ISSN: 2476-5279; International Journal of Musculoskeletal Pain Prevention. 2025;10(2): 1229-1235

Comparison of the Effects of the Vivifrail and Locotra Exercise Programs on Motor Performance and Quality of Life in Older Adults with Locomotive Syndrome

ARTICLEINFO

Article Type
Original Article

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How to cite this article

Rashidy P Rahnama N, Comparison of the Effects of the Vivifrail and Locotra Exercise Programs on Motor Performance and Quality of Life in Older Adults with Locomotive Syndrome. Int.J. Musculoskelet. Pain. Prev. 2025; 10(2) 1229-1235.

ABSTRACT

Aims: Aging causes locomotive syndrome, which is characterized by difficulties during this period. The present study explores the effects of the Vivifrail and Locotra exercise programs on motor performance and quality of life in older adults.

Method and Materials: In this study, 30 elderly individuals aged 65 and above from Isfahan, Iran, were purposefully selected and randomly assigned to either the Vivifrail group (N = 15) or the Locotra group (N = 15). The intervention lasted eight weeks, during which pre- and post-tests were conducted using the Timed Up and Go test, Loco-check questionnaire, and the OPQOL-35 questionnaire. Analysis of covariance was used to compare the effects of the two exercise programs, controlling for pre-test values ($P < 0.05$).

Findings: The results showed that the effect of the pre-test variable on Older People's Quality of Life Questionnaire - 35 items (OPQOL) scores, loco-check scores, and Timed Up and Go (TUG) was significant on the post-test values ($p < 0.001$). After controlling for the effect of the pre-test, there was no significant difference in the average post-test OPQOL scores ($p = 0.622$, $\eta^2 = 0.011$) and TUG time ($p = 0.064$, $\eta^2 = 0.141$) between the two groups of elderly individuals. However, a significant difference was observed in the Loco-Check questionnaire scores between the elderly individuals in the two groups ($p = 0.034$, $\eta^2 = 0.181$).

Conclusion: This study highlights the importance of structured exercise programs in improving physical capacity and addressing locomotive syndrome among older adults. While Vivifrail and Locotra demonstrated benefits, their varying effects on specific outcomes indicate the need for targeted interventions.

Keywords: Aging, Locomotive Syndrome, Performance

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10.22034/IJMPP.10.2.1229

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Article History
Received: Apr 12, 2025
Accepted: Jun 12 2025
ePublished: Jun30, 2025

Introduction

Aging refers to a stage of life in which individuals gradually experience physical, psychological, and social changes [1]. According to the World Health Organization (WHO) report, in 2020, the number of individuals aged 60 and older worldwide exceeded 1.4 billion, projected to reach 1.5 billion by 2030 [2]. This stage typically begins at 65 and is associated with a decline in physical abilities and changes in Quality of Life (QOL) [3]. Aging is accompanied by issues such as a decline in physical and cognitive skills, sensory problems, chronic diseases, feelings of loneliness, and the need for care [4]. It leads to syndromes such as frailty, confusion, falls, chronic pain, and insomnia, which require social and medical attention and support[5]. Geriatric Syndromes (GS) refer to common clinical conditions that often occur in older adults, which are not necessarily linked to a specific disease but can significantly impact their health and QOL [6]. These syndromes include various issues such as frailty, falls, incontinence, cognitive impairment, polypharmacy, and Locomotive Syndrome (LS)[7]. One specific syndrome that has garnered attention in recent years is LS, which is characterized by a decline in physical mobility and function due to musculoskeletal disorders [8]. Locomotive Syndrome was defined and elaborated in 2007 by the Japanese Orthopedic Association to facilitate the early identification of older adults at risk and to reduce the number of elderly individuals requiring nursing care [9, 10].

Despite the well-documented benefits of exercise therapy,

[DOI: 10.22034/IJMPP.10.2.1229]

many patients face barriers to Locomotive Syndrome characterized by conditions such as osteoarthritis, osteoporosis, and sarcopenia, which significantly impact physical capacity in older adults, leading to reduced mobility and an increased risk of falls [11, 12]. Approximately 30% of older adults are affected by LS, resulting in limitations in activities of daily living and a decreased quality of life (QOL). [10].

The decline in physical capacity limits individuals' ability to engage in social and physical activities and increases their susceptibility to physical stressors, ultimately impacting their mental health and ability to maintain functional independence [13]. Addressing LS is crucial for preserving physical capacity and enhancing the overall well-being of older adults [14]. Regular exercise is essential for older adults to improve physical capacity, muscle strength, flexibility, and balance, manage pain, and enhance mental health, ultimately leading to greater independence and a better QoL [8, 15]. LOCOTRA is a locomotion training program that aims to improve and sustain standing and gait functions in older adults through safe, home-based exercises like squatting and single-leg standing with eyes open [10]. A study showed that the Locotra positively affects the improvement of LS symptoms by enhancing balance, coordination, and muscle strength [16].

Vivifrail is an exercise program designed to enhance frail older adults' physical capacity and overall well-being through strength, balance, flexibility, and endurance training [17]. A study showed that the Vivifrail training program is an effective and safe treatment for improving physical capacity in elderly patients with frailty or pre-frailty [18]. Although exercise is widely recommended for managing LS, evidence comparing the effectiveness of specific programs remains limited. The Vivifrail and Locotra programs offer structured approaches targeting mobility and functional independence in older adults, yet no direct comparison has been made regarding their impact on physical performance and QOL in individuals with LS. Given the rising prevalence of LS and its association with falls and reduced independence, identifying the most effective intervention is essential.

Method and Materials

The population of this research consisted of 50 elderly individuals from the Rangin Kaman Sepid Daycare Center located in Isfahan, Iran. Based on the inclusion and exclusion criteria, 30 eligible individuals aged over 65 years were purposefully selected as the research sample. After participating in an orientation session and being fully informed about the study conditions, they voluntarily indicated their willingness to participate by completing a consent form. The sample size was determined using G*Power statistical software, based on an analysis of covariance for the test, with a significance level of 5% ($\alpha = 0.05$), a power of 80% ($\beta = 0.2$), and a large effect size ($d = 0.6$). They were then randomly assigned to the Vivifrail group ($n = 15$) and the Locotra group ($n = 15$).

The inclusion criteria included being female, at least 65 years old, without any physical or cognitive limitations that would prevent exercise, scoring one or higher on the Loco-check questionnaire, and signing the informed consent form. The exclusion criteria involved withdrawal from the exercise program, inability to perform exercises, absence from three consecutive sessions or a total of eight training sessions, and failure to participate in pre-test and post-test assessments. The research process began with obtaining the necessary permissions and an introduction letter from the Isfahan Provincial Welfare Department. Coordination meetings were held with the management of the Rangin Kaman Sepid Daycare Center to discuss the safety of the elderly and the necessary training. Eligible individuals were then introduced, and a comprehensive briefing session was conducted to explain the programs, potential benefits, risks, and proper execution of the exercises.

Participants were asked to refrain from participating in other exercise programs during the intervention to avoid potential conflicting effects. They were assured that their personal information would remain

[DOI: 10.22034/IJMPP.10.2.1229]

confidential and would be reported only in aggregate form. Participants were also allowed to withdraw from the study at any time. After the management's review and approval, the Loco-check questionnaire was administered as an entry criterion for the exercise protocols. A demographic questionnaire was given to all participants, followed by pre-tests, including the Timed Up and Go (TUG) test, Loco-check, and a 35-item quality of life questionnaire for the elderly (OPQOL-35). For participants with low literacy, the questionnaires were completed through interviews. The training phase lasted eight weeks, with three sessions per week held in the gym equipped at the Rangin Kaman Sepid Daycare Center. Post-tests, including the TUG, Loco-check, and the OPQOL_35 questionnaire, were administered after the training phase, with interviews also conducted for participants with low literacy.

In this study, the following tests were completed. The Timed Up and Go test is a widely used assessment for evaluating motor performance and balance, particularly in older adults and individuals with mobility issues. The test involves the participant sitting in a chair, and upon hearing "go," they stand up, walk three meters to a designated marker, turn around, return to the chair, and sit down again while the total time taken is measured [19]. The validity and reliability of this test have been examined in a study by Aslankhani et al. (2015) [20].

The Older People's Quality of Life Questionnaire - 35 items (OPQOL-35) is a tool designed to assess the quality of life (QoL) in older adults. It consists of 35 items that cover various aspects of life, including physical health, psychological well-being, social relationships, environment, and independence [21]. The validity and reliability of this questionnaire were examined by Nikkhah et al. (2018), and the results indicated that the questionnaire possesses appropriate validity and reliability [22].

The Loco-check self-assessment questionnaire is a tool for diagnosing LS in the elderly. It consists of seven key questions regarding motor status, balance, and the need for assistance in daily activities. Even if one of the questions receives a positive response, it indicates that the elderly individual has LS, and a higher score reflects more advanced levels of this syndrome [23]. The results of the studies showed that this questionnaire has appropriate validity and reliability[24]. In this study, we compared the scores of two groups after they completed the protocols.

The multi-dimensional training protocol by Vivifrail was designed to improve physical performance and reduce the risk of falls in older adults. This protocol categorizes individuals into four groups based on scores obtained from functional tests, including the SPPB, TUG, and 6MWTT, as well as cognitive assessments. The groups include: frail (scores 0 to 3), pre-frail (4 to 6), at-risk (7 to 9), and fit individuals (10 to 12). Those with cognitive impairments and at risk of falling receive specialized training. Each group's training sessions are supervised by a coach, occurring thrice a week for 45 to 60 minutes over eight weeks. To facilitate the execution of the exercises, a translated guidebook is provided to each individual in the group, and the coach utilizes the Vivifrail training app for greater accuracy. The exercises are designed based on the progressive protocol of Vivifrail, and the training load is increased by 0.5 kg using water bottles, elastic bands, balls, and sandbags, according to each individual's capacity. The Vivifrail exercises encompass several different aspects. Strength training begins with sets of ten repetitions, with the load adjusted so that the individual can complete 30 repetitions. Additionally, cardiovascular exercises include walking and resting at specified intervals. Balance exercises involve walking over obstacles and maintaining balance for a designated duration. Finally, flexibility exercises are performed by maintaining balance with appropriate rest periods.

The Locotra exercise intervention, proposed by the Japanese Orthopedic Association, is designed to improve and control the symptoms of LS. This program includes two main exercises: standing on one leg and squats, and two supplementary exercises: calf raises and forward lunges, along with exercises to strengthen the quadriceps and

[DOI: 10.22034/IJMPP.10.2.1229]

hamstrings. These exercises were conducted for eight weeks, three sessions per week, under the supervision of a coach. Each session consisted of 15 minutes of warm-up, 20 minutes of main exercises, and 10 minutes of cool-down, totaling 60 minutes. This structure helps participants effectively increase their physical fitness and manage the symptoms of movement syndrome.

Analysis was performed at both descriptive and inferential levels. Mean and standard deviation indices were used at the descriptive level. At the inferential level, to compare the effects of the Vivifrail exercise program and Locotra exercises on QOL, loco-check questionnaire scores, and TUG, analysis of covariance was used, controlling for the initial values of these variables (pre-test). The underlying assumptions of the model, including the normality of the error distribution, homogeneity of error variance, and homogeneity of regression slopes, were examined and confirmed to be valid. Independent t-tests were conducted to compare the individual characteristics of the elderly in both groups, considering the normality of the data distribution. The tests were performed at a five percent error level using version 27 of SPSS software.

Findings

The Shapiro-Wilk test results indicated that the data followed a normal distribution. Table 1 displays the demographic characteristics of participants in both groups. There were no significant differences in demographic data among the study groups.

The results of Table 2 showed that the effect of the pre-test variable on OPQOL scores, loco-check scores, and TUG was significant on the post-test values ($p < 0.001$). After controlling for the effect of the pre-test, there was no significant difference in the average post-test OPQOL scores ($p = 0.622$, $\eta^2 = 0.011$) and TUG time ($p = 0.064$, $\eta^2 = 0.141$) between the elderly individuals in the two groups. However, a significant difference was observed in the Loco-Check questionnaire scores between the elderly individuals in the two groups ($p = 0.034$, $\eta^2 = 0.181$).

Table 1) Demographic characteristics of individuals

Variables	Group	Mean± SD	P-value
Age (years)	Vivifrail	73.14±6.50	.191
	Locotra	70.00±5.20	
Height (cm)	Vivifrail	151.57±5.98	.114
	Locotra	155.50±6.20	
Height (cm)	Vivifrail	66.36±12.92	.975
	Locotra	66.50±9.71	
Weight (kg)	Vivifrail	29.03±6.48	.422
	Locotra	27.38±2.84	

Table 2) Results of the Analysis of Covariance

Variable	Test phase	Vivifrail		Locotra		Covariance analysis test results	
		Mean	SD	Mean	SD		
QOL scores	Pre-Test	112.07	23.02	125.25	18.21	p=0/001	p=0/622
	Post-Test	134.64	20.09	139.00	18.89	η^2= 0 /382	η^2= 0.011
	Adjusted Post-Test	138.15	16.09	134.96	16.11		
Loco-check Questionnaire Scores	Pre-Test	5.43	1.55	3.67	1.67	p<0/001	p=0/034
	Post-Test	3.79	1.42	2.75	1.96	η^2=0/853	η^2=0/181
	Adjusted Post-Test	3.00	0.71	3.67	0.72		
TUG (seconds)	Pre-Test	9.51	3.44	7.83	2.85	p<0/001	p=0/064
	Post-Test	6.71	2.31	6.54	2.75	η^2=0/764	η^2=0/141
	Adjusted Post-Test	6.18	1.27	7.17	1.27		

Discussion

The present study examined the impact of two structured exercise programs, Vivifrail and Locotra, on motor performance and OPQOL in

[DOI: 10.22034/IJMPP.10.2.1229]

older adults with LS. The results indicated that both exercise programs could improve OPQOL, motor performance, and LS. However, their effects varied in certain aspects. The results of the TUG test showed that both exercise programs had a positive impact on motor performance; however, a significant difference in Loco-check scores was observed between the two groups, indicating the different effects of these programs on specific aspects of motor performance. This result is supported by previous research [25]. These findings emphasize the importance of designing exercise programs tailored to the particular needs of each individual [26]. Prior research indicates that regular physical activity can help improve the physical and mental condition of elderly individuals [27]. Exercise helps improve physical performance, increases strength and balance, and reduces the risk of diseases in the elderly [28]. Exercise interventions for older adults significantly enhance muscle strength and endurance, which are crucial for maintaining mobility and reducing the risk of falls [29]. Training programs focused on balance and coordination help older adults improve their stability, which is essential for daily activities and preventing injuries [30]. Exercise interventions stimulate the nervous system, leading to better reaction times and improved motor coordination [31]. Incorporating stretching and mobility exercises into training programs enhances flexibility, which is vital for maintaining a full range of motion [32]. Exercise improves cardiovascular health by enhancing blood circulation, ensuring muscles receive adequate oxygen and nutrients, thereby improving overall motor performance [33]. Physical activity can boost self-esteem and reduce anxiety and depression in older adults, further contributing to better motor performance and Qol [34]. The results showed no significant difference in OPQOL-35 scores between the two groups, indicating that both exercise groups were effective in improving the QOL of elderly individuals, consistent with the study by Schwartz (2025) [35]. Exercise plays a crucial role in improving the quality of life (QOL) for the elderly by enhancing physical strength and endurance, improving balance and coordination, reducing anxiety and depression, strengthening social relationships, and decreasing the risk of chronic diseases [36, 37]. Additionally, exercise can improve sleep quality and increase a sense of community belonging, ultimately leading to a more vibrant and healthier life [38, 39]. Exercise programs such as the Multi-component and Locotra can be considered effective interventions to address the challenges associated with aging and geriatric syndromes [14, 28]. Exercise has a positive impact on LS, including muscle strengthening, improved balance, increased flexibility, reduced pain, and enhanced mood [40].

Despite some strength, this study has limitations, including a small sample size and a lack of diversity in the population being studied. Additionally, the absence of long-term follow-up to assess the sustained impacts of the exercise programs can also be considered a limitation. Ultimately, the findings of this study suggest that structured exercise programs can play a crucial role in enhancing the quality of life (QOL) and motor performance of older adults. However, further research is needed to understand the effects of these programs better and identify the best practices for their implementation.

Conclusion

This study highlights the importance of structured exercise programs in improving physical capacity and addressing Locomotive Syndrome among older adults. While Vivifrail and Locotra demonstrated benefits, their varying effects on specific outcomes indicate the need for targeted interventions.

Acknowledgment

The authors would like to thank all participants.

Authors' Contribution

All authors participated in the design and conduct of the research. The manuscript was written and confirmed by all authors.

Conflicts of Interest

The researchers claim no conflicts of interest.

Ethical Permissions

The ethical approval for the research is granted under the code IR.UI.REC.1403.101 by

[DOI: 10.22034/IJMPP.10.2.1229]

the Research Ethics Committees of the University of Isfahan.

Funding

The General Welfare Organization of Isfahan Province in Iran supports this study.

Referances

1. 1.Tran M and Reddy PH. Defective Autophagy and Mitophagy in Aging and Alzheimer's Disease. Front. Neurosci. 2021; 14:612757. doi: 10.3389/fnins.2020.612757
2. Organization WH. Ageing and Health. 2020.
3. Tucker E, Luscombe-Marsh N, Ambrosi C, Lushington K. Nutritional status and quality-of-life of older adults in aged care: A systematic review and meta-analysis. Exp Gerontol. 2022;162:111764. doi: 10.1016/ j.exger. 2022.111764.
4. Chan AKY, Tamrakar M, Jiang CM, Lo ECM, Leung KCM, Chu CH. Common Medical and Dental Problems of Older Adults: A Narrative Review. Geriatrics (Basel). 2021;6(3):76. doi: 10.3390/geriatrics6030076.
5. Cheever CR, Shams RB, Willingham KR, Sim H, Cook LM, Ahmidouch MY, et al. Understanding constipation as a geriatric syndrome. Geriatr Nurs. 2025;61:440-448. doi: 10.1016/j.gerinurse.2024.12.012.
6. Wang L-Y, Hu Z-y, Chen H-x, Tang M-l, Hu X-y. Multiple geriatric syndromes in community-dwelling older adults in China. SR. 2024;14(1):3504. doi.org/10.1038/s41598-024-54254-y
7. Calafat M, Kochar B, Ananthakrishnan AN. A Comprehensive Review of Geriatric Syndromes and Assessment in Older Adults With Inflammatory Bowel Diseases. Clin Gastroenterol Hepatol. 2025;23(7):1088-1101. doi: 10. 1016/ j.cgh.2024.09.042.
8. Ikemoto T, Inoue M, Nakata M, Miyagawa H, Shimo K, Wakabayashi T.Ushida T. Locomotive syndrome is associated not only with physical capacity but also degree of depression. J Orthop Sci. 2016;21(3):361-5. doi: 10.1016/j.jos.2016.01.003.
9. Sadeghimahalli N, Hosseini MA, Rahgozar M, Norouzi Tabrizi K. [Locomotive Syndrome in the Elderly and Its Risk Factors (Persian)]. Salmand: Iranian Journal of Ageing. 2019; 13(Special Issue):604-613. https://doi.org/10.32598/SIJA.13.Special-Issue. 604// doi.org/10.32598/SIJA.13.Special-Issue.60
10. Nakamura K, Ogata T. Locomotive Syndrome: Definition and Management. Clin Rev Bone Miner Metab. 2016;14(2):56-67. doi: 10.1007/s12018-016-9208-2.
11. Muramoto A, Imagama S, Ito Z, Hirano K, Ishiguro N, Hasegawa Y. Physical performance tests are useful for evaluating and monitoring the severity of locomotive syndrome. J.Orthop. Sci. 2012;17 (6):782-8. https://doi.org/10.1007/s00776-012-0283-z
12. Veley, A., Degen, M., Rimmer, L., Collins, L., Dorocicz, I., Smith, J., et al. Do measures of physical capacity and walking self-efficacy relate to frailty in older adults with difficulty walking outdoors? A secondary data analysis. *Disabil. Rehabil 2023*, 46(17):3905–3912. https://doi.org/10.1080/09638288.2023.2258336
13. Lamb SE, Keene DJ. Measuring physical capacity and performance in older people. Best Pract Res Clin Rheumatol. 2017;31(2):243-254. doi: 10.1016/j.berh.2017.11.008
14. Ikemoto T, Arai Y-C. Locomotive syndrome: clinical perspectives. Clin Interv Aging. 2018;13:819–827. doi: 10.2147/CIA.S148683
15. Akai M, Doi T, Seichi A, Okuma Y, Ogata T, Iwaya T. Locomotive Syndrome: Operational Definition Based on a Questionnaire, and Exercise Interventions on Mobility Dysfunction in Elderly People. Clin Rev Bone Miner Metab. 2016;14:119-130. doi: 10.1007/s12018-016-9210-8.
16. Kikuchi, C., Yamaguchi, K., Kojima, M. et al. Comparative trial of the effects of continuous locomotion training provided at pharmacies: a pilot study. J Pharm Health Care Sci 2020; 6(24). doi.org/10.1186/s40780-020-00182-8.
17. Sánchez-Sánchez JL, de Souto Barreto P, Antón-Rodrigo I, Ramón-Espinoza F, Marín-Epelde I, Sánchez-Latorre M, et al. Effects of a 12-week Vivifrail exercise program on intrinsic capacity among frail cognitively impaired community-dwelling older adults: secondary analysis of a multicentre randomised clinical trial. Age and ageing. 2022;51(12):afac303.doi: 10.1093/ageing/afac303
18. Casas-Herrero Á, Sáez de Asteasu ML, Antón-Rodrigo I, Sánchez-Sánchez JL, Montero-Odasso M, et al.Effects of Vivifrail multicomponent intervention on functional capacity: a multicentre, randomized controlled trial. J Cachexia Sarcopenia Muscle. 2022;13(2):884-893. doi: 10.1002/ jcsm. 12925.
19. Zhou J, Yao Q, Han R, De Bock P, Vassard-Yu G, Hallemans A, et al. Reliability and Validity of Instrumented Timed Up and Go Test in Typical Adults and Elderly: A Systematic Review. Arch Phys Med Rehabil. 2025:S0003-9993(25)00545-3. doi: 10.1016/j.apmr.2025.03.001.
20. Aslankhani MA, Farsi A, Fathirezaie Z, Zamani Sani SH, Aghdasi MT. Validity and reliability of the timed up and go and the anterior functional reach tests in evaluating fall risk in the elderly. salmand:Iranian Journal of Ageing. 2015;10(1):16-25.
21. Bilotta C, Bowling A, Nicolini P, Casè A, Pina G, Rossi SV, et al. Older People's Quality of Life (OPQOL) scores and adverse health outcomes at a one-year follow-up. A prospective cohort study on older outpatients living in the community in Italy. Health Qual Life Outcomes. 2011;9:72. doi: 10.1186/1477-7525-9-72.
22. Nikkhah M, Heravi-Karimooi M, Montazeri A, Rejeh

[DOI: 10.22034/IJMPP.10.2.1229]

N, Sharif Nia H. Psychometric properties the Iranian version of Older People's Quality Of Life questionnaire (OPQOL). Health Qual Life Outcomes. 2018;16(1):174. doi: 10.1186/s12955-018-1002-z.
23. Kobayashi T, Morimoto T, Shimanoe C, Ono R, Otani K, Mawatari M. Development of a tool for screening the severity of locomotive syndrome by the loco-check. J Orthop Sci. 2022;27(3):701-706. doi: 10.1016/j.jos.2021.03.011.
24. .Sadeghi Mahall N, Hoseini M-A, Rahgozar M, Norouzi Tabrizi K. Comparing Psychometric Properties of GLFS-5 With GLFS-25 for Screening Locomotive Syndrome in Community-dwelling Iranian Older People. Iranian Rehabilitation Journal. 2021;19(4):417-24.doi: 10.32598/irj.19.4.875.2
25. Keele, S. W., Cohen, A., & Ivry, R. (1990). Motor programs: Concepts and issues. In M. Jeannerod (Ed.), *Attention and performance 13: Motor representation and control* (pp. 77–110). Lawrence Erlbaum Associates, Inc.
26. Li G, Li X, Chen L. Personally tailored exercises for improving physical outcomes for older adults in the community: A systematic review. Arch Gerontol Geriatr. 2022;101:104707. doi: 10.1016/j.archger.2022.104707.
27. De Sousa RAL, Rocha-Dias I, de Oliveira LRS, Improta-Caria AC, Monteiro-Junior RS, Cassilhas RC. Molecular mechanisms of physical exercise on depression in the elderly: a systematic review. Mol Biol Rep. 2021 Apr;48(4):3853-3862. doi: 10.1007/s11033-021-06330-z.
28. Sharma A, Sharma N, Chahal A. Home care program and exercise prescription for improving quality of life in geriatric population with knee osteoarthritis: A systematic review and meta-analysis. J Bodyw Mov Ther. 2024;40:1645-1656. doi: 10.1016/ j.jbmt.2024.09.003.
29. Li Y, Gao Y, Hu S, Chen H, Zhang M, Yang Y, Effects of multicomponent exercise on the muscle strength, muscle endurance and balance of frail older adults: A meta-analysis of randomised controlled trials. J Clin Nurs. 2023;32(9-10):1795-1805. doi: 10.1111/jocn.16196.
30. Mak TCT, Wong TWL, Ng SSM. Visual-related training to improve balance and walking ability in older adults: A systematic review. Exp Gerontol. 2021;156:111612. doi: 10.1016/j.exger. 2021.111612.
31. Daniela M, Catalina L, Ilie O, Paula M, Daniel-Andrei I, Ioana B. Effects of Exercise Training on the Autonomic Nervous System with a Focus on Anti-Inflammatory and Antioxidants Effects. Antioxidants (Basel). 2022;11(2):350. doi: 10.3390/antiox11020350.
32. Kim M, Kuruma H, Thawisuk C. The use of elastic band exercise as a physical therapy intervention for improving shoulder function in older adults: a scoping review. J Exerc Rehabil. 2021;17(5):313-318. doi: 10.12965/jer.2142574.287.
33. Grässler B, Thielmann B, Böckelmann I, Hökelmann A. Effects of different exercise interventions on heart rate variability and cardiovascular health factors in older adults: a systematic review. Eur Rev Aging Phys Act. 2021;18(1):24. doi: 10.1186/s11556-021-00278-6.
34. Baldelli G, De Santi M, De Felice F, Brandi G. Physical activity interventions to improve the quality of life of older adults living in residential care facilities: a systematic review. Geriatr Nurs. 2021;42(4):806-815. doi: 10.1016/ j.gerinurse . 20 21.04.011
35. Schwartz BD, Liu H, MacDonald EE, Mekari S, O'Brien MW. Impact of physical activity and exercise training on health-related quality of life in older adults: an umbrella review. Geroscience. 2025. doi: 10.1007/s11357-024-01493-6.
36. Wei L, Hu Y, Tao Y, Hu R, Zhang L. The effects of physical exercise on the quality of life of healthy older adults in China: A systematic review. Front. Psychol. 2022;13: doi.org/10.3389/ fpsyg. 2022. 895373
37. Zhang SK, Gu ML, Zhang T, Xu H, Mao SJ, Zhou WS. Effects of exercise therapy on disability, mobility, and quality of life in the elderly with chronic low back pain: a systematic review and meta-analysis of randomized controlled trials. J Orthop Surg Res. 2023;18(1):513. doi: 10.1186/s13018-023-03988-y.
38. Alnawwar MA, Alraddadi MI, Algethmi RA, Salem GA, Salem MA, Alharbi AA. The Effect of Physical Activity on Sleep Quality and Sleep Disorder: A Systematic Review. Cureus. 2023;15(8):e43595. doi: 10.7759/cureus.43595.
39. Kennedy RA, McKenzie G, Holmes C, Shields N. Social Support Initiatives That Facilitate Exercise Participation in Community Gyms for People with Disability: A Scoping Review. Int J Environ Res Public Health. 2022;20(1):699. doi: 10.3390/ ijerph20010699
40. Rungruangbaiyok C, Ohtsuka H, Lektip C, Nawarat J, Miyake E, Aoki K, et al. Effectiveness of physical therapy for locomotive syndrome: Study protocol for a systematic review and meta-analysis. medRxiv. 2024: 11. doi: 10.1101/ 2024.11.08.24317013

[DOI: 10.22034/IJMPP.10.2.1229]