SHORT-TERM EFFECTS OF EYE MUSCLE EXERCISES ON BALANCE AND COORDINATION IN YOUNG HEALTHY ADULTS – A PILOT STUDY

КОРОТКОЧАСНІ ЕФЕКТИ ВПРАВ ДЛЯ ОЧНИХ М'ЯЗІВ НА РІВНОВАГУ ТА КООРДИНАЦІЮ В МОЛОДИХ ЗДОРОВИХ ОСІБ: ПІЛОТНЕ ДОСЛІДЖЕННЯ

Speh K.[1], Miletic B.[2], Vlahovic H.[3]
[1]Department of Physiotherapy, Faculty of Health Studies, University of Rijeka, Croatia
[2]Department of Clinical Medical Sciences, Faculty of Health Studies, University of Rijeka, Croatia
[3]Department of Physiotherapy, Faculty of Health Studies, University of Rijeka, Croatia
[1]ORCID:0009-0002-0294-9861
[2]ORCID:0000-0002-8787-9550
[3]ORCID:0000-0003-2508-707X

DOI https://doi.org/10.32782/2522-1795.2025.19.4.9

Abstracts

Background and Study Aim. Balance and coordination are based on the integration of signals from different systems, including proprioceptive, vestibular, and visual systems. Oculomotor function plays an important role in spatial orientation and maintaining postural stability. Previous research has shown the positive effects of oculomotor exercises in certain populations. However, their short-term effects on healthy young adults remain underexplored. The aim of the study was therefore to investigate the short-term effects of oculomotor exercises on balance and coordination in healthy young adults.

Material and Methods. Thirty healthy physiotherapy students (aged 19–25) from the Faculty of Health Studies, University of Rijeka, Croatia, took part in the study. Exclusion criteria included any condition that impaired balance or coordination. Participants performed eye muscle exercises twice a day for seven days, focusing on activation of the vestibulo-ocular reflex and lateral eye movements. Balance was assessed using the "Posturomed 202" device during a one-legged stance test, and coordination was measured using the Wall Toss Test. The results before and after the intervention were compared using the Student's t-test.

Results. After the intervention, the participants showed significant improvements in the areas of balance (increase in mean score from 64.37 to 70.03, p=0.001) and coordination (increase in repetitions of the wall toss from 17.90 to 22.40, p=0.001). Both left and right leg balance improved significantly. Our results are consistent with those of other studies, which also found a positive effect of oculomotor exercises on postural stability and balance in young people, as well as a reduction in the frequency of falls and risk of falls in older people after stroke, and improved function in children with traumatic brain injury. Despite the relatively small sample size and short duration of the intervention, the data obtained demonstrate the feasibility of integrating such exercises into training, rehabilitation, and prevention programs for different age groups.

Conclusions. Short-term eye muscle exercises improve balance and coordination in healthy young adults. These simple exercises can serve as effective preventive and rehabilitative strategies. Further studies with larger samples and longer follow-up are needed.

Key words: balance, coordination, eye muscle exercises, proprioception.

Передумови та мета дослідження. Рівновага та координація ґрунтуються на інтеграції сигналів від різних систем, зокрема пропріоцептивної, вестибулярної та зорової. Окуломоторна функція відіграє важливу роль у просторовій орієнтації та підтриманні постуральної стійкості. Попередні дослідження засвідчили позитивний вплив окуломоторних вправ у певних групах населення. Однак їх короткотривалий ефект у молодих здорових осіб не досить вивчений. Тому **метою цього дослідження** було визначення короткострокового впливу вправ для м'язів очей на рівновагу та координацію у молодих здорових людей.

Матеріал і методи. У дослідженні брали участь 30 здорових студентів-фізичних терапевтів (віком 19–25 років) факультету медичних досліджень Рієцького університету (Хорватія). Критеріями

виключення були будь-які умови, що порушують рівновагу або координацію. Учасники виконували вправи для очних м'язів двічі на день впродовж семи днів, зосереджуючись на активації вестибуло-окулярного рефлексу та латеральних рухах очей. Рівновагу оцінювали за допомогою пристрою «Posturomed 202» під час тесту стійки на одній нозі, а координацію – за допомогою тесту Wall Toss. Результати до і після інтервенції порівнювали за допомогою t-тесту Стьюдента.

Результати. **Після проведеної інтервенції учасники продемонстрували суттєве покращення** координації рухів, що стало наслідком виконання вправ, спрямованих на активацію окуломоторних м'язів. Середня кількість успішних повторень у тесті на координацію зросла з 17,90 до 22,40, що відображає істотне підвищення швидкісно-координаційних можливостей. Статистичний аналіз підтвердив значущість цього покращення (p=0,001), що вказує на реальний функціональний ефект.

Позитивні зміни також спостерігалися у показниках статичної рівноваги. Загальний баланс зріс з 64,37 до 70,03 (p=0,001). Покращення рівноваги підтверджено як для лівої, так і для правої ніг: показники лівої ноги зросли до 69,17, а правої – до 71,07 стосовно вихідних значень.

Отримані нами результати узгоджуються з даними інших досліджень, у яких також виявлено позитивний вплив окуломоторних вправ на постуральну стабільність та рівновагу в молодих людей, а також на зменшення частоти падінь і ризику падіння у літніх людей після інсульту та на покращення функцій у дітей із наслідками черепно-мозкових травм. Попри відносно невелику вибірку та коротку тривалість інтервенції, отримані дані демонструють доцільність інтеграції таких вправ у тренувальні, реабілітаційні та профілактичні програми для різних вікових груп.

Висновки. Короткотривалі вправи для очних м'язів покращують рівновагу та координацію у молодих здорових осіб. Ці прості вправи можуть бути ефективним профілактичним і реабілітаційним засобом. Потрібні подальші дослідження з більшими вибірками та тривалішим періодом спостереження.

Ключові слова: рівновага, координація, вправи для м'язів очей, пропріоцепція.

Introduction. Maintaining balance and coordinated movements results from a complex interaction among various sensory systems, including the proprioceptive, vestibular, and visual systems. Proprioception, often referred to as the "sixth sense", is the body's ability to sense its position and movement in space, which is essential for everyday activities and athletic performance [14].

The visual system, particularly oculomotor function, plays a significant role in maintaining postural stability. Oculomotor functions – such as eye movements and gaze stability – enable precise spatial orientation and integration of sensory information necessary for balance control [12; 13]. Recent research has shown that exercises targeting oculomotor function and gaze stability can improve postural stability and dynamic visual acuity in healthy adults, as demonstrated in a study by Wu and colleagues [19]. Additionally, Matsuura et al. showed that a combination of oculomotor and coordination exercises can immediately enhance balance stability in athletes [11]. Dunsky, in a review article, drew attention to and highlighted the positive impact of balance and coordination exercises on the quality of life in older adults [4]. Kang and colleagues further focused their research on the beneficial effects of eye movement training on gait function in patients who have experienced a stroke [6]. It has been proven that these exercises strengthen the eye muscles, improve oculomotor control, and activate brain regions responsible for balance. It is unequivocal that the cerebellum plays a crucial role in planning and correcting movement, and is involved in defining motor coordination, balance, and postural control [7]. When this is combined with the function of the parietal lobe, which, through visuomotor integration of vision and space, defines the body's position in space, it becomes clear how significant the impact of eye movement training can be [1]. While previous research has explored these effects in specific populations, there remains a gap in understanding their application among healthy young adults. This is particularly important when it comes to the unknowns regarding the short-term effects of exercise. This is especially important given today's very dynamic pace of life and high individual expectations. Good short-term effects with potential long-term significance can significantly increase motivation to maintain the continuity of training. Since young people

are generally healthy, the potential preventive benefits of these exercises are often overlooked. However, it can be expected that such exercises may lead to long-term improvements in attention, concentration, and spatial orientation [8]. Better postural stability and balance can reduce the risk of falls or sports-related injuries, which is particularly important in today's era of increasingly promoted active lifestyles, while also laying the foundation for long-term fall prevention in older age [15]. Improvements in motor skills and coordination can contribute to better performance in recreational sports activities, as well as in the daily life of young individuals, including improved academic performance among students, who are now facing growing expectations from society, family, and even themselves [16].

While previous studies have primarily examined oculomotor training in clinical populations or through long-term interventions, this study introduces a short-term experimental approach in healthy young adults – individuals without existing motor deficits. This provides new insights into the early neuromotor adaptations that underlie balance and coordination, making a novel contribution to existing research.

Furthermore, the use of objective posturographic assessment (Posturomed 202) enhances the precision of postural stability measurements, constituting an additional methodological advancement in the field.

Therefore, this study aimed to investigate the effects of eye muscle exercises on balance and coordination in healthy young individuals, with the hypothesis that participants engaging in oculomotor exercises would show significant improvements in balance and coordination tests compared to baseline measurements.

Materials and methods. The study included undergraduate professional students of Physiotherapy at the Faculty of Health Studies, University of Rijeka, Croatia. A total of 30 participants of both sexes, aged between 18 and 25, willing and able to provide informed consent, were examined. Exclusion criteria for the study included self-reported diseases or conditions that cause balance and coordination disorders, any acute illness or injury at the time of the study that may interfere with testing. Participants currently involved in any other research were also excluded.

Methods

The participants were measured individually. Data on gender, height, weight, and year of birth were collected before the test.

The Alternate Hand Wall Toss Test was used to assess coordination. Participants throw a ball against a wall with one hand in a forearm movement and try to catch it with the other hand from a distance of 2 meters. The ball is then thrown back against the wall and caught with the original hand. The test lasts 30 seconds, after which the number of successful repetitions is recorded [18].

The Postural Cybernetic Test with the Posturomed 202 device (Haider Bioswing, Germany) was used to assess balance. The participants stood barefoot on the balance test platform. The arms were placed next to the body, and they stood on one leg with the raised leg bent at the hip and knee and the inner ankle at knee level. Participants maintained this posture for 10 seconds in a stable position with their head facing forward. This procedure was repeated ten times for each leg [2].

The Microswing software tracked the movement of the left and right leg along the x and y axes, processed the data on the displacements and the effectiveness of maintaining static balance, and the final measurement was expressed in millimeters.

Exercises for the extraocular muscles included exercises to activate the vestibulo-ocular reflex, lateral eye movements, and an exercise called "eye push-ups". These exercises were performed continuously twice a day for 7 days. The exercises were performed with 10–15 repetitions, depending on how much fatigue the participants' eye muscles experienced.

The tests were repeated after 7 days. This short-term intervention design enables the assessment of rapid adaptive changes in oculomotor-related balance control, providing preliminary insights into early-phase neuromotor responses that have not previously been quantified in healthy

populations. These findings lay the groundwork for future, more detailed and extensive investigations.

Statistical analysis

The results obtained from the research were processed using the statistical data analysis software Statistica 14.0.0.15 (TIBCO Software Inc.). The variables balance and coordination were described using the arithmetic mean, standard deviation, and range, and their statistical significance was tested ($p < 0.05$). The collected data on participants' age, height, and weight were descriptively analyzed by calculating the arithmetic mean as a measure of central tendency and standard deviation as a measure of variability. For statistical analysis, Student's t-test for small dependent samples was used, while the Kolmogorov-Smirnov test was applied to check the normality of data distribution.

Ethical considerations

The Ethics Committee for Biomedical Research of the Faculty of Health Studies of the University of Rijeka, Croatia, approved the study on 12 April 2024 (approval number 600-05/24-01/222). The study was conducted following the principles of the Declaration of Helsinki. All participants were informed about the study procedure. Participants signed a consent form to confirm their participation in the study. The anonymity of the participants was strictly guaranteed by encrypting their data when they were entered into the database.

Research results. The study included a total of 30 participants, comprising 11 men (36.7%) and 19 women (63.3%), all aged between 19 and 25 years, with an average age of 19.77 years. Their basic anthropometric characteristics are shown in Table 1.

Table 1

Anthropological characteristics of the participants

	Range	Mean	Standard deviation
Age (years)	19–25	19.77	1.30
Height (cm)	160–198	175	10.80
Weight (kg)	49–102	70.03	12.37

The coordination of movements after the eye muscle exercises (mean = 22.40 successful repetitions, SD = 6.24) was significantly better compared to the results obtained before the eye muscle exercises were applied (mean = 17.90 successful repetitions, SD = 5.62). A statistically significant difference was found in the participants' movement coordination before and after the eye muscle exercises ($t = 5.49$, $df = 29$, $p = 0.001$), and the results are shown in Table 2.

Table 2

Coordination before and after performing eye muscle exercises

	Mean	SD	Median	IQR	p
Coordination before exercises (successful repetitions)	17.90	5.62	18	4–29	0.001
Coordination after exercises (successful repetitions)	22.40	6.24	23.50	8–32	

Notes: IQR – interquartile range, SD – standard deviation, p – p value; $p<0.05$ – statistically significant difference

The overall balance of the participants was better after the eye muscle exercises (mean = 70.03, SD = 12.05) than before the eye muscle exercises (mean = 64.37, SD = 13.83). This difference is statistically significant ($p = 0.001$) and is shown in Table 3.

Table 3

Overall balance before and after performing eye muscle exercises

	Mean	SD	Median	IQR	p
Overall balance before exercises (mm)	64.37	13.83	69	29–84	0.001
Overall balance after exercises (mm)	70.03	12.05	72.50	33–86	

Notes: IQR – interquartile range, SD – standard deviation, p – p value; $p<0.05$ – statistically significant difference

A separate analysis was also carried out for the left and right legs. A significant improvement in the balance of the left leg was found (post-training mean = 69.17, SD = 12.97; pre-training mean = 64.37, SD = 14.25), as well as for the

right leg (post-training mean = 71.07, SD = 11.92; pre-training mean = 64.47, SD = 15.56). The results are shown in Tables 4 and 5.

Table 4

Balance of the left leg before and after performing eye muscle exercises

	Mean	SD	Median	IQR
Balance left leg before exercises (mm)	64.37	14.25	69	31–85
Balance left leg after exercises (mm)	69.17	12.97	72	34–87

Notes: IQR – interquartile range, SD – standard deviation

Table 5

Balance of the right leg before and after performing eye muscle exercises

	Mean	SD	Median	IQR
Balance right leg before exercises (mm)	64.47	15.56	66	22–84
Balance right leg after exercises (mm)	71.07	11.92	74	31–85

Notes: IQR – interquartile range, SD – standard deviation

Discussion. This study extends existing knowledge by showing that even a short, seven-day program of oculomotor exercises can produce measurable improvements in balance and coordination in healthy young adults. This finding provides new evidence of the plasticity of the sensorimotor system, suggesting that targeted visual-motor activation can induce rapid neural adaptations even in individuals without motor deficits. Morimoto and colleagues conducted a study in 2011 on the effects of eye muscle exercises on postural stability and dynamic visual acuity in healthy young adults. Their results are consistent with the results of our study, as the oculomotor exercises led to an improvement in postural stability [12]. A randomized trial conducted in 2021 by Correia and colleagues aimed to investigate the effects of oculomotor exercises and gaze stability on the frequency of falls and the risk of falling in people after a stroke. This study showed the positive effect of these exercises in an elderly population affected by stroke [3]. Although the target population is different, these results suggest that eye muscle exercises can be used for long-term prevention of falls, which is certainly one of the most common health problems in older people. Sorek et al. focused their study on a younger population – children and adolescents – similar in age to our study, but they chose a population affected by moderate traumatic brain injury. They confirmed the effectiveness of oculomotor exercises and defined a treatment protocol for vestibular, i.e., oculomotor, rehabilitation [17]. Zampieri and Di Fabio investigated the effects of balance and oculomotor exercises on the improvement of gait in people with progressive supranuclear palsy and concluded that these exercises can contribute to a more successful rehabilitation [20].

In our study, a significant positive effect of oculomotor exercises on coordination was found. Hollands and colleagues hypothesized that movement of the eyes and head may influence whole-body movement coordination, based on the assumption that eye movements and eye muscle activation are important for whole-body coordination. Their results confirmed a significant contribution to eye–foot coordination, albeit in a small sample of only five participants [5].

The improvements observed in this study may result from more efficient vestibulo-ocular reflex function, which stabilizes gaze and supports postural orientation, and better integration of visual and motor information across cortical and cerebellar networks. Through repeated eye movements, the cerebellum likely undergoes subtle recalibration of sensorimotor pathways, improving coordination between sensory input and motor output and thereby refining balance control. Neuroimaging findings from previous research support this view. They show that oculomotor activity influences brain regions essential for postural regulation, particularly the cerebellum, parietal cortex, and supplementary motor area, as demonstrated by Li et al. and Matsugi et al. [9; 10]. These results align with the idea that even brief eye movement training can trigger short-term neural adaptations within these systems. Compared with earlier investigations in

post-stroke or older adults, our data reveal similar trends of improvement in a healthy population. This suggests that the underlying processes are not merely compensatory responses to deficit but reflect the brain's broader capacity for rapid neuromotor adjustment. Taken together, these findings extend the role of oculomotor training beyond rehabilitation contexts and highlight its potential as a practical approach for enhancing performance and reducing injury risk among healthy individuals. Comparing a significant positive effect of eye muscle exercises on both balance and coordination in ours study with the relatively limited existing research, which is characterised by different methods and target groups, it can be concluded that eye muscle exercises can be used in people with various neurological conditions such as stroke and progressive neurological diseases to improve recovery and the success of rehabilitation interventions, especially concerning gait. In addition, these exercises have a positive influence on balance, peripheral vision, and coordination, and thus on athletic performance and the improvement of stability and dynamic visual acuity in various dynamic sports. These facts are particularly important when it comes to promoting an active, healthy, and highly dynamic life. As the positive effects were observed after only one week, they could further motivate the young, healthy population to perform these exercises regularly. Considering the positive preventive effect of these exercises on the elderly population and their ease of use, eye muscle exercises could certainly become part of public health prevention initiatives for both young and elderly people, with potentially significant health and economic benefits.

Limitations of the study

Several limitations should be considered when interpreting the results of this study. The study included a small group of healthy young adults. All subjects came from a single institution, so it is impossible to generalize the results and project them to a wider population. The intervention period and evaluation of the effects of the intervention were very short, which makes it impossible to conclude potential long-term effects. Finally, there was no control group and no randomization of subjects in the study. However, this study aimed to collect only preliminary knowledge about how healthy individuals respond to short-term oculomotor training, which is still an unknown area. Therefore, results indicating possible positive effects in improving performance and consequently preventing injuries define the foundations for future, more extensive research.

Conclusions. In conclusion, our study suggests that even a short period of oculomotor exercises can improve balance and coordination in healthy young adults. The findings highlight the close interaction between visual and proprioceptive systems and show that the brain can adapt quickly, even after minimal training. From a practical perspective, incorporating eye movement exercises into sports routines, physiotherapy, or preventive programs could help enhance postural control, reduce injury risk, and support overall motor performance. While these results are encouraging, it is important to remember that this was a small pilot study. Future research with larger and more diverse populations, longer follow-up periods, and randomized controlled designs will be essential to confirm these effects and understand their long-term significance.

Conflicts of interest. The authors declare that there is no conflict of interest.

Funding. This research received no specific grant from any funding agency.

Data access. The data that support the findings of this study are available from the corresponding author upon reasonable individual request.

References

1. Bai, S., Liu, W., Guan, Y. (2021). The Visuospatial and Sensorimotor Functions of Posterior Parietal Cortex in Drawing Tasks: A Review. *Front Aging Neurosci*, No. 13, pp. 717002. https://doi.org/10.3389/fnagi.2021.717002.

2. Bioswing. (2025). *User Guide Posturomed*. Retrieved from: https://bioswing.de/en/wp-content/uploads/sites/9/2022/01/User-guide-BIOSWING-Posturomed-MDR-2017.pdf.

3. Correia, A., Pimenta, C., Alves, M., Virella, D. (2021). Better balance: a randomised controlled trial of oculomotor and gaze stability exercises to reduce risk of falling after stroke.

Clin Rehabil, No. 35, pp. 213–221. https://doi.org/10.1177/0269215520956338.

4. Dunsky, A. (2019). The Effect of Balance and Coordination Exercises on Quality of Life in Older Adults: A Mini-Review. *Front Aging Neurosci*, No. 11, pp. 318. https://doi.org/10.3389/fnagi.2019.00318.

5. Hollands, M.A., Ziavra, N.V., Bronstein, A.M. (2004). A new paradigm to investigate the roles of head and eye movements in the coordination of whole-body movements. *Exp Brain Res*, No. 154, pp. 261–266. https://doi.org/10.1007/s00221-003-1718-8.

6. Kang, K.Y., Yu, K.H. (2016). The effects of eye movement training on gait function in patients with stroke. *J Phys Ther Sci*, No. 28, pp. 1816–1818. https://doi.org/10.1589/jpts.28.1816.

7. Koziol, L.F., Budding, D., Andreasen, N., D'Arrigo, S., Bulgheroni, S., Imamizu, H., Ito, M., Manto, M., Marvel, C., Parker, K., Pezzulo, G., Ramnani, N., Riva, D., Schmahmann, J., Vandervert, L., Yamazaki, T. (2014). Consensus paper: the cerebellum's role in movement and cognition. *Cerebellum*, No. 13, pp. (1):151–77. https://doi.org/10.1007/s12311-013-0511-x.

8. Krause, A., Poth, C.H. (2023). Maintaining eye fixation relieves pressure of cognitive action control. *iScience*, No. 26, pp. 107520. https://doi.org/10.1016/j.isci.2023.107520.

9. Li, Q., Xu, H., Chen, W., Su, A., Fu, M.J., Walker, M.F. (2024). Short-term learning of the vestibulo-ocular reflex induced by a custom interactive computer game. *J Neurophysiol*, No. 131, pp. 16–27. https://doi.org/10.1152/jn.00130.2023.

10. Matsugi, A., Yoshida, N., Nishishita, S., Okada, Y., Mori, N., Oku, K., Douchi, S., Hosomi, K., Saitoh, Y. (2019). Cerebellum-mediated trainability of eye and head movements for dynamic gazing. *PLoS One*, No. 14, pp. e0224458. https://doi.org/10.1371/journal.pone.0224458.

11. Matsuura, Y., Sakairi, Y., Sato, H., Takiura, K. (2024). Do Combined Oculomotor and Bimanual Coordination Exercises Instantly Stabilize Balance in Athletes? *Open Access J Sports Med*, No. 15, pp. 77–89. https://doi.org/10.2147/OAJSM.S472125.

12. Morimoto, H., Asai, Y., Johnson, E.G., Lohman, E.B., Khoo, K., Mizutani, Y., Mizutani, T. (2011). Effect of oculo-motor and gaze stability exercises on postural stability and dynamic visual acuity in healthy young adults. *Gait Posture*, No. 33, pp. 600–603. https://doi.org/10.1016/j.gaitpost.2011.01.016.

13. Park, S.Y., Kang, T.W., Koo, D.K. (2024). Investigating Eye Movement and Postural Stability Relationships Using Mobile Eye-Tracking and Posturography: A Cross-Sectional Study. *Bioengineering (Basel)*, No. 11, pp. 742. https://doi.org/10.3390/bioengineering11080742.

14. Proske, U., Gandevia, S.C. (2012). The proprioceptive senses: their roles in signaling body shape, body position and movement, and muscle force. *Physiol Rev*, No. 92, pp. 1651–1697. https://doi.org/10.1152/physrev.00048.2011.

15. Safee, M.K.M., Osman, N.A.A. (2023). Relationship between postural stability and fall risk in young adults after lower limb muscle fatigue. *Healthcare in Low-Resource Settings*, No. 11, pp. S1. https://doi.org/10.4081/hls.2023.11182.

16. Salgado-Fernández, A., Vázquez-Amor, A., Alvarez-Peregrin, C., Martinez-Perez, C., Villa-Collar, C., Ángel Sánchez-Tena, M. (2022). Influence of eye movements on academic performance: A bibliometric and citation network analysis. *J Eye Mov Res*, No. 15, pp. 10.16910/jemr.15.4.4. https://doi.org/10.16910/jemr.15.4.4.

17. Sorek, G., Katz-Leurer, M., Gagnon, I., Chevignard, M., Stern, N., Fadida, Y., Kalderon, L., Shaklai, S., Schneider, K. (2021). The development and the inter-rater agreement of a treatment protocol for vestibular/oculomotor rehabilitation in children and adolescents post-moderate-severe TBI. *Brain Inj*, No. 35, pp. 1542–1551. https://doi.org/10.1080/02699052.2021.1972454.

18. Tanineh, W., Halaweh, H. (2023). Cardiorespiratory Fitness, Motor Coordination, and Academic Achievement in School Students (11–13 years). *Glob Pediatr Health*, No. 10, pp. 2333794X231207311. https://doi.org/10.1177/2333794X231207311.

19. Wu, Y., Zhou, X., Jung, Y., Kim, M. (2024). Effect of Gaze Stabilization Exercise with Balance Exercise on Static and Dynamic Balance Function of Healthy Young Adults: A Randomized Controlled Trial. *KSPM*, No. 19, pp 1–16. https://doi.org/10.13066/kspm.2024.19.2.1.

20. Zampieri, C., Di Fabio, R.P. (2008). Balance and eye movement training to improve gait in people with progressive supranuclear palsy: quasi-randomized clinical trial. *Phys Ther*, No. 88, pp. 1460–1473. https://doi.org/10.2522/ptj.20070302.

Прийнято до публікації: 12.11.2025
Опубліковано: 31.12.2025
Accepted for publication on: 12.11.2025
Published on: 31.12.2025