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Effect of Short-Term Multicomponent Exercise Intervention on Motor Fitness and Gait Performance in Middle-Aged Women: A Randomized Controlled Trial

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Abstract

Background*:** Middle age involves shifts in neuromuscular and functional aspects that impact women's motor fitness and gait. Among women in this age range, balance, coordination, reaction time, and gait pattern declines can increase the risk of functional limitations later in life. Although multicomponent exercise programmes have proven benefits for older women, there is a lack of evidence for middle-aged women, particularly for short-duration interventions. ***Purpose: The purpose of this pilot study was to assess the impact of a six-week multicomponent exercise programme on some motor fitness components and gait patterns of middle-aged women. ***Methods:*** A randomized controlled trial was conducted on 40 apparently healthy women aged 40-55 years old into two groups. Based on a non-repeated random number, all the volunteers were divided into two groups; control group (N=20) and experimental group (N=20). The experimental group completed a supervised six-week multicomponent exercise program, while the control group maintained their usual daily activities. The motor fitness variables and their assessing tools included reaction time (ruler drop test), hand-eye coordination (alternate-hand wall-toss test), and balance (unipedal balance test). The 10 m walk test was used to assess gait performance. The intervention program was conducted four days a week for about 50 minutes, with difficulty increased each week. ***Results***: The experimental group offered improvements in all of the assessed components of motor fitness and in gait performance. However, between group differences did not reach significance, although in the experimental group there were positive changes in reaction time, coordination, balance, and speed of gait. Conclusion: Positive trends were observed in motor fitness and gait parameters in middle-aged women after participating in a six-week, multicomponent exercise program. Findings demonstrate that short-term, structured multicomponent exercise programs may be effective in preventing decline in functional mobility and midlife neuromuscular efficiency; however, longer term exercise interventions are required to achieve significant improvements.

Keywords: Multi-Component Exercise, Middle Aged, Women, Fitness.

INTRODUCTION

The middle stage of life signifies an essential transition for women. It brings with it the termination of child bearing years and the initiation of systemic losses in neuromuscular capacity, sensory integration, and overall movement (Park *et al*., 2008). During this stage of life, women begin to experience changes in the control of their balance, the coordination and timing of their body movements, their reaction speed, and their patterns of walking. These changes are often prior to the onset of age-related declines of muscle and the central nervous system, and lifestyle factors, such as inactivity, inadequate physical movement, and psychosocial factors. These declines can be chronic and without intervention, can lead to increase the mobility and quality of life. Motor fitness is vital to adjust this changing environmental and task demands in everyday life. Problems in these areas are often manifested in walking patterns, such as fewer and smaller steps, and an overall reduction in walking speed. All of these factors are well known indicators of reducing the overall functioning of the body (Lord *et al*., 1996). Increasing physical activity for older women has been advocated for as a solution to these age-related declines in functional capabilities.

Combining several exercise components such as balance, strength, coordination, agility, and aerobic

activities, or multicomponent exercise programs, have shown some promise. In studies involving older women, multicomponent training has positively influenced functional fitness, postural stability, and quality of life (Kang *et al*., 2015; Suzuki *et al*., 2018). It is likely that such programs impact several physiological systems simultaneously, leading to better outcomes than single-mode training regarding practical activities and exercising. Balance and exercising together have been shown to improve outcomes meaningfully and quickly. A six-week balance exercise program in elderly women led to postural control improvements that were dependent on the level of intensity in the program (Borysiuk *et al.*, 2018). This exemplified the rapid and even substantial responsiveness of postural control systems in women. In non-strict conditions, older women who regularly exercised had better balance and faster reaction times than older women who did not exercise (Antônio Gomes de Resende *et al*., 2019). This emphasizes the importance of classical training in facilitating the control of muscular responses and the coordination of the entire muscular system. Another important functional health measure in aging women is gait performance. Optimizing stability and efficiency in walking is an aspect of functional health that can be positively influenced by exercise, as demonstrated in some randomized control trials. Improvements in the stability and efficiency of walking were matched with favourable changes in gait parameters after the exercise (Nikravesh *et al*., 2025).

In community-dwelling elderly women, combined exercise training resulted in increased positive changes in gait patterns and balance ability (Lord *et al.*, 1996; Park *et al*., 2008). More recent studies indicate that multicomponent exercise, particularly, compared to strength training alone, is effective in improving gait ability (Wolf *et al*., 2020). Step-based coordination exercises, a form of task-specific training, have improved various training components of gait after six-week training protocols (Nikravesh *et al.*, 2025). The majority of this research has concentrated on older women; in comparison, middle-aged women have been overlooked, although this is a critical stage for early prevention. The research done on older populations is evidential; longer interventions lasting several months to half a year, yield positive changes in body composition, functional fitness, and fall-related outcomes (Rodrigues *et al*., 2023; Schneider *et al*., 2025; Thaiyanto *et al*., 2021). However, even short activities provide positive outcomes. It appears that well designed, multicomponent activities tend to be particularly effective. For middle-aged women, researching these short-duration activities may be significant in identifying early functional changes and preventative strategies. Also, a majority of extant studies tend to be more focused on general functional fitness or fall risk with limited patching of specific motor fitness components and gait patterns in middle-aged women. Researching the relationship between balance, coordination, and reaction time, and gait adaptations following a short-term multicomponent exercise programme may help improve exercise prescriptions for this population. These parameters may improve early enough to delay the more severe age-related decline in mobility later in life. From this point of view, the study examines a six-week multicomponent exercise programme and its impact on selected motor fitness components, including balance, coordination, and reaction time, and gait patterns in middle-aged women. This pilot study seeks to provide evidence for early, comprehensive exercise interventions to help preserve mobility and functional independence in women in a very short time and at an early functional transition stage.

METHODOLOGY

Study Design:

Randomized controlled trial design was adopted to identify the impact of a six-week, multi-component exercise programme, on the motor fitness and gait parameters of middle-aged women. Randomization was done using the Mathcracker (Non-Repeated Random Numbers Generator) software (Spatenkova *et al.,* 2023). The randomization process completed the unbiased and non-overlapping allocation of participants to the different study groups. This study design was selected to create a robust cause and effect relationship between the selected intervention and the defined outcome. The study designed was approved and supervised by the Departmental Research Committee (DRC), Registration No.:3260001 (Ref. No. KU/Ph.D.-1412 of 2024).

Location of the Study:

The study was conducted in Raiganj, West Bengal, an eastern state of India. Study participants were involved from the local community using community announcements and personal contact. All testing and training sessions were held in the same community location and in order to establish and maintain consistent testing conditions, utilized a community facility that was easily accessible to all participants.

Participants:

A total of 40 apparently healthy, middle-aged women between the ages of 40 and 55 years were selected for the study. Potential study participants were screened to ensure that they did not possess any of the following exclusionary criteria: neurological disorders; recent musculoskeletal injuries; balance impairments; or any medical conditions which would limit or preclude the individual's ability to participate in physical activity. Women who had participated in structured exercise programmes in the prior six months were also excluded from the study. Before conducting the pre-test, the duly signed informed consent form was obtained from each participant. Participants were randomly assigned to one of two groups after the initial assessment: an experimental group (n = 20) and a control group (n = 20). The control group did not participate in any exercise intervention. The experimental group completed a six-week multicomponent exercise program.

Study Variables:

The multicomponent exercise training program was an independent variable where Aerobic Exercise, Flexibility Exercise, Balance Exercise, Resistance Exercise and Coordination Exercise were included. The dependent variables were the selected motor fitness components such as reaction time, hand-eye co-ordination, balance (left leg, right leg) and gait performance. Experimental group was prescribed a structured six-week multicomponent exercise intervention program designed especially for middle aged women. The program was planned on a day wise of a week, incorporating a systematic combination different exercise. Detailed information regarding exercise type, sets, repetitions, duration, and holding time is presented in the following table.

Table 1: Prescribed six weeks multicomponent exercise intervention programme for Experimental Group for middle aged women (initial phase)

Day	Multicomponent Exercises	Set	Repetition and Workout Duration/Distance/Times
Day 1	Aerobic Exercise: Brisk Walking (4.8km/h)	1	1 x 20 min
	Flexibility Exercise with Swiss Ball: Up and Down, Back Bend, Arm and Leg Raise with Core Support, Seated Side Stretch	3	3 x 10 times each
	Balance Exercise: One Leg Standing Tree Pose;	3	3 x 20 sec;
	Walking on Marking Lines		3 x 10 m
Day 2	Resistance Exercise (with Thera Band): Gastrocnemius and Soleus Stretch, Front Raise (Deltoids), Squat, Triceps Extension, Band Pull Apart from Front, Band Pull Apart from Back, Standing Leg Extension, Standing Leg Abduction, Standing Leg Adduction, Standing Hamstring Curl	3	3 x 10 times each (holding time:6-10sec)
	Coordination Exercise: Small Ball Tossing, Target Practice, Small Ball Dribbling, Wall Ball Bounce and Catch	3	3 x 10 times each
Day 3	Aerobic Exercise: Brisk Walking (4.8km/h)	1	1 x 20 min
	Flexibility Exercise with Swiss Ball: Up and Down, Back Bend, Arm and Leg Raise with Core Support, Seated Side Stretch	3	3 x 10 times each
	Balance Exercise: One Leg Standing Tree pose; Walking on Marking Lines	3	3 x 20 sec;
			3 x 10 m
Day 4	Resistance Exercise (with Thera Band): Gastrocnemius and Soleus Stretch, Front Raise (Deltoids), Squat, Triceps Extension, Band Pull Apart from Front, Band Pull Apart from Back, Standing Leg Extension, Standing Leg Abduction, Standing Leg Adduction, Standing Hamstring Curl	3	3 x 10 times each (holding time:6-10sec)
	Coordination Exercise: Small Ball Tossing, Target Practice, Small Ball Dribbling, Wall Ball Bounce and Catch	3	3 x 10 times each
Four Days per Week for Six Weeks Warming Up (10 min): Walking, Jogging, Rotational Exercise, Various Type of Free Hand Exercise; Multicomponent Exercise: Aerobic Exercise, Flexibility Exercise, Balance Exercise, Resistance Exercise, Coordination Exercise; Cooling Down (10 min): Stretching, Slow Walking, Static Yoga Posture.			

The following section briefly describes the procedures adopted for assessing reaction time, hand eye co-ordination, balance and gait pattern in the selected participants.

Reaction Time:

The ruler drop test (Ferreira *et al*., 2024) was the method used to assess reaction time. Participants were instructed to grab the ruler before it falls. The distance fallen was measured and converted to reaction time using a prescribed standard. This test measures the speed of a motor response to a visual stimulus.

Hand-Eye Coordination:

Hand-eye coordination was evaluated by observing performance in the Alternate-Hand Wall-Toss Test (Hodgetts *et al*., 2021). Participants used either a tennis ball or a baseball and a smooth, solid wall. Participants were instructed to stand at the same distance from the wall and throw and catch the ball with each hand alternately for a specified amount of time. The score was determined by the number of catches made.

Balance:

The Unipedal Balance Test (Weirich *et al*., 2010) was used to measure static balance. Participants were instructed to stand on one leg with one hand placed on the hip while maintaining balance. The duration for which balance was maintained was recorded using a stopwatch, starting from the moment the position was assumed until the raised foot touched the floor. Each

participant performed three trials, and the best time recorded was used for analysis.

Gait Performance:

The 10 metre walk test (Peters *et al*., 2013) was used for gait evaluation. Participants were asked to walk at their preferred normal comfortable pace. The distance was measured with two markers at either end of the 10 m, and the time was measured. The time was recorded and from it, gait speed was calculated. This test gives a straight forward and valid assessment of gait performance.

Intervention Programme:

The experimental group took part in six weeks supervised exercise program specially designed with multicomponent exercise. This programme consisted of balance, coordination, reaction, and functional exercises relevant to everyday activities. The exercise program was held four days per week of approximately 50 minutes of a session and each week the difficulty was increased. The control group received no such exercise training.

Statistical Analysis:

All variables were assessed before and after the six-week period for the experimental and control groups. The data collection was carried out systematically and the data was analyzed using Jamovi (version 2.6.19) to evaluate the pre-test and post-test differences within each of the study groups. The significance level was set at $p < 0.05$.

RESULTS

The general physical characteristics of the middle-aged women were assessed to describe the basic profile of the participants. The details are presented in the following table.

Table 2: General physical characteristics of middle-aged women

Groups	Age (y)	Height (cm)	Body mass (kg)	BMI (kg/m^2)
Control	46.2±4.9	155.7±6.1	62.9±7.4	26.1±3.8
Experimental	44.8±6.8	156.3±5.2	64.5±8.2	26.5±3.5
p value	0.547	0.781	0.394	0.689

Table 2 presents the details physical characteristics of middle-aged women in the control and multicomponent exercise groups. At baseline, both groups were similar in age, height, body mass, and body mass index. The study results indicate that the groups were well matched on the demographic criteria, as no significant differences were found between the groups.

Table 3: Comparative analysis of dependent variables in motor fitness between the groups of middle-aged women

Motor components	Ex.		Con.		p value
	Pre	Post	Pre	Post	
Reaction Time (Sec)	40.33±18.993	44.8±12.099	40.48±3.234	39.45±3.471	0.286
Hand-Eye Co-ordination (Times/No.)	6.05±4.54	7.95±4.39	6.83±3.411	6.25±3.552	0.107
Balance (Left)(Sec)	27.19±21.374	42.53±16.86	28.14±9.216	33.10±11.05	0.134
Balance (Right)(Sec)	33.38±20.39	45.53±20.92	32.38±22.59	39.40±13.70	0.723

Table 3 presents changes in selected motor fitness components between experimental and control groups of middle-aged women before and after the intervention are illustrated in Table 3. After the six-week multicomponent exercise program, the experimental group improved in reaction time, hand–eye coordination, and balance on both the left and right sides.

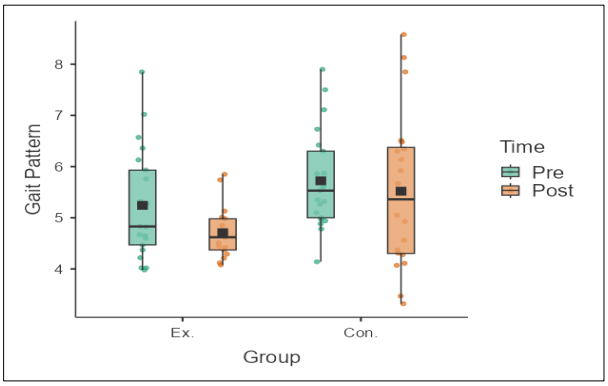

Figure 1: Graphical representation of gait pattern (walking) between the groups of middle-aged women

The figure 1 shows that experimental group enhanced their walking performance after the six-week multicomponent exercise program. The mean time taken to complete the 10-meter walk decreased from 5.24 ± 1.07 seconds in the pre-test to 4.71 ± 0.51 seconds in the post-test. The control group, on the other hand, showed minimal improvement with values decreasing from 5.72 ± 0.96 seconds to 5.52 ± 1.53 seconds. Even though the difference between the groups was not statistically significant ($p = 0.504$), the improvement in walking time in the experimental group suggests that the multicomponent exercise program positively impacted their gait efficiency and functional mobility.

DISCUSSION

This control trial examined the effects of a six-week multicomponent exercise programme aimed at improving motor fitness skills and gait patterns in middle-aged women. Although most changes did not reach statistical significance, compared to the control group, the experimental group showed consistent positive trends in reaction time, hand-eye coordination, balance, and gait. These findings are relevant to the understanding of early functional adaptations occurring in middle age and are consistent with the limited literature available for studies marketed primarily towards older women.

In the reaction time test, the experimental group showed a small improvement, while the control group showed a small decline during the same period. This pattern indicates that multicomponent exercise may assist in the maintenance or enhancement of neuromotor processing speed for women in the middle age demographic. Numerous prior studies have demonstrated similar findings, with the largest relative changes attributed to the women demonstrating the most physical activity, resulting in quicker reaction times and improved sensorimotor integration (Lord *et al*., 1993). While the results of the current study regarding modification of reaction time did not reach statistical significance, the magnitude of change supports the premise that reaction time can improve with very brief exposure to exercise that targets the specific task. In addition, compared to the control group, hand-eye coordination in the experimental group improved while the control group diminished.

The improvements might be attributable to the different activities that constitute multicomponent programmes, such as tasks that require synchronised timing, visual tracking, and the use of both limbs (Bandyopadhyay, 2020). Significant enhancements in the measured coordination-related functional fitness after multicomponent training in older women were reported by Kang *et al*., (2015) and Suzuki *et al.,* (2018) (Kang *et al*., 2015; Suzuki *et al*., 2018). Considering that the present participants were younger and that the duration of the intervention was shortened, it is understandable that the present study reported a smaller magnitude of change, as middle-aged women generally have higher levels of baseline coordination than older persons. The experimental group showed improvements in balance performance, assessed separately for the left and right limbs, particularly in unipedal stance time, while the control group showed smaller improvements. These results are in line with previous findings that balance is quickly changeable with specific training stimuli. Borysiuk *et al*., (2018) noted that even a six-week balance-focused programme could lead to significant improvements in postural control among elderly women, illustrating how quickly the balance mechanisms can be modified through training (Borysiuk *et al*., 2018). Postural stability and functional independence are improved by multicomponent interventions that include a variety of balance challenges (Schneider *et al*., 2025). Although there were no statistically significant findings in this study that may be due to the absence of physiological adaptation the limited sample size, and inter-individual variability.

In the experimental group of this study, gait performance, as measured by the 10 m walk test, improved as demonstrated by the reduction of time taken to walk the 10 m, while the control group demonstrated no significant change. This finding it significant as gait velocity is an important predictor of functional mobility and neuromuscular efficiency. The effect of structured exercise on advancing the gait parameters in women has been documented in several randomized control trials (Lord *et al*., 1996; Park *et al*., 2008). Wolf *et al*., (2020) noted that compared to strength training, multicomponent exercise resulted in greater improvements to gait, validating the approach taken in the current study (Wolf *et al*., 2020). The gait improvement observed in middle aged women in this study suggests that preventative and efforts to aid in the preservation of gait function are needed to counter the detrimental effects of aging. For interventions of six months or longer, the changes observed in this study are of a more modest magnitude (Rodrigues *et al*., 2023). Rodrigues *et al*., (2023) highlighted the positive changes in body composition and functional outcomes after prolonged training with multiple components in aged women (Rodrigues *et al.*, 2023; Bandyopadhyay & Das , 2022). Still, the present findings sustain the idea that short-term interventions can prompt positive changes in neuromotor functioning, more so when the exercises are diverse and functional. Step and coordination-based activities of similar kinds have demonstrated positive changes in gait in the first six weeks of training and further give credibility to the current findings (Nikravesh *et al.*, 2025). An additional strength of this study is its emphasis on middle-aged women, who have been understudied in exercise intervention research compared to other demographic groups. Most research has been focused on older or elderly people, especially in relation to fall risk and functional decline (Thaiyanto *et al*., 2021). These findings imply that introducing multicomponent exercise in the middle-ages is

potentially an early intervention to sustain motor fitness and gait efficiency before impairments associated with aging become more pronounced. The present findings suggest that introducing multicomponent exercise during middle or older age may act as an early preventive approach to preserve motor fitness and gait efficiency before age-related impairments become more evident. Meaningful improvements were observed within a short intervention period, indicating that multicomponent exercise can be effective even over a limited duration. However, the brief training period may have limited a clearer understanding of the magnitude and long-term sustainability of these improvements, which might be more apparent with a longer intervention of 10 weeks or more. Therefore, future studies should consider extended training durations along with long-term follow-up. It is also noteworthy that the women participants engaged in the program voluntarily, enjoyed the sessions, and performed the exercises with full effort according to their capacity, which likely contributed positively to the observed outcomes.

CONCLUSION

The study concluded that six-week multicomponent exercise intervention positively impacts several constituents of motor fitness and gait performance amongst middle-aged women. Participants in the experimental group demonstrated improvements in reaction time, hand–eye coordination, balance, and gait speed relative to the control group, an indication of initial neuromuscular and functional changes in response to the structured exercise. While the changes in measurements were not statistically significant, the consistent direction of change shows promise in the potential of short-term, tailored multicomponent training to sustain and enhance middle-aged functional capabilities. These findings reaffirm early exercise intervention as a means of preserving mobility, balance, and movement efficiency, and potentially decrease the likelihood of functional decline at older ages. However, to obtain significant improvements, longer duration exercise interventions are required.

REFERENCES

- Antonio Gomes de Resende, N., Matheus Amarante do, N., Danilo Rodrigues Pereira da, S., Raquel Simões Mendes, N., Josimari Melo de, S., & Marzo Edir Da Silva, G. (2019). Effects of Multicomponent Training on Functional Fitness and Quality of Life in Older Women: A Randomized Controlled Trial. *International Journal of Sports and Exercise Medicine*, *5*(4), 1–7. https://doi.org/10.23937/2469-5718/1510126
- Bandyopadhyay, N. (2020). Role of low-cost multi-component exercise programme on aging of Indian women. Theory and Methods of Physical Education and Sports.2020;4:62-66. DOI:10.32652/tmfvs.2020.4.62-66
- Bandyopadhyay, N., & Das, T. (2022). Effectiveness of Ten Weeks Community-Based Multicomponent Exercise Program on Physiological Health of Elderly Women. *International Journal of Kinesiology and Sports Science*, *10*(4), 25-33. DOI: 10.7575/aiac.ijkss.v.10n.4p.25
- Borysiuk, Z., Pakosz, P., Konieczny, M., & Kręcisz, K. (2018). Intensity-Dependent Effects of a Six-Week Balance Exercise Program in Elderly Women. *International Journal of Environmental Research and Public Health*, *15*(11), 2564. https://doi.org/10.3390/ijerph15112564
- Ferreira, S., Raimundo, A., del Pozo-Cruz, J., Leite, N., Pinto, A., & Marmeleira, J. (2024). Validity and reliability of a ruler drop test to measure dual-task reaction time, choice reaction time and discrimination reaction time. *Aging Clinical and Experimental Research*, *36*(1), 61. https://doi.org/10.1007/s40520-024-02726-6
- Hodgetts, C. J., McLeish, T., Thomas, E., & Walker, B. F. (2021). Association between chiropractic students' Hand-Eye coordination or general Self-efficacy and their performance on a spinal manipulative therapy examination: A Cross-sectional Study. *Journal of Chiropractic Medicine*, *20*(4), 183-190. https://doi.org/10.1016/j.jcm.2021.12.011
- Kang, S., Hwang, S., Klein, A. B., & Kim, S. H. (2015). Multicomponent exercise for physical fitness of community-dwelling elderly women. *Journal of Physical Therapy Science*, *27*(3), 911–915. https://doi.org/10.1589/jpts.27.911
- Lord, S. R., Caplan, G. A., & Ward, J. A. (1993). Balance, reaction time, and muscle strength in exercising and nonexercising older women: A pilot study. *Archives of Physical Medicine and Rehabilitation*, *74*(8), 837–839. https://doi.org/10.1016/0003-9993(93)90010-8
- Lord, S. R., Lloyd, D. G., Nirui, M., Raymond, J., Williams, P., & Stewart, R. A. (1996). The Effect of Exercise on Gait Patterns in Older Women: A Randomized Controlled Trial. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, *51A*(2), M64–M70. https://doi.org/10.1093/gerona/51A.2.M64
- Nikravesh, M., Moghadas Tabrizi, Y., Karimizadeh Ardakani, M., & Tavakoli, A. (2025). The Effect of a 6-Week Nine-Square Step Exercise Protocol on Gait Components in Older Women. *Journal of Motor Control and Learning*, *7*(2). https://doi.org/10.5812/jmcl-162824
- Park, H., Kim, K. J., Komatsu, T., Park, S. K., & Mutoh, Y. (2008). Effect of combined exercise training on bone, body balance, and gait ability: a randomized controlled study in community-dwelling elderly women. *Journal of Bone and Mineral Metabolism*, *26*(3), 254–259. https://doi.org/10.1007/s00774-007-0819-z
- Peters, D. M., Fritz, S. L., & Krotish, D. E. (2013). Assessing the reliability and validity of a shorter

walk test compared with the 10-Meter Walk Test for measurements of gait speed in healthy, older adults. *Journal of geriatric physical therapy*, *36*(1), 24-30. *DOI:* 10.1519/JPT.0b013e318248e20d

- Rodrigues, F., Teixeira, J. E., Monteiro, A. M., & Forte, P. (2023). The Effects of 6-Month Multi-Component Exercise Intervention on Body Composition in Aged Women: A Single-Arm Experimental with Follow-Up Study. *Applied Sciences*, *13*(10), 6163. https://doi.org/10.3390/app13106163
- Schneider, A., Leite, L. B., Teixeira, J., Forte, P., Barbosa, T. M., & Monteiro, A. M. (2025). Multicomponent Exercise and Functional Fitness: Strategies for Fall Prevention in Aging Women. *Sports*, *13*(6), 159. https://doi.org/10.3390/sports13060159
- Spatenkova, V., Zvercova, I., Jindrisek, Z., Veverkova, I., & Kuriscak, E. (2023). Comparison of nursing students' performance of cardiopulmonary resuscitation between 1 semester and 3 semesters of manikin simulations in the Czech Republic: a non-randomized controlled study. *Journal of Educational Evaluation for Health Professions*, *20*, 9. DOI: https://doi.org/10.3352/jeehp.2023.20.9
- Suzuki, F. S., Evangelista, A. L., Teixeira, C. V. L. S., Paunksnis, M. R. R., Rica, R. L., Evangelista, R. A. G. de T., João, G. A., Doro, M. R., Sita, D. M., Serra, A. J., Figueira Junior, A. J., Alonso, A. C., Peterson, M., & Bocalini, D. S. (2018). Effects of a Multicomponent Exercise Program on the Functional Fitness in Elderly Women. *Revista Brasileira de Medicina Do Esporte*, *24*(1), 36–39. https://doi.org/10.1590/1517-869220182401179669
- Thaiyanto, J., Sittichoke, C., Phirom, K., & Sungkarat, S. (2021). Effects of Multicomponent Exercise on Cognitive Performance and Fall Risk in Older Women with Mild Cognitive Impairment. *The Journal of Nutrition, Health and Aging*, *25*(2), 160–164. https://doi.org/10.1007/s12603-020-1458-5
- Weirich, G., Bemben, D. A., & Bemben, M. G. (2010). Predictors of balance in young, middle-aged, and late middle-aged women. *Journal of Geriatric Physical Therapy*, *33*(3), 110-117. *DOI:* 10.1097/JPT.0b013e3181eda25b
- Wolf, R., Locks, R. R., Lopes, P. B., Bento, P. C. B., Rodacki, A. L. F., Carraro, A. N., & Pereira, G. (2020). Multicomponent Exercise Training Improves Gait Ability of Older Women Rather than Strength Training: A Randomized Controlled Trial. *Journal of Aging Research*, *2020*, 1–8. https://doi.org/10.1155/2020/6345753