

The Effectiveness of Pregnancy Gymnastics in Reducing Low Back Pain in Pregnant Women in the Third Trimester at the Tamalate Health Center, Makassar

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ABSTRACT

Background: Low back pain is a common musculoskeletal complaint in late pregnancy and may interfere with mobility, sleep quality, daily activities, and maternal comfort. Pregnancy exercise is a feasible non-pharmacological intervention that can be integrated into antenatal services, particularly in primary health care. However, local evidence from community health centers remains limited.

Objective: This study aimed to compare the level of low back pain before and after pregnancy exercise among third-trimester pregnant women at Tamalate Public Health Center, Makassar.

Methods: This pre-experimental study used a one-group pretest-posttest design. Thirty-six third-trimester pregnant women with low back pain were selected using purposive sampling. Pain intensity was assessed before and after the intervention using a structured pain questionnaire/numeric pain scale. Data were analyzed descriptively and using the Wilcoxon signed-rank test because the paired data were ordinal or not normally distributed.

Results: Before the intervention, 17 respondents (47.2%) reported severe pain, 14 (38.9%) moderate pain, and 5 (13.9%) mild pain. After the intervention, severe pain decreased to 1 respondent (2.8%), while mild pain increased to 20 respondents (55.6%). The Wilcoxon test showed a significant reduction in pain after pregnancy exercise ($Z = -5.215$; $p < 0.001$), with a large effect size ($r = 0.87$).

Conclusion: Pregnancy exercise was associated with a significant reduction in low back pain among third-trimester pregnant women. Nevertheless, the absence of a control group, the relatively small sample size, and the subjective nature of pain measurement should be considered when interpreting the findings.

Keywords: low back pain; pregnancy exercise; third trimester; pregnant women; pretest-posttest

ABSTRAK

Latar Belakang: Nyeri punggung bawah merupakan keluhan muskuloskeletal yang sering dialami ibu hamil trimester III dan dapat mengganggu mobilitas, kualitas tidur, aktivitas sehari-hari, serta kenyamanan ibu selama kehamilan. Senam hamil merupakan intervensi nonfarmakologis yang relatif mudah diterapkan dalam pelayanan antenatal, khususnya pada layanan primer. Akan tetapi, bukti lokal mengenai penerapannya di tingkat puskesmas masih perlu diperkuat.

Tujuan: Penelitian ini bertujuan membandingkan tingkat nyeri punggung bawah sebelum dan sesudah senam hamil pada ibu hamil trimester III di Puskesmas Tamalate, Makassar.

Metode: Penelitian ini menggunakan desain pre-eksperimental dengan pendekatan one-group pretest-posttest. Sampel terdiri atas 36 ibu hamil trimester III dengan nyeri punggung bawah yang dipilih menggunakan purposive sampling. Tingkat nyeri diukur sebelum dan sesudah intervensi menggunakan kuesioner/skala nyeri terstruktur. Data dianalisis secara deskriptif dan menggunakan uji Wilcoxon signed-rank karena data berpasangan bersifat ordinal atau tidak berdistribusi normal.

Hasil: Sebelum intervensi, 17 responden (47,2%) mengalami nyeri berat, 14 responden (38,9%) nyeri sedang, dan 5 responden (13,9%) nyeri ringan. Setelah intervensi, nyeri berat menurun menjadi 1 responden (2,8%), sedangkan nyeri ringan meningkat menjadi 20 responden (55,6%). Uji Wilcoxon menunjukkan penurunan nyeri yang bermakna setelah senam hamil ($Z = -5,215$; $p < 0,001$), dengan ukuran efek besar ($r = 0,87$).

Kesimpulan: Senam hamil berhubungan dengan penurunan nyeri punggung bawah pada ibu hamil trimester III. Namun, hasil perlu diinterpretasikan dengan mempertimbangkan tidak adanya kelompok kontrol, ukuran sampel yang relatif kecil, dan sifat subjektif pengukuran nyeri.

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INTRODUCTION

Pregnancy causes anatomical, physiological, hormonal, and biomechanical changes that are necessary to support fetal growth. In the third trimester, uterine enlargement, weight gain, shift in the center of gravity, increased lumbar lordosis, and changes in ligament stability can increase the load on the lumbopelvic region and give rise to complaints of low back pain. International physical activity guidelines state that pregnant women without contraindications are encouraged to remain physically active, with adjustments to the type, intensity, and safety of exercise according to pregnancy conditions (American College of Obstetricians and Gynecologists [ACOG], 2020; World Health Organization (WHO), 2020).

Low back pain in pregnancy is a common problem and has an impact on daily functioning. A global meta-analysis reports that back pain during pregnancy has a high prevalence and tends to increase in the final trimester (Salari et al., 2023). Another systematic review of lumbopelvic pain shows that these complaints not only cause discomfort, but are also related to decreased quality of life, limited activity, sleep disturbances, and increased healthcare needs (Hong et al., 2024; Manyozo et al., 2019).

Antenatal services in Indonesia emphasize early detection of risk factors, health education, and healthy behavior support during pregnancy. Maternal and Child Health books and antenatal service guidelines can be educational media for pregnant women to understand common complaints, safe physical activity, and danger signs that require further examination (Ministry of Health of the Republic of Indonesia, 2020, 2021, 2024). In the context of primary services, simple interventions such as pregnancy exercises have the potential to be included in pregnant women's classroom education or routine antenatal services.

Various studies show that pregnancy exercises, ergonomics education, stabilization exercises, Pilates, yoga, pelvic floor muscle exercises, and ball-based exercises can help reduce pain intensity or improve function in pregnant women with lumbopelvic complaints (Diez-Buil et al., 2024; Kandru et al., 2023; Koukoulithras et al., 2021; Santos et al., 2023; Sonmezer et al., 2021). However, the evidence shows large variation between intervention protocols, duration, frequency, and pain measures. Therefore, local research remains important to describe the benefits of pregnancy exercises in the context of health center services.

Several studies in Indonesia have reported a reduction in back pain after pregnancy gymnastics or similar exercises, but there are still limitations in the form of small sample sizes, designs without control groups, and variations in measurement instruments (Ariendha et al., 2022; Nurlitawati et al., 2022; Sari et al., 2020; Veronica et al., 2021). The gap that is to be answered in this study is how the level of low back pain changes before and after pregnancy exercise intervention in pregnant women in the third trimester at the Tamalate Health Center, Makassar, as one of the descriptions of the implementation of non-pharmacological interventions in primary services.

The general purpose of this study is to determine the effectiveness of pregnancy exercises in reducing the level of low back pain in pregnant women in the third trimester. The specific objectives of the study were to identify the level of low back pain before pregnancy exercises, identify the level of pain after pregnancy exercises, and analyze differences in pain levels before and after pregnancy exercises.

METHOD

Types of Research

This type of research is pre-experimental with a one-group pretest-posttest approach. This design was used to evaluate changes in low back pain levels in the same group of respondents before and after the pregnancy exercise intervention.

Research Location and Time

The research was carried out at the Tamalate Health Center, Makassar City, for the period September 2025 – February 2026.

Population and Sample

The study population was all pregnant women in the third trimester who made antenatal visits at the Tamalate Health Center during the study period. The sample totaled 36 respondents and was selected using purposive sampling based on the research criteria. The purposive sampling technique allows researchers to select subjects that are suitable for the purpose of the study, but have the potential to cause selection bias, so the generalization of results must be done carefully.

Inclusion criteria include: (1) pregnant women in the third trimester; (2) experiencing low back pain with mild to severe pain categories; (3) being able to follow pregnancy gymnastics instructions; and (4) willing to be a respondent by signing an agreement after explanation. Exclusion criteria include: (1) having obstetric complications or medical conditions that are contraindications to physical activity; (2) have a history of severe spinal injury or disease; (3) experiencing pregnancy danger signs; or (4) not following the complete series of pretest and posttest measurements.

Intervention

The intervention was structured pregnancy exercises directed at improving stretching, core muscle stability, pelvic mobility, relaxation, and postural comfort. In principle, pregnancy gymnastics sessions include warm-ups, breathing exercises, back and pelvic stretching movements, light strengthening exercises, relaxation, and cooling. The series of exercises is adjusted to the condition of pregnancy and the principle of physical activity safety in pregnant women (ACOG, 2020; WHO, 2020). Pregnancy exercise interventions are given in a structured manner twice per week for a minimum of four weeks, with a duration of 30–45 minutes per session. Each session consists of warm-ups, breathing exercises, back and pelvic muscle stretches, light lumbopelvic stabilization exercises, pelvic floor exercises, relaxation, and cool-down. The intensity of the exercise is maintained at a light to moderate level, with the principle that the mother is still able to speak during the exercise. Before participating in pregnancy exercises, respondents were screened to ensure that there were no contraindications to physical activity during pregnancy.

Data Collection

Data were collected through measurements of low back pain levels before and after the intervention. The research instrument was in the form of a questionnaire/structured pain scale. Based on the categories used in the initial manuscript, the level of pain was classified into mild, moderate, and severe pain.

Data Processing and Analysis

Data were analyzed descriptively to describe respondent characteristics and distribution of pain levels before and after the intervention. The normality test is carried out first. Because the paired data is not normally distributed or ordinal, the analysis of the difference between the pretest and posttest was carried out using the Wilcoxon signed-rank test. A $p < 0.05$ is considered statistically significant. In addition to the value p , the size of the effect is calculated using the formula $r = |Z|/\sqrt{n}$ to help interpret the magnitude of the pain changes.

RESEARCH RESULTS

A total of 36 pregnant women in the third trimester were included in the study. Characteristics of respondents based on age and obstetric status are presented in Table 1. The majority of respondents were in the age group of 20-35 years, namely 26 respondents (72.2%). Based on obstetric status, primary respondents totaled 19 people (52.8%) and multipara 17 people (47.2%).

Table 1. Frequency Distribution of Respondent Characteristics (n=36)

Respondent Characteristics	Category	n	Percent (%)
Age	<20 years	5	13.9
	20-35 years	26	72.2
	>35 years	5	13.9
	Total	36	100.0
Obstetric status	Primipara	19	52.8
	Multipara	17	47.2
	Total	36	100.0

Source: Primary data, 2024.

The distribution of low back pain levels before the intervention is presented in Table 2. Before pregnancy exercises, the most common pain category was severe pain, which was 17 respondents (47.2%), followed by moderate pain for 14 respondents (38.9%) and mild pain for 5 respondents (13.9%). These findings suggest that most respondents started the intervention with complaints of moderate to severe pain.

Table 2. Distribution of Low Back Pain Level Before Pregnancy Exercise (n=36)

Pain status	n	Percent (%)
Mild pain	5	13.9
Moderate pain	14	38.9
Severe pain	17	47.2
Total	36	100.0

Source: Primary data, 2024.

After the pregnancy exercise intervention, there was a shift in the distribution of pain levels to a lighter category. Mild pain increased to 20 respondents (55.6%), moderate pain to 15 respondents (41.6%), and severe pain remained 1 respondent (2.8%) as shown in Table 3. Thus, the proportion of severe pain decreased by 44.4 percentage points from the initial condition.

Table 3. Distribution of Low Back Pain Level After Pregnancy Exercise (n=36)

Pain status	n	Percent (%)
Mild pain	20	55.6
Moderate pain	15	41.6
Severe pain	1	2.8
Total	36	100.0

Source: Primary data, 2024.

The results of the Wilcoxon signed-rank test showed a significant difference between pain levels before and after pregnancy exercises. The calculated effect size of the Z-value is $r = 0.87$, which indicates a large effect. These results support that pregnancy exercises are associated with a decrease in low back pain levels in study respondents.

Table 4. Wilcoxon Signed-Rank Test for Pain Level Before and After Pregnancy Exercise

Comparison	Z	p-value	Effect size (r)
Posttest - Pretest	-5.215	<0.001	0.87 (large)

Source: Primary data, 2024. Note: $r = |Z|/\sqrt{n}$.

DISCUSSION

The results of the study showed a decrease in the level of low back pain after the implementation of pregnancy exercises in pregnant women in the third trimester. Before the intervention, almost half of the respondents were in the severe pain category. After the intervention, most of the respondents were in the mild pain category, while severe pain remained in only one respondent. This shift is not only statistically significant, but it also shows a clearly descriptive change in the distribution of pain levels.

Physiologically, pregnancy exercises can help reduce pain through a combination of the mechanism of stretching the back and pelvic muscles, improving posture, improving circulation, improving core muscle stability, and relaxing effects. This principle is in line with the recommendation that physical activity during pregnancy can be carried out safely in pregnant women without contraindications and adapted to anatomical and physiological changes in pregnancy (ACOG, 2020; WHO, 2020; Tsakiridis et al., 2020).

The findings of this study are consistent with the research of Nurlitawati et al. (2022) which reported a decrease in the average back pain after pregnancy exercises in pregnant women in the third trimester at Ciawi Hospital. Research by Sari et al. (2020) at the Jembatan Kecil Health Center also showed a decrease in the level of low back pain after pregnancy exercises. Similarly, Ariendha et al. (2022) concluded that pregnancy exercise can help reduce back pain in pregnant women. The consistency of these findings reinforces the relevance of pregnancy exercises as a non-pharmacological intervention that is worthy of consideration in antenatal services.

These results are also in line with international evidence. A systematic review with the GRADE approach by Santos et al. (2023) showed that exercise interventions may play a role in the prevention of low back pain and pelvic girdle pain during pregnancy. Diez-Buil et al. (2024) reported that the combination of exercise and education was more effective in reducing pain and disability than education alone in pregnant women with low back pain and/or pelvic pain. This evidence supports the importance of combining pregnancy exercises with posture education, ergonomics of daily activities, and red flags that require referrals.

CONCLUSIONS AND SUGGESTIONS

Pregnancy exercises are related to reducing the level of low back pain in pregnant women in the third trimester at the Tamalate Health Center, Makassar. The proportion of severe pain decreased from 47.2% before the intervention to 2.8% after the intervention, and the Wilcoxon test showed a significant difference ($p < 0.001$) with large effect sizes.

Health centers and health workers are advised to consider pregnancy exercises as part of antenatal education and pregnant women's classes, while still paying attention to contraindication screening, movement safety, and maternal ability. Further research is recommended using control groups, larger sample sizes, intervention adherence measurements, and additional instruments to assess function, sleep quality, and quality of life of pregnant women.

Author's Contribution Statement:

Sitti Nur Ain: conceptualization, investigation, data curation, writing - original draft. **Agustina Ningsi:** methodology, investigation, data curation, writing - original draft. **Hidayati:** supervision, methodology, validation, writing - review and editing. **Ros Rahmawati:** supervision, validation, writing - review and editing. **Andi Syintha Ida:** validation, visualization, writing - review and editing.

CONFLICTS OF INTEREST

There are no financial, personal, or institutional conflicts of interest that may affect the implementation or reporting of this research.

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BIBLIOGRAPHY

- American College of Obstetricians and Gynecologists. (2020). Physical activity and exercise during pregnancy and the postpartum period: ACOG Committee Opinion No. 804. *Obstetrics & Gynecology*, 135(4), e178-e188. <https://doi.org/10.1097/AOG.0000000000003772>
- Ariendha, D. S. R., Setyawati, I., Utami, K., & Hardaniyati. (2022). The effect of pregnancy exercises on low back pain in pregnant women. *Journal of Quality in Public Health*, 5(2), 607-612. <https://doi.org/10.30994/jqph.v5i2.364>
- Atisook, R., Euasobhon, P., Saengsanon, A., & Jensen, M. P. (2021). Validity and utility of four pain intensity measures for use in international research. *Journal of Pain Research*, 14, 1129-1139. <https://doi.org/10.2147/JPR.S303305>
- Carvalho, A. P. F., Dufresne, S. S., Rogerio de Oliveira, M., Couto Furlanetto, K., Dubois, M., Dallaire, M., et al. (2020). Effects of lumbar stabilization and muscular stretching on pain, disabilities, postural control and muscle activation in pregnant woman with low back pain. *European Journal of Physical and Rehabilitation Medicine*, 56(3). <https://doi.org/10.23736/S1973-9087.20.06086-4>
- Diez-Buil, H., Hernandez-Lucas, P., Leiros-Rodriguez, R., & Echeverria-Garcia, O. (2024). Effects of the combination of exercise and education in the treatment of low back and/or pelvic pain in pregnant women: Systematic review and meta-analysis. *International Journal of Gynecology & Obstetrics*, 164(3), 811-822. <https://doi.org/10.1002/ijgo.15000>
- Ermasari, A., & Winarno, R. (2024). Optimizing pelvic rocking with gym ball to reduce low back pain in pregnancy. *Jurnal Kesehatan*, 15(3), 387-395. <https://doi.org/10.26630/jk.v15i3.4658>
- Fatmarizka, T., Ramadanty, R. S., & Khasanah, D. A. (2021). Pregnancy-related low back pain and the quality of life among pregnant women: A narrative literature review. *Journal of Public Health for Tropical and Coastal Region*, 4(3), 108-116. <https://doi.org/10.14710/jphtcr.v4i3.10795>
- Hong, S., Chen, L., Zhang, H., Wang, Y., Liu, T., Tong, J., et al. (2024). Prevalence of lumbopelvic pain during pregnancy: A systematic review and meta-analysis of cross-sectional studies. *Acta Obstetrica et Gynecologica Scandinavica*, 103(2), 225-240. <https://doi.org/10.1111/aogs.14714>
- Hrvatin, I., & Puh, U. (2021). Measurement properties of the numerical pain rating scale in patients with musculoskeletal impairments of the limbs: A systematic literature review. *Zdravniški Vestnik*, 90(9-10), 512-520. <https://doi.org/10.6016/ZdravVestn.3108>
- Kandru, M., Zallipalli, S. N., Dendukuri, N. K., Linga, S., Jeewa, L., Jeewa, A., et al. (2023). Effects of conventional exercises on lower back pain and/or pelvic girdle pain in pregnancy: A systematic review and meta-analysis. *Cureus*, 15(7), e42010. <https://doi.org/10.7759/cureus.42010>
- Kazeminia, M., Rajati, F., & Rajati, M. (2023). The effect of pelvic floor muscle-strengthening exercises on low back pain: A systematic review and meta-analysis on randomized clinical trials. *Neurological Sciences*, 44(3), 859-872.
- Kementerian Kesehatan Republik Indonesia. (2020). *Pedoman pelayanan antenatal terpadu* (Edisi ketiga). Jakarta: Kementerian Kesehatan RI. <https://repository.kemkes.go.id/book/147>
- Kementerian Kesehatan Republik Indonesia. (2021). *Peraturan Menteri Kesehatan Republik Indonesia Nomor 21 Tahun 2021 tentang penyelenggaraan pelayanan kesehatan masa sebelum hamil, masa hamil, persalinan, dan masa sesudah melahirkan, pelayanan kontrasepsi, dan pelayanan kesehatan seksual*. Jakarta: Kementerian Kesehatan RI.
- Kementerian Kesehatan Republik Indonesia. (2024). *Buku Kesehatan Ibu dan Anak 2024*. Jakarta: Kementerian Kesehatan RI. https://kesprimkom.kemkes.go.id/assets/uploads/contents/others/Buku_KIA_2024.pdf

- Koukoulithras, I., Stamouli, A., Kolokotsios, S., Plexousakis, M., & Mavrogiannopoulou, C. (2021). The effectiveness of non-pharmaceutical interventions upon pregnancy-related low back pain: A systematic review and meta-analysis. *Cureus*, 13(1), e13011. <https://doi.org/10.7759/cureus.13011>
- Mamipour, H., Ahmadabadi, Z., & Rezaei, N. (2023). Effect of core stabilization exercises on pain, functional status, and quality of life in pregnant women with lumbopelvic pain: A randomized controlled trial. *BMC Pregnancy and Childbirth*, 23, 512. <https://doi.org/10.1186/s12884-023-06023-y>
- Manyozo, S. D., Nesto, T., Bonongwe, P., & Muula, A. S. (2019). Low back pain during pregnancy: Prevalence, risk factors and association with daily activities among pregnant women in urban Blantyre, Malawi. *Malawi Medical Journal*, 31(1), 71-76. <https://doi.org/10.4314/mmj.v31i1.12>
- McCarthy, T. A., Reddy, P. S., Simonds, A. H., & Spaeth, A. M. (2023). The effects of exercise training on low back/pelvic girdle pain during pregnancy: A systematic review. *Journal of Women's & Pelvic Health Physical Therapy*. <https://doi.org/10.1097/JWH.0000000000000269>
- Mutoharoh, S., Astuti, D. P., Kusumastuti, K., Rahmadhani, W., & Purnomo, M. D. P. (2021). Effectiveness of pregnancy exercise with kinesio taping on lower back pain in pregnant women in the third trimester. *Jurnal Ilmu Kesehatan Masyarakat*, 12(3), 241-249. <https://doi.org/10.26553/jikm.2021.12.3.241-249>
- Nugent, S. M., Lovejoy, T. I., Shull, S., Dobscha, S. K., & Morasco, B. J. (2021). Associations of pain numeric rating scale scores collected during usual care with research administered patient reported pain outcomes. *Pain Medicine*, 22(10), 2235-2241. <https://doi.org/10.1093/pm/pnab110>
- Nurlitawati, E. D., Aulya, Y., & Widowati, R. (2022). Efektivitas senam hamil terhadap penurunan nyeri punggung pada kehamilan trimester III di RSUD Ciawi. *Jurnal Akademika Baiturrahim Jambi*, 11(2), 237. <https://doi.org/10.36565/jab.v11i2.525>
- Pangaribuan, I. K., Lubis, K., Yanti, S., & Sibarani, L. (2023). Pregnancy exercises on reducing lower back pain in pregnant women trimester II and III. *Journal of Maternal and Child Health Sciences*, 3(2). <https://doi.org/10.36086/maternalandchild.v3i2.2041>
- Salari, N., Mohammadi, A., Hemmati, M., Hasheminezhad, R., Kani, S., Shohaimi, S., et al. (2023). The global prevalence of low back pain in pregnancy: A comprehensive systematic review and meta-analysis. *BMC Pregnancy and Childbirth*, 23(1), 830. <https://doi.org/10.1186/s12884-023-06151-x>
- Santos, F. F., Lourenco, B. M., Souza, M. B., Maia, L. B., Oliveira, V. C., & Oliveira, M. X. (2023). Prevention of low back and pelvic girdle pain during pregnancy: A systematic review and meta-analysis of randomised controlled trials with GRADE recommendations. *Physiotherapy*, 118, 1-11. <https://doi.org/10.1016/j.physio.2022.09.004>
- Sari, R. M., Ramadhaniati, Y., & Indaryani, D. (2020). Pengaruh senam hamil terhadap penurunan tingkat nyeri punggung bawah pada ibu hamil TM III di wilayah kerja Puskesmas Jembatan Kecil. *Jurnal Ilmiah PANNMED*, 15(1), 22-29. <https://doi.org/10.36911/pannmed.v15i1.644>
- Shen, Y., Wang, Y., & Huang, P. (2025). Effects of exercise during pregnancy on maternal and newborn outcomes. *BMC Pregnancy and Childbirth*, 25(1), 1158. <https://doi.org/10.1186/s12884-025-08285-6>
- Sonmezer, E., Ozkoslu, M. A., & Yosmaoglu, H. B. (2021). The effects of clinical Pilates exercises on functional disability, pain, quality of life and lumbopelvic stabilization in pregnant women with low back pain: A randomized controlled study. *Journal of Back and Musculoskeletal Rehabilitation*, 34(1), 69-76. <https://doi.org/10.3233/BMR-191810>
- Tsakiridis, I., Bakaloudi, D. R., Oikonomidou, A. C., Dagklis, T., & Chourdakis, M. (2020). Exercise during pregnancy: A comparative review of guidelines. *Journal of Perinatal Medicine*, 48(6), 519-525. <https://doi.org/10.1515/jpm-2019-0419>
- Veronica, S. Y., Kumalasari, D., & Gustianingrum, C. (2021). Hubungan senam hamil dengan kejadian nyeri punggung pada kehamilan trimester III. *Jurnal Aisyah: Jurnal Ilmu Kesehatan*, 6(S1), 219-224. <https://doi.org/10.30604/jika.v6iS1.790>

- World Health Organization. (2020). WHO guidelines on physical activity and sedentary behaviour. Geneva: World Health Organization. <https://www.who.int/publications/i/item/9789240015128>
- Yildirim, P., Basol, G., & Karahan, A. Y. (2023). Pilates-based therapeutic exercise for pregnancy-related low back and pelvic pain: A prospective, randomized, controlled trial. *Turkish Journal of Physical Medicine and Rehabilitation*, 69(2), 207-215. <https://doi.org/10.5606/tftrd.2023.11054>