in both environments

Note: * = $p < 0.05$, significant decrease in anxiety scores PRE x POST; # = greater PRE x POST effect in the session held öutdoors".

Participants who reported experiencing greater emotional distress in recent weeks exhibited higher levels of state anxiety before the Pilates sessions. The relationship resulted in a significant positive correlation ($p < 0.01$) between "recent distress" and "pre-session anxiety," with a Person's r of 0.70 and a coefficient of determination (R^2) of 0.489.

These findings suggest a strong influence of pre-existing mental discomfort on the anxiety levels measured by the STAI-S.

Conversely, participants who reported engaging in regular physical activity showed a significant negative correlation ($p<0.01$) between pre-session anxiety and weekly physical activity frequency, with a Pearson's r of -0.543. This indicates that individuals who engage in more frequent physical activity tend to report lower anxiety levels, highlighting the beneficial role of regular exercise on mental health. The coefficient of determination ($R^2 = 0.294$) further supports this association.

DISCUSSION

Regular physical activity has a well-established positive impact on anxiety levels. The results of this study demonstrated a significant reduction in participants' anxiety following a single Pilates session, both in studio and outdoor settings. The reduction was more pronounced in the outdoor group (33.1%, d = 1.41) compared to the studio group (17%, d = 0.72). These findings are consistent with existing literature emphasizing the mental health benefits of regular physical activity[4,17].

The greater effectiveness of outdoor Pilates may be attributed to additional elements inherent in natural environment, such as exposure to nature and opportunities for social interaction – factors known to promote emotional well-being and reduce stress[18]. Previous research supports this, indicating that exercising in natural settings-referred to as "green exercise" – may offer superior psychological benefits compared to other environments[19-21]. Theories such as the psychoevolutionary theory and the attention restoration theory help explain these findings[22,23]. The former suggests an innate human preference for natural environments, while the latter posits that nature restores mental fatigue by requiring less directed attention, thereby facilitating cognitive ease[22]. Notably, both theories converge on the idea that contact with nature pleasure and relaxation[24]. The Pilates method itself – grounded in principles such as concentration, breathing, and fluidity[9]– may amplify these effects when practiced in a natural setting.

A positive correlation between recent distress and pre-session anxiety levels (Pearson's r = 0.70; $R^2 = 0.489$) indicates that individuals experiencing higher levels of recent stress reported greater baseline anxiety. Conversely, the negative correlation between habitual physical activity and anxiety (Pearson's r = -0.543; $R^2 = 0.294$) suggests that regular exercise may offer a protective effect, aligning with existing studies on the mental health benefits of physical activity[4,25].

Although baseline anxiety levels were higher in the outdoor group – possibly due to contextual or subjective participant variables – the greater reduction observed supports the notion that natural environment may be more effective in alleviating anxiety symptoms. This is agreement with previous research highlighting the restorative and psychological benefits of exercising in outdoor spaces, including enhanced well-being and reduced stress[16,18].

The perception of well-being elicited by nature-based activities may be a key contributor, as proximity to nature has been associated with greater reductions in psychological stress compared to indoor settings[4,26]. According to Fleming and Herring[8], the effects of Pilates on mental health have been less explored compared to other integrative practices such as Yoga and Tai Chi. This study helps fill gap by emphasizing the acute anxiolytic effects of Pilates, particularly in outdoor environments.

Findings from this study demonstrate that even a single session of Pilates can effectively reduce anxiety in adults, regardless of the setting. Neuroendocrine responses to exercise - including increased serotonin and dopamine levels reduced sympathetic nervous system activity - may explain the benefits observed[25,27]. Improvements in functional capacity, autonomy and self-esteem further support the psychosocial advantages of physical exercise[4].

Despite the promising results, the study has some limitations, such as the small sample size and lack of a control group. Additionally, the exclusivity of female participants may limit the generalizability of the findings. Future research involving larger, more diverse samples and long-term interventions is necessary to assess cumulative effects of Pilates and better understand the mechanisms underlying its impact on anxiety.

In this context, regular physical activity emerges as a crucial strategy for stress reduction in adults. Specifically, outdoor Pilates sessions yielded a 33.1% reduction in anxiety compared to pre-session levels (Table 2). This study reinforces the role of Pilates in promoting mental health and underscores the added benefits of practicing it in natural Settings. Outdoor sessions appear practice particularly beneficial, suggesting that nature-based interventions may be more effective in managing anxiety. Given its wide applicability and low physical impact, Pilates could serve as a valuable component in stress management programs for individuals facing high levels of emotional distress.

CONCLUSION

Pilates has been shown to have positive effects on anxiety levels in adults and represents a promising strategy for promoting mental health, particularly when practiced outdoors. Further long-term studies are recommended to evaluate the cumulative effects of this activity.

Ethical considerations

This research meets the ethical standards of the committee responsible for human experimentation, and all participants gave written consent to participate in the research.

Author Contributions: C.C.B., R.F.S. and P.R.S.: Conceptualization. C.C.B., W.A.S. and A.M.S.R.: Methodology and writing–original draft. Investigation: C.C.B., U.P.L., P.M.A. and W.A.S. Writing–review and editing: P.R.S., A.M.S.R., U.P.L. and P.M.A.

Financial Support: There was no external funding.

Conflict of interest: The authors declare that they have no competing interests.

REFERENCES

1. Wu Y, Li X, Ji X, Ren W, Zhu Y, Chen Z, et al. Trends in the epidemiology of anxiety disorders from 1990 to 2021: A global, regional, and national analysis with a focus on the sociodemographic index. J Affect Disord. 2025;373:166-74.
2. Bezerra HS, Barbosa IR. Poor access to health services for depression treatment in Brazil. Rev Saude Publica. 2023;57:49.
3. Javaid SF, Hashim IJ, Hashim MJ, Stip E, Samad MA, Ahbabi AA. Epidemiology of anxiety disorders: global burden and sociodemographic associations. Middle East Current Psychiatry. 2023;30(1):44.
4. Chekroud SR, Gueorguieva R, Zheutlin AB, Paulus M, Krumholz HM, Krystal JH, et al. Association between physical exercise and mental health in 1·2 million individuals in the USA between 2011 and 2015: a cross-sectional study. Lancet Psychiatry. 2018;5(9):739-46.
5. Singh B, Olds T, Curtis R, Dumuid D, Virgara R, Watson A, et al. Effectiveness of physical activity interventions for improving depression, anxiety and distress: an overview of systematic reviews. Br J Sports Med. 2023;57(18):1203-9.
6. Stubbs B, Koyanagi A, Hallgren M, Firth J, Richards J, Schuch F, et al. Physical activity and anxiety: A perspective from the World Health Survey. J Affect Disord. 2017;208:545-52.
7. Ensari I, Greenlee TA, Motl RW, Petruzzello SJ. Meta-analysis of acute exercise effects on state anxiety: an update of randomized controlled trials over the past 25 years. Depress Anxiety. 2015;32(8):624-34.
8. Fleming KM, Herring MP. The effects of pilates on mental health outcomes: A meta-analysis of controlled trials. Complement Ther Med. 2018;37:80-95.
9. Wells C, Kolt GS, Bialocerkowski A. Defining Pilates exercise: a systematic review. Complement Ther Med. 2012;20(4):253-62.
10. Souza ROB, Marcon LF, Arruda ASF, Junior FLP, Melo RC. Effects of Mat Pilates on Physical Functional Performance of Older Adults: A Meta-analysis of Randomized Controlled Trials. Am J Phys Med Rehabil. 2018;97(6):414-25.
11. Cruz-Ferreira A, Fernandes J, Laranjo L, Bernardo LM, Silva A. A systematic review of the effects of pilates method of exercise in healthy people. Arch Phys Med Rehabil. 2011;92(12):2071-81.
12. Guidotti S, Fiduccia A, Morisi G, Pruneti C. Benefits of Pilates on Depression, Anxiety, and Stress: An Observational Study Comparing People Practicing Pilates to Non-Active Controls. Healthcare. 2025;13(7):772.
13. Fleming KM, Campbell M, Herring MP. Acute effects of Pilates on mood states among young adult males. Complement Ther Med. 2020;49:102313.
14. Parveen A, Kalra S, Jain S. Effects of Pilates on health and well-being of women: a systematic review. Bulletin of Faculty of Physical Therapy. 2023;28(1):17.
15. Novy DM, Nelson DV, Goodwin J, Rowzee RD. Psychometric comparability of the State-Trait Anxiety Inventory for different ethnic subpopulations. Psychological Assessment. 1993;5(3):343-9.
16. Bieling PJ, Antony MM, Swinson RP. The State--Trait Anxiety Inventory, Trait version: structure and content re-examined. Behaviour Research and Therapy. 1998;36(7):777-88.
17. Anderson E, Shivakumar G. Effects of exercise and physical activity on anxiety. Front Psychiatry. 2013;4:27.

18. Gladwell VF, Brown DK, Wood C, Sandercock GR, Barton JL. The great outdoors: how a green exercise environment can benefit all. Extrem Physiol Med. 2013;2(1):3.
19. Lawton E, Brymer E, Clough P, Denovan A. The Relationship between the Physical Activity Environment, Nature Relatedness, Anxiety, and the Psychological Well-being Benefits of Regular Exercisers. Front Psychol. 2017;8:1058.
20. Li H, Zhang X, Bi S, Cao Y, Zhang G. Psychological benefits of green exercise in wild or urban greenspaces: A meta-analysis of controlled trials. Urban Forestry & Urban Greening. 2022;68:127458.
21. Pretty J, Peacock J, Sellens M, Griffin M. The mental and physical health outcomes of green exercise. Int J Environ Health Res. 2005;15(5):319-37.
22. Kaplan S. The restorative benefits of nature: Toward an integrative framework. Journal of Environmental Psychology. 1995;15(3):169-82.
23. Ulrich RS, Simons RF, Losito BD, Fiorito E, Miles MA, Zelson M. Stress recovery during exposure to natural and urban environments. Journal of Environmental Psychology. 1991;11(3):201-30.
24. Mavrantza AM, Bigliassi M, Calogiuri G. Psychophysiological mechanisms underlying the effects of outdoor green and virtual green exercise during self-paced walking. Int J Psychophysiol. 2023;184:39-50.
25. Aylett E, Small N, Bower P. Exercise in the treatment of clinical anxiety in general practice – a systematic review and meta-analysis. BMC Health Services Research. 2018;18(1):559.
26. Barton J, Pretty J. What is the best dose of nature and green exercise for improving mental health? A multi-study analysis. Environ Sci Technol. 2010;44(10):3947-55.
27. Wegner M, Helmich I, Machado S, Nardi AE, Arias-Carrion O, Budde H. Effects of exercise on anxiety and depression disorders: review of meta- analyses and neurobiological mechanisms. CNS Neurol Disord Drug Targets. 2014;13(6):1002-14.